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Increasing the Production of Soybean (Glycine Max L.) By Using Mulch of Rice Straw and Appliying Poc (Liquid Organic Fertilizer) From Seaweed (Gracilaria Sp.) and Cattle's Urine

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Abstract
Soybean is the crops that are important in the food and feed industry. It acts as a source of vegetable protein thatis very important in improving people's nutrition because it is safe for health and cheaper. This study aimed to assess the effect of combined treatment of liquid organic fertilizer from waste of seaweed and urine of cattle and supplementing rice straw mulch with different dose to the growth and production of soybean of Wili variety. This study was conducted in November 2014 until March 2015 in the Dusun Kajuara, Awangcenrana Village, District Cenrana, Bone regency. This study was prepared by using the Separated Plots Draft (RPT). The main plot is the use of rice straw mulch with four treatments, ie: without the straw, straw mulch 2 tons / ha, straw mulch 4 ton / ha, and straw mulch 6 tonnes / ha. The subplots were fertilization with four treatments, ie: without POC, Seaweed POC, cow urine POC, and the combination of seaweed POC and cow urine POC. The results showed that the combination of supplementing rice straw mulch and POC from waste seaweed and cow urine occured real interaction to the weight of berangkasan, number of empty pods, soy production per plot, productionton.ha-1. The combination of supplementing rice straw mulch and POC from waste seaweed and cow urine showed the best response because it is capable of producing (2.6 ton / ha) is higher than the potential ability of the results (1.6 ton.ha).
Keywords: soy, straw mulch, poc seaweed, cattle's urine

1. Introduction

Soybean is the third most important food crop after rice and corn. It is the legumes crops which contain many vegetable protein, carbohydrates and fat. Soybeans also contain phosphorus, iron, calcium, vitamin B with a complete amino acid composition, therefore, it is the potential for growth of the human body (Pringgohandoko and Padmini, 1999). Soybeans also contain unsaturated acids that can prevent the rise of arterial sclerosis, that is the hardening of the arteries (Taufiq and Novo, 2004). Soy acts as a source of vegetable protein that is very important in order to improve people's nutrition because it is safe for health and cheaper. Soybean demand increase continuesly in line with population growth and the needs of industrial materials for processed food such as tofu, tempe, soy sauce, soy milk, tauco, snacks, etc.

The efforts to increase the productivity of soybean plants is strongly influenced by the techniques of cultivation, pest control and fertilization that can be done through the roots and leaves. Fertilization through the leaves is done by spraying fertilizer in liquid form on the plants directly. This method is effective to provide the nutrients contained in the fertilizer, because fertilizer is easy to entry and it is also easy to be absorbed into the stomata. The results of study of the size of openingthe gap of soybean leaf stomata (Glycine max (L.) Merrill var. Lokon) in the morning, afternoon and evening, show that stomata opensmaximally in the morning. In the afternoon, stomata keep opening during the day but it is not the maximum, to reduce the occurrence of evaporation, while in the afternoon occurre stomata opening is greater than during the day (Meirina, 2006).

Cow urine is one alternative to increase the availability, adequacy, and efficiency of nutrient absorption for plants that contain microorganisms that can reduce the use of inorganic fertilizers (N, P, K) and increase crop yields maximally (Dharmayanti, et al., 2013).

Seaweed is one of the living marine resources of commercial renewable. Since the long time, macroscopic marine algae has had a close relationship with human life and has been used deeply in a variety of ways as a source of food, feed, pharmaceuticals, fertilizers, and especially for phycocolloid that is economically valuable (Lakshmi et al., 2010). In agriculture, seaweed used as animal feed, soil fertilizer and compost in extract liquid form, as a substance of growth stimulator and plant protector in facing pests and diseases (Verkleij, 1992).

Liquid organic fertilizer provides several advantages, such as fertilizer can be used bywatering it to the root or spraying onto plants and save energy. So that the process of watering can maintain soil moisture. Liquid organic fertilizer in fertilization can be done more evenly, there will be no cumulation of concentration fertilizer in one place, this is due to liquid organic fertilizers 100% soluble. (Priangga, et al., 2013).

At the time of spraying a liquid organic fertilizer, not all of the solution can be absorbed by plants.

Most of the fertilizer solution that is sprayed fall onto the ground. To avoid the absorption of liquid organic fertilizer which falls to the ground by the weeds, the use of liquid organic fertilizer can be combined with the use of mulch. So that the POC solution that fall onto the ground can be detained by the mulch before it is absorbed by the weeds.

Mulch is element or material which overlaid on the surface of the land or agricultural land to protect the soil from damage caused by external factors. The laying of the material can be done by spreadingit out then forming a layer of a certain thickness. Rice straw can be used as mulch, which functioning to obstruct the weed growth and soil micro climate change. Suhartini and Adisarwanto's research results (1996) reported that the use of rice straw as mulch which were spread out evenly over the soil surface of 5 tons ha-1 can obstruct weed growth to 37-61% compared without mulch, while if the rice straw were burned, the growth of weeds would decrease by 27-31% only. The effect caused by laying the mulch will depend on the dose used, so that it is necessary dose of mulch right.

Based on the explanation above, then it is donethe research on the use of liquid organic fertilizer made from seaweed and sewage waste from cattle (urine), and the use of waste from rice straw as mulch contained in the research land for soybean cultivation.

2. Research Method

2.1 Time and Place

This research was conducted in the Kajuarahamlet, Awangcenrana Village, CenranaDistrict, Bone regency. The study was conducted from November 2014 - March 2015. The research related to analysis of the nutrient content of the seaweed waste and cow urine was done in the Laboratory ofBPTP Tanah Maros, Maros Regency.

2.2 Materials and Tools

The materials used were waste seaweed (Gracilaria sp), seeds of soybean (Wilis), straw mulch, insecticide Decis, and waste of cattle urine to be processed into liquid organic fertilizer and other chemicals for analysis. The tools were used: meter, digital cameras, scales, blenders, sprayer, tractor engines, nylon rope, ruler, drill tools, scissors, board observation, buckets and other tools that support this research.

2.3 Design of Study

This study was prepared by using the Apart Plots Draft (RPT). The main plot is the use of rice straw mulch with four treatments, ie: without the straw (M0), straw mulch 2 tons / ha (M1), straw mulch 4 ton / ha (M2), and straw mulch 6 tonnes / ha (M3). The subplots were fertilization with four treatments, ie: without POC (P0), POC of Seaweed (P1), POC of cow urine (P2), and a combination of POC of seaweed with POC of cow urine (P3). There are 8 combinations of treatments were repeated 3 times to observe the 4 samples of plants per treatment plot. So there are 192 plants to be observed.

2.4 Implementation of Study

The implementation of study was: Land preparation was done with minimum soil processing by using a tractor engine for once and then flattened using a hoe. The next process was making experiment plot of 4 x 3 m for 4 plots (treatment of straw mulch). As for the plot of fertilizer treatments (POC) is only by being spreaded rope of 1 x 2,5 metersfor 16 plots, while the distance between the main plot is 50 cm. Planting is done by drill as deep as 5 cm with a spacing of 40 x 20 cm. To facilitate the determination of the depth of the hole, the drill tool was given limit of cloth. Furthermore, it was planted with 2 seeds per planting hole, which first is soybean seed mixed with Rhizobium. Installation of straw mulch was done after planting soybeans.It wasdone by spreading it out onto the surface of land evenly in accordance with the treatment that was (M0) without rice straw, (M1) 2 ton / ha (2.4 kg / plot), (M2) 4 ton / ha (4.8 kg / plot) and (M3) 6 ton / ha (7.2 kg / plot). Implementing compost as much as 50 kg were given evenly to all treatments. Then the next fertilization was by spraying on the plant leaves at 15 HTS (days after planting),next fertilization was done every week until arising the pods. In accordance with the treatment that is: (P1): POC of seaweed (15 ml / 2 liters of water) 5 liters of water / treatment, (P2): POC of cow urine (10 ml / 1 liter of water) 5 liters of water / treatment, (P3): POC of seaweed + POC of cow urine (7.5 ml / 1 liter of water + 5 ml / 0.5 liters of water) 5 liters / treatment. Then for control treatment (P0) was given chemical fertilizers (Urea, SP36, KCl), phosphates (SP36) and KCl. It was given at the age of plants was 15 days after planting, while urea was given before flowering plants or after the plant was 30 days of after planting time.

2.5 Parameters of Observation

1. Components of growth observed include:
   a. The plant height (cm) was measured from the surface of ground up to the point of the plants growth at the age of 14, 30, and 60 HTS (day after planting).

b. The number of productive branches at harvest.
c. The age of the plant at the time of flowering (days) computed from samples of plants flowering.
d. The age of the plant at harvest (day) is done according to criteria of crops.
e. The dry weight of plant at harvest, measured by weighing the dry weight of sample plants without roots previously dried for 2 x 24 hours.

2. Components of observed production:
a. The number of empty pods and containing pods were calculated when the plants at harvest
b. The weight of seed per plant.
c. The weight of 100 dry seeds (g ton^{-1}) was weighed to weight of 100 seed of samples plant at harvest.
d. The weight of dry seed per plot (kg $plot^{-1}$) was weighed then converted into tons ha^{-1}.

3. Results and Discussion

3.1 Plant Height

Table 1. The average of plant height (cm).

Type of Liquid Organic Fertilizer	Straw Muclh				Average
	m0	m1	m2	m3	
p0	77.75	81.83	84.92	84.58	82.27_{y}
p1	87.75	85.00	94.50	87.33	88.65_{x}
p2	88.83	80.58	90.42	88.92	87.19_{x}
p3	89.75	85.83	92.00	96.17	90.94_{x}

Description: The numbers are still followed by the same letter in the column ($_{xyz}$), it means that there is not significantly different from the test $BNT_{\alpha = 0:05}$ with NP BNT_{p}, that is 3.99

3.2 Number of Branches

Table 2. Average of number of branches (branches of plant $^{-1}$).

Type of Liquid Organic Fertilizer	Straw Muclh				Average
	m0	m1	m2	m3	
p0	3.38	3.46	4.25	3.75	3.71_{y}
p1	3.96	4.17	4.75	4.42	4.32_{x}
p2	3.58	4.21	3.96	4.46	4.05_{xy}
p3	3.67	3.79	4.71	4.92	4.27_{x}
Average	3.65^{b}	3.91^{ab}	4.42^{a}	4.39^{a}	

Description: The numbers are still followed by the same letter in the column $_{(xyz)}$ and rows $^{(abc)}$ means not significantly different from the test $BNT_{\alpha = 0.05}$ with NP $BNT_{p,}$ that is 0.43 in the testing of the same m and NP BNT_{m} is 0.53 on the testing the same p.

3.3 Flowering age and Harvest

Table 3. Average of flowering and harvesting (HST).

Flowering Age						
Type of Liquid Organic Fertilizer	Straw Muclh				Rata-rata	NPp BNT
	m0	m1	m2	m3		
p0	37.00	36.67	36.33	36.33	36.58_{y}	
p1	36.33	36.33	36.33	36.67	36.42_{y}	0.79
p2	36.33	36.67	36.33	36.00	36.33_{xy}	
p3	35.33	36.00	36.33	34.67	35.58_{x}	
Harvest Age						
p0	89.00	88.67	88.33	88.33	88.58y	
p1	88.33	88.33	88.33	88.67	88.42_{y}	0.72
p2	88.33	88.67	88.33	88.00	88.33_{y}	
p3	87.33	88.00	88.33	86.67	87.58_{x}	

Description : The numbers are still followed by the same letter in the column $_{(xyz)}$ means not significantly different from the test $BNT_{\alpha = 0:05}$

3.4 Weight of Brangkasan (waste of dry plant)

Table 4. Average weight of berangkasan wet and dry (g).

Weight of Wet Brangkasan					
Type of Liquid Organic Fertilizer	Mulch Dose				NP BNT
	m0	m1	m2	m3	
p0	2.20^{a}_{x}	2.10^{a}_{xy}	1.93^{a}_{y}	2.10^{a}_{y}	
p1	2.23^{ab}_{x}	2.13^{b}_{x}	2.63^{a}_{x}	2.27^{ab}_{xy}	0.37
p2	2.13^{a}_{x}	2.37^{a}_{x}	2.47^{a}_{xy}	2.23^{a}_{xy}	
p3	2.23^{ab}_{x}	1.77^{c}_{y}	2.07^{bc}_{x}	2.60^{a}_{x}	
NP BNT		0.43			
Weight of Dry Brangkasan					
Type of Liquid Organic Fertilizer	Mulch Dose				NP BNT
	m0	m1	m2	m3	
p0	1.13^{a}_{x}	1.10^{a}_{x}	1.07^{a}_{z}	1.17^{a}_{y}	
p1	1.23^{a}_{x}	0.97^{b}_{x}	1.33^{a}_{xy}	1.13^{ab}_{y}	0.24
p2	1.00^{b}_{x}	1.10^{b}_{x}	1.40^{a}_{x}	1.20^{ab}_{y}	
p3	1.10^{b}_{x}	1.10^{b}_{x}	1.10^{b}_{yz}	1.53^{a}_{x}	
NP BNT		0.26			

Description : The numbers are still followed by the same letter in the column $_{(xyz)}$ and rows $^{(abc)}$ means not significantly different from the test of $BNT_{\alpha = 0:05}$.

3.5 Weight of Seed

Table 6. Average of weight of seed (g.plant $^{-1}$), and a weight of 100 seeds (g).

Weight of Seed						
Type of Liquid Organic Fertilizer	Straw Muclh				Average	NPp BNT
	m0	m1	m2	m3		
p0	7.50	8.21	8.88	9.92	8.63_{y}	
p1	10.42	11.83	13.21	12.42	11.97_{x}	2.13
p2	10.21	10.50	15.33	13.83	12.47_{x}	
p3	9.83	11.42	15.17	14.13	12.64_{x}	
Average	9.49^{c}	10.49^{bc}	13.15^{a}	12.57^{ab}		
NPm BNT		2.13				
Weight of 100 Seeds						
p0	11.67	11.33	10.67	11.33	11.25_{y}	
p1	11.33	11.33	11.33	12.33	11.58_{xy}	0.53
p2	10.67	11.33	11.67	11.33	11.25_{y}	
p3	12.00	12.00	12.00	12.00	12.00_{x}	

Description : The numbers are still followed by the same letter in the column $_{(xyz)}$ and rows $^{(abc)}$) means not significantly different from the test $BNT_{\alpha = 0:05}$.

3.6 Production of Soybean Plant

Table 7. Average of production (ton.ha^{-1}).

Production of ton.ha^{-1}					
p0	1.52^{a}_{y}	1.87^{a}_{xy}	1.99^{a}_{x}	2.07^{a}_{y}	
p1	2.09^{a}_{x}	1.57^{a}_{y}	2.05^{a}_{x}	2.04^{a}_{y}	0.45
p2	1.70^{a}_{xy}	2.09^{a}_{x}	2.24^{a}_{x}	2.21^{a}_{y}	
p3	1.97^{b}_{xy}	2.07^{b}_{x}	2.12^{ab}_{x}	2.69^{a}_{x}	
NPm BNT		0.60			

Description : The numbers are still followed by the same letter in the column $_{(xy)}$ and the line $^{(ab)}$ means not significantly different from the test $BNT_{\alpha = 0.05}$.

4.1 Discussion

From the results of test statistically was shown that the parameters of plant height starting from 2 weeks after planting (MST) until the time of plants starting flowering was done with intervals of once a week. The treatment with liquid organic fertilizer showed improvement and development in plant height. The treatment with the provision of POC of seaweed (p1), POC of cow urine (p2) and the combination of both treatments (p3) gave a good response in plant height, it showed significant differences in treatment p0 (without POC).

In addition, the provision of POC was also significantly affected to the parameter of number of productive branches, number of pods per plant, number of pods, weight of seed per plant, weight of 100 seeds, flowering and harvest age.From the several stages of observation, improvement and development showedthe real differences in the treatment p0 (without POC). For parameter of number of branches, the best soybean plants were in treatment of liquid organic fertilizer p2 and p3. For the parameter of age of flowering, thefastest soybean plants were in the combination of treatment of liquid organic fertilizer of seaweed and cow urine (p3). For the parameters age of harvest as well as that the combination of a liquid organic fertilizer of seaweed and cow urine (p3) is 87.58 HST, and significantly different from other treatments. For the parameters of number of pods per plant and number of contained pods on soybean plants are the most at treatment of p1, p2 and p3.

On the parameter of number of branches on the soybean plants with treatment p1 (POC of seaweed), with an average of 4.32 branch.plant^{-1}, and p3 (combination of POC of seaweed and cow urine) with an average 4.27 of branch.plant-1 gave the response of largest number of branches and the response was significantly different from p0 (without giving POC). It related with growth of stems or height of plants where the stems were composed from the segments which spanning among the books of stemswhere the branches were growing. Therefore, by increasing the length of the stems, it would cause the number of formed branches was also growing. Stem elongation (plant height growth) occured as a result of elongation and accretion of stem segments. Elongation segment occurred because the activity of cell fission, which in turn led to the growth of the number of cells. This process can not be separated from the physiological activity in the body that is affected by the influence of hormones given to plants. As proposed by Gardner, et.al (1991) which stated that the high growth stems happened in maristem intercalary of segment. The segment extended as result of the increasing the number of cells and especially because of the elongation of cells which can cause the increasing up to 25 cm or more. Growth as cell fission occured in the basic of segment (intercalary).

At the parameter flowering and harvesting age, the combination treatment of liquid organic fertilizer of seaweed and cow urine gave the fastest response and it was significantly different from other treatments. It was caused by the combination treatment between organic fertilizer, and the nutrients like N, P and K increased. It was in line with the opinion of Lingga and Marsono (2001) that formation of N, P and K in plants can accelerate flowering, seed and fruit growth, helping the formation of carbohydrates, protein, fat and variety of other compounds, as well as helping assimilation and respiration for plants. In addition,it was assumed that the P element contained in the liquid organic fertilizer that can improve the quality of the fruit crop.

In the parameter of weight of wet and dry berangkasan, all treatment of liquid organic fertilizer gave good response, but treatment of p1 and p3 gave high dominant results. It was caused by the content of substance of growth regulators, such as auksi, cytokinins, and giberalin which can increase crop production. This was in accordance with Jamal (2009) stated that seaweed contained many minerals trace (Fe, B, Ca, Cu, Cl, K, Mg, and Mn) and also the substance of growth regulator (PGR) such as auxin, cytokinin, and giberalin which used to stimulate the growth and increase crop production. With good growth then all components of the plants will give better results, it caused the liquid organic fertilizer of seaweed giving good response in soybean plants.

Test results of BNT at the level of 0.05 indicated that the treatment of p1, p2 and p3 gave the best results on the parameters of seed weight per plant. But the combination of liquid organic fertilizer of seaweed with cow urine (treatment p3) in an average value of 12.64 g.plant^{-1}gave the response of heaviest seed weight

and it was significantly different with the treatment p0 (without giving POC). It indicated that the effectiveness of the liquid organic fertilizer can be enhanced when combined. It was consistent with the research results of Basmal et al (2009), that in making organic fertilizer, silage combination with seaweed powder was obtained value of cation exchange capacity (CEC) 156-190 me / 100 g. Organic fertilizer that has a CEC> 20 me / 100 g was categorized as very good. It means that the plant will be easier to absorb nutrients. The soil of organic fertilizers can save water, not easy to dry, become looser and the soil aeration became better and microbial activity in the soil will be higher than land which was not given organic fertilizer. Fertilizer made from seaweed were rich in elements of K, Ca, Mg, Mn, and B. The elements of nutrients is very useful for forming chlorophyll, whereas Ca and Mg in the form of dolomite.

The combination treatment of POC of seaweed with cow urine (p3) gave the heaviest weight of 100 seeds was 12.00 g, compared with p1 (POC of seaweed) 11.58 g, and p2 (POC of cow urine) 11.25 g. Results of the dry weight of 100 seeds in varieties Willis has been able to achieve and even exceed the potential of 100 seeds, that wasabout 10 g. It showed that soybean plants had good response to the liquid organic fertilizer (combination) which was given, so it was able to increase production as seen from the observation of the dry weight of 100 seeds. Nasir (2002) stated that the maximum result would be achieved if a superior cultivars received a response to the optimum combination of water, fertilizer and other farming practices. All of these combinations were important in achieving high productivity.

From the results of statistical tests, the interaction between a liquid organic fertilizer and straw mulch showed the real influence to the parameter of berangkasan weight, number of pods and soybean crop production. This was because both factors (POC and mulch) supported each other vegetative and generative growth of soybean plants. Straw mulch applied directly onto the ground can help to improve soil structure so that it can be a good growing medium for plants. The content of nutrients contained in the straw mulch for plants which was important were N, P and K. Those three elements was the most widely needed by plants. Each nutrient has a different function and complementary to the plant. Thus plant growth became optimal; while the liquid organic fertilizer which was directly implemented to the plant, can directly fulfill the needs of nutrients for the plants to be used in the process of photosynthesis.

According Widyasari, Sumami and Arifin (2011) stated on land that was given mulch has tended to increased soil temperature. The mulching hadfunction to suppress the fluctuations of soil temperature and keep the soil moist so that it can reduce the amount of water provision. Mulching can reduce water loss by maintaining temperature and soil moisture (Mulyatri (2003) and Sutejo, 2002). Those factors which caused the vegetative and generative growth of plants became optimum, therefore production of soybeans plants had also increased.

Rice straw that is usually burned by farmers has benefits for soybean plant. Rice straw containednutrient between 0.5-0.8% of N, 0.07 to 0.12% of P, 1.2 to 1.7% of K (Dobermann and Fairhurst, 2000), and C / N approximately 80%. In 6 tons of straw contained 72 kg of nitrogen, 12 kg of phosphorus, 140 kg of potassium, 22 kg of calcium, 12 kg of magnesium, and 38 kg of manganese. For 1 ha of wetland can produce straw between 2-10 tonnes. The content of nutrient component was very beneficial in increasing growth and improving the growth of plants in the field (Mansyah, E, 2012).

The interaction between straw mulch with organic liquid fertilizer type affected significantly to the production of soybean crop and decreased the result of number of empty pods. It because the liquid organic fertilizer and straw mulch contained all macro and micro nutrients for plants that had important role on plant growth and in improving the quantity and quality of crop production. Besides, the use of straw mulch can reduce weeds in the crop. Weeds were important factors that determine crop yields, and mulching was important to control weeds (Bilalis et, al., 2002).

Amirullah (2008) stated that cow urine can be used as liquid fertilizer. Cow urine should be done fermentation first. The fermentation used brown sugar, spices and decomposer microbes. Besides being able to increase stimulating root growth and leaf, it can also be pest eliminator or pesticides for disease on the leaves due to insect attack (trip). Because the typical smell of cow urine, it also prevented the arrival of various pests so that cow urine can be functioned as a crop pest control, because they contain active substances that are toxic to the pest. Normal urine contained very complex chemical composition, such as: water, urea, creatinine, allantion, hipurik acid, ammonia, ammonia acid, sulfur, sulfates, organic salts, pigments of urokrom, and urobulin.

While the use of liquid organic fertilizer from seaweed had a role in the growth of soybean plants because seaweed contains a growth hormone which was needed by plants. In addition, it contained many essential minerals from the sea needed by plants, seaweed also contain growth hormone boosters that have been proven to increase plant growth and yields (Fornes et al., 2002; Padhi & Swain, 2006; Sivansankari et al. 2006; Prithiviraj, 2009).

Some other studies also noted that giving extracts of *A. nodosum* (seaweed) also can improve the immunity of plants against pests by increasing the amount of organic compounds in the leaves and it was also assumed that it was caused by cytokines (Norrie and Hiltz, 1999; Craigie, 2011). Beside cytokinins played a role

in addition to stimulate cell division, formation of organ, and formation of sprouds, it also prevented cell aging. Giving sitokonin on plants resulted in translocation of nutrients to the plants that received cytokines increased. In addition, giving cytokines was able to maintain the integrity of tonoplas membrane, then the cytokinin prevented oxidation-unsaturated fatty acids in membranes (Salisbury and Ross, 1992).

4. Conclusion

Rice straw mulching with a thickness of 4 tons / ha and 6 tonnes / ha significantly effected on the parameters of a number of branches, number of pods cropping, and seed weight. Liquid organic fertilizer from seaweed waste and cow urine had the real effect on the parameters of plant height, number of branches, flowering age, harvesting age, number of pods per crop, number of contained pods per crop and seed weight. But among treatment POC, combination treatment of liquid organic fertilizer seaweed and cow urine was most dominating on each parameter and highly significant with the control treatment. The combination of rice straw mulching with different thickness and liquid organic fertilizer from seaweed waste and cow urine caused the occurrence of real interaction to berangkasan weight, number of empty pods, soy production / plot, and production ton.ha^{-1}. It caused the soybean growth and yield increased.

5. Suggestions

Utilization of alternative materials, especially rice straw mulch and liquid organic fertilizer in agriculture was very well implemented. However, further research is needed on the effect of the addition of other components that can enhance nutrient elements in a liquid organic fertilizer of seaweed.

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