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SOYBEAN PLANT GROWTH AND PRODUCTION RESPONSE (Glycine max (L.) Merril) TO THE APPLICATION OF LIQUID ORGANIC FERTILIZER (POC) APU – APU (Pistia stratiotes L.) PLANTS AND VARIOUS SOIL REFORMERS ON ULTISOL SOIL MEDIA

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ABSTRACT

This study aims to determine the growth and production response of soybeans (Glycine max L. Merril) against the application of liquid organic fertilizer (LOF) Apu-Apu (Pistia stratriotes L.) plants on Ultisol soil media. To determine the growth and production response of soybeans (Glycine max L.) to the administration of various soil conditioners on Ultisol soil media. to determine the response of soybean growth and production (Glycine max L.) to the combination of liquid organic fertilizer (POC) Apu-Apu (Pistia stratriotes L.) plants and various soil conditioners on Ultisol soil media. This research was conducted in the experimental garden of the Faculty of Agriculture, University of Medan Area (UMA) located on Jalan Kolam No.1 Medan Area, Percut Sei Tuan District, with a height of 22 meters above sea level (masl), plain topography, Ultisol soil type and pH 4.94 carried out from September to December 2020. It uses a random block design with two factors. The first factor is the treatment of liquid organic fertilizer (POC) for Apu-Apu plants (without POC treatment, 25, 50, 75% POC
/ 1 liter of water) and the second factor is the treatment of various soil conditioners (without soil conditioner treatment, rice husk biochar, green manure for Mucuna bracteata leguminous plants, human hair waste 50g/polybag). The parameters observed were plant height (cm), number of branches (branches), flowering age (days), number of bunches per sample plant (bunches), number of bunches per plot (bunch), number of pods per sample plant (pod), number of pods per plot (pod), seed weight per plant sample (g), seed weight per plot (g weight), seeds 100 dry seeds (g). The results obtained from this study, namely: 1). The application of liquid organic fertilizer (LOF) apu - apu has a significant effect on the number of branches aged 6 WAP, the number of bunches per sample plant, the number of bunches per plot, the number of pods per sample plant, the number of pods per plot, the weight of seeds per plant sample, the weight of seeds per plot. and weigh 100 dry seeds. 2). The provision of various soil conditioners has a very significant effect, it cannot have an effect on the number of branches of plants aged 4 to 6 WAP, the number of bunches per sample plant, the number of bunches per plot, very different from the height of plants aged 4 to 6 WAP,

the number of pods per sample plant, the number of pods per plot, the weight of seeds per sample plant, the weight of the seeds per plot and the weight of 100 dry seeds.
Keywords: Apu-Apu POC, Various Soil Improvements, Soybeans

INTRODUCTION

In Indonesia, soybeans are the most important food commodities after rice and corn, these commodities are used for household food consumption, industry, animal feed and seeds. In 2017 soybean production was 538.72 thousand tons and increased in 2018 to 982.59 thousand tons for domestic food needs against soybeans as much as 3.07 million tons, of which 95% were for the needs of the food sector and 160 thousand tons for animal feed, so that Indonesia experienced a deficit in soybean production. With the deficit period of production to soybean needs, the rest is imported from abroad as much as 2.5 million tons (Central Statistics Agency, 2019).

The instability of soybean production in Indonesia is caused by several factors, especially the availability of less and less agricultural land because it has changed functions and factors for the continuous use of chemical fertilizers used by farmers, causing a decrease in soil fertility and damaging the soil due to changes in soil physical properties (Triyono et al, 2013).

However, most of the land is marginal dry land. Marginal dryland is land that has a low soil fertility rate, reacts sourly with a soil pH below 5.5 and low macro N, P, K, Ca and Mg nutrient content as well as high solubility of Al and Fe which can poison plant growth and one of them is Ultisol soil (Director General of Food Crops, 2012).

Ultisol marginal lands that are low in nutrients will inhibit the process of plant growth and production, organic fertilizers are divided into two, namely solid and liquid organic fertilizers. One alternative organic fertilizer that can be used is liquid organic fertilizer apu – apu plant.

The Apu – apu plant (Pistia stratiotes L.) ranks third out of ten weeds that cause potential problems in Southeast Asia after water hyacinth (Eichornia crassipes) and kiambang (Salvinia molesta). The plant has a very rapid breeding, causing farmers difficulty to cope with it. A solution to reduce cultivated plants, especially rice, by utilizing the apu - apu plant (Pistia stratiotes L.) as liquid organic fertilizer.

Fiolita et al, (2013) explained that the nutrients contained from apu – apu (Pistia stratiotes L.) among them there are N: 2.83%, P: 0.17%, K: 0.96%, C / N: 10 and organic matter 47,
070. In addition to the use of liquid organic fertilizers, in increasing the growth and production of soybeans can also use various soil reformers. The provision of soil reformers can improve soil quality and soil properties, both physical, chemical and biological properties. Soil reformers can be used in various ways such as the use of rice husk biochar, green manure of mucuna bracteata legume plants and human hair waste.

Biochar is a biological charcoal from an incomplete combustion so as to provide nutrients that can improve land function. Rice husk ash serves to loosen the soil so that it can make it easier for plant roots to absorb nutrients in it (Pane et al, 2014).

The application of green manure Mucuna bracteata as organic matter will improve soil properties both physical, chemical, and biological soil. The legume type green fertilizer used is LCC Mucuna bracteata has a relatively high nitrogen nutrient content compared to other types of plants. Mucuna bracteata as an organic matter contains nitrogen (N) 3.71%, phosphorus (P) 0.38 %, potassium (K) 2.92%, calcium (Ca) 2.02%, magnesium (Mg) 0.36%, C-organic 31.4% and C / N 8.46% (Simamora and Salundik, 2006).

However, research on the use of organic waste such as human hair as a soil reformer for agricultural crops has not been done by many people. Research conducted zheljazkov et al, (2005) showed that human hair waste cannot be used as a single source of nutrition for plants. This is because human hair takes longer to release its nutrients. Human hair can form a pore space of the soil for a long time, the presence of a pore chamber allows the exchange of CO2, N2, and NH3 gases with O2 from the atmosphere, human hair contains N, P, K and Cu but not necessarily can become available nutrients, such conditions are very supportive of the activity of autotrophic microbes that play a role in the provision of unsure nutrients. In addition, it can also support root development and plant growth (Ignatova et al, 1999 in Zheljazkov 2005).

Based on the above background, the author is interested in conducting research with the title "Response to Soybean Plant Growth and Production (Glycine max (L.) Merril) to the Application of Liquid Organic Fertilizer (POC) Apu-Apu plants (Pistia stratiotes L.) and Various Soil Reformers on Ultisol Soil Media.

RESEARCH METHODOLOGY

This research was carried out on the experimental land of the Faculty of Agriculture, Medan Area University. This research was conducted from September to December 2020.

The ingredients used in this research are soybean seeds of the Anjasmoro variety, Apu - apu plant (Pistia stratiotes L.), EM-4 (Effective Microorganisms), Brown Sugar, Air, Chicken Manure, Ultisol Soil, Mucuna bracteata Legume Plant, Rice Husk, Human Hair Waste.

The tools used in this study were hoes, tripe, drills, knives, crossbars/meters, tarpaulins, scales, plastic ropes, sprayers, buckets, polybags measuring 30 cm x 35 cm (5kg) and stationery.

This study was conducted using a Factorial Randomized Group Design (RAK) with 2 treatment factors, namely:

1. Liquid Organic Fertilizer (POC) Apu - apu Plant consisting of 4 levels, namely:

A0 = Control

A1 = 25% POC / 1 liter of air A2 = 50% POC / 1 liter of air A3 = 75 % POC / 1 liter of air

2. Various Soil Reformers consist of 4 levels, namely:

P0 =Control

P1 =Biochar rice husks with a dose of 20 tons / ha (50 g / polybag)

P2 =Pupukhijau plant legume Mucuna bracteata with a dose of 20 tons / ha (50 g / polybag)

P3 =Human hair waste at a dose of 20 tons / ha (50 g / polybag)

Thus obtained the number of treatment combinations as much as 4 x 4 = 16 treatment combinations.

RESULTS AND DISCUSSION

1. Plant Height (cm)

The provision of various soil reformers on ultisol soil media at the age of 2 to 3 weeks after planting is not significantly different, this is due to the nature of Ultisol soil as a planting medium has many fertility problems and also has a pH (H20) soil that is classified as acidic soil so that it affects the pattern of nutrient availability needed by plants. After entering the observation of the height of plants aged 4 to 6 weeks after planting, soybean plants showed a noticeable difference in plant height, this shows that in this phase soil reformers have been able to improve the physical and chemical properties in the soil ultisol, according to the opinion of Djojoprawiro (1984) who stated stating that the application of organic matter would result in flocculation in the soil, so that the process of consolidation of soil aggregates occurs.

The combination of applying Apu-Apu liquid organic fertilizer (POC) and various soil reformers at the age of 2 to 6 weeks after planting is not significantly different as well as a single application of Apu-Apu POC does not differ markedly, if referring to fertilizer quality indicators according to the use of organic fertilizers in solid and liquid form besides having advantages, also has several disadvantages including low and diverse nutrient content often so that it is not sufficient for plant needs. This is in accordance with Damanik et al., (2011) which states that the disadvantages of organic fertilizers have nutrients that are difficult to obtain in large quantities and are slow to be available to plants. For more details, a summary of the plant height variety fingerprints can be seen in table 1.

Table 1. Summary of Soybean Plant Height (cm) Fingerprints against The Provision of POC Apu - Apu and Various Soil Reformers At The Age of 2 to 6 MST

Sk	F. Calculate at age					F. Table	
	2 MST	3 MST	4 MST	5 MST	6 MST	0,05	0,01
Group	0.19 tn	0.53 tn	0.62 tn	3.07 tn	1.01 tn	4,54	8,68
Factor A	0.73 tn	1.23 tn	3.17 tn	3.17 tn	3.05 tn	3,29	5,42
Factor P	2.44 tn	1.82 tn	3,66 *	3,79 *	4,50 *	3,29	5,42
AP Treatment	0.59 tn	0.52 tn	0.43 tn	0.12 tn	0.03 tn	2,59	3,89
KK	9,55%	7,46%	6,09%	6,55%	5,06%		

Description: tn = Not Real * = Real

2. Number of Branches (branches)

The application of liquid organic fertilizer (POC) Apu-Apu at the age of 2 and 4 weeks after planting is not significantly different, this is because the planting medium used is ultisol soil as this soil is acidic soil that has low N and c-organic nutrients. However on

Age 6 weeks after planting shows a noticeable difference in the number of branches, this is indicated that the nutrients contained in the Apu-Apu POC in this phase can be absorbed by plants. Agree with Salisbury and Ross (1995) in Puspadewi, et al., (2014) the states that the absorption of nutrients, especially nitrogen nutrients, affects the number of branches. Furthermore, Djuaja, et al, (2012) said that plants need elements N, P and K to stimulate the synthesis and division of cell walls anticlinally so that they can accelerate the addition of the number of leaves, plant height, and branch growth.

The provision of various soil reformers at the age of 4 and 6 weeks after planting is very noticeable, this is thought to be because by giving organic matter, the nutrients needed by plants are sufficient so that they can support soybean growth. In accordance with the opinion of Muhtiar et. Al.

(2012) which states that the application of organic matter is able to provide essential nutrients such as N, P, K and Surfur, KTK, and increase the solubility of soil P so that plants absorb the nutrients available sufficiently for plants and can obtain maximum growth and yield. In addition, Sevindrajuta (2012) also stated that the application of organic matter to the soil in Ultisol can increase the levels of C- organic, N- total and bases, P nutrients available increase and reduce the content and saturation of soil Al. For more details, a summary of the fingerprints of the variety of branches can be seen in table 2.

Table 2. Summary of The Number of Soybean Branches (Branches) Against the Provision of POC Apu - Apu and Various Soil Reformers At the Age of 2 to 6 MST

Sk	F. Calculate at age			F. Table	
	2 MST	4 MST	6 MST	0,05	0,01
Group	31,96 **	2.14 tn	0.25 tn	4,54	8,68
Factor A	3.04 tn	2.10 tn	5,29 *	3,29	5,42
Factor P	1.74 tn	5,51 **	5,91 **	3,29	5,42
AP Treatment	1.30 tn	0.05 tn	0,14	2,59	3,89
KK	19,46%	12,24%	8,01%		

Description: tn =Not Real * = Real ** = very real

3. Number of Dompolan Per Sample Plant (dompolan)

The application of liquid organic fertilizer (POC) Apu-Apu is significantly different, this is because the more nutrients provided, the more plant needs can be fulfilled. According to the results of research by Ralahalu et al., (2013) stated that applying a high concentration of organic fertilizer will support plant growth and vice versa if the concentration given is too low, it will suppress growth or not spur growth of both plants in the vegetative and generative phases.

That the amount of dompolan per plant sample plant soybean (Glycine max (L.) Merril) due to the provision of various soil reformers differs is very evident, this is because the provision of biochar adds nutrients to the soil, increases nutrient retention and affects the dynamics of microbes in the soil (Annisa et al. 2017). According to Sukristiyonubowo (1993), the provision of natural organic soil reformers is able to maintain soil organic matter levels and soil KTK, as well as increasing the pH and P available. For more details, a summary of the fingerprints the variety of dompolan quantities per sample plant can be seen in table 3.

Table 3. Summary of Fingerprints of Various Dompolan Quantities Per Plant Samples (dompolan) soybeans against the provision of POC Apu - Apu and Various Soil Reformers

Sk	F. Count	F. Table	
		0,05	0,01
Group	3.71 Mr	4,54	8,68
A Factor	4,78 *	3,29	5,42
Factor P	8,03 **	3,29	5,42
Ap Treatment	2.53 Mr	2,59	3,89
KK	3,07%		

Description: Mr = Unreal * = Real ** = Very Very Real

4. Number of Dompolans Per Plot (dompolan)

That the amount of dompolan per plot of Soybean plants (Glycine max (L.) Merril) due to the application of Apu-Apu liquid organic fertilizer (POC) is significantly different, this is because the nutrients contained in the Apu-Apu POC in this phase have been absorbed by plants , especially the formation of pods that become soybean dompolan According to Dwijosaputro (2002), plants thrive when the necessary elements are sufficiently available and located and are in the appropriate concentration to be absorbed for plants, so as to provide better results for plants.

The provision of various soil reformers has a very real effect. According to Sutedjo (2008) flower formation requires sufficient P and K elements, because in the prospective fruit or pod flowers that become soybean dompolan are in the formation of flowers and fruit fruits that are maximally needed sufficient P and K elements are needed. According to Fahmi (2014) in the process of fertilization, nitrogen is not really needed, while phosphorus and potassium are one of the many nutrients needed in generative growth. For clarity, a summary of the variety of dompolan numbers per plot can be seen in table 4.

Table 4. Summary of Various Dompolan Quantities Per Plot (dompolan) Soybeans Against The Provision of POC Apu - Apu and Various Soil Reformers

Sk	F. Count	F. Table	
		0,05	0,01
Group	3.09 Mr	4,54	8,68
A Factor	4,51 *	3,29	5,42
Factor P	5,43 **	3,29	5,42
Ap Treatment	1.44 Mr	2,59	3,89
KK	2,39%		

Description: Mr = Unreal * = Real ** = very very real

5. Number of Pods Per Sample Plant (pods)

That the number of pods per plant sample plant soybean (Glycine max (L.) Merril) due to the application of liquid organic fertilizer (POC) Apu-Apu is significantly different, it is indicated that the elements ha ra phosphorus and potassium contained in the liquid organic fertilizer (POC) Apu-Apu can supply nutrients to plants until soybeans are generative (pod formation). Nutrients dissolved in water and sprayed on plants can be absorbed by plants through the stomata, as they allow fertilizer to enter through the stomata gap when opening (Hardjowigeno, 1995). Foliar fertilization during the pod filling stage can improve the filling of soybean pods. The application of nutrients through the leaves will overcome the nutrient deficiency in the leaves as due to the retranslocation of nutrients from leaves to seeds that are being formed (Garcia and Hanway 1976 in Hakim et al, 2004).

That the number of pods per plant sampled soybean plant (Glycine max (L.) Merril) due to the provision of various soil reformers differed markedly. According to Yaduvanshi (2003), the addition of 20 tons of green manure can substitute half the amount of inorganic fertilizer recommended in the availability of N and K element suppliers in the soil. Supported hardjoloekito (2009), the element phosphorus is indispensable for the formation or growth of plant generation. Sufficient phosphate element adanaya in the soil can spur the formation of pods in plants. For more details, a summary of the number of pods per sample plant can be seen in table 5.

Table 5. Summary of Fingerprints of Various Numbers of Pods Per Plant Soybean Samples (pods) Against The Provision of POC Apu - Apu and Various Soil Reformers

Sk	F. Calculate	F. Table	
		0.05	0.01
Group	1.61 tn	4,54	8,68
Factor A	3,42 *	3,29	5,42
Factor P	3,76 *	3,29	5,42
AP Treatment	0.41 tn	2,59	3,89
KK	5,94%		

Description: tn = Not Real * = Real

6. Number of Pods Per Plot (pods)

That the number of pods per plant sample plant soybean (Glycine max (L.) Merril) due to the application of liquid organic fertilizer (POC) Apu-Apu is significantly different. According to Dwidjoseputo (1990) who explained that a plant will grow vigorously if enough elements are needed. This is also supported by Hafizah (2012), that the application of liquid organic fertilizer can increasing the number of fruits, phosphorus (F) nutrients play a very important role in generative growth, so that in addition to affecting flower formation, it also affects the formation of fruits and seeds and accelerates fruit ripening.

That the number of pods per plot of soybean crops (Glycine max (L.) Merril) due to the provision of various soil reformers differs markedly. According to Hardjoloekito (2009), not sure phosphorus is indispensable for the formation or growth of plant generation. Sufficient phosphate element adanaya in the soil can spur the formation of pods in plants. The number of pods affected is also influenced by plant height, this is supported by Anggraeni (2010) who states that high plant height causes an even distribution of light throughout the canopy so that photosynthesis will be maximum, photosynthetic the ones that fill the pods will be more and more. With the provision of soil reformers so that it can increase the amount of P available in the soil, the fulfillment of P nutrient needs will increase metabolic activity so that organic matter translocated to soybean seeds or pods also increases. For clarity, a summary of the variety of pods per plot can be seen in table 6.

Table 6. Summary of The Number of Pods Per Plot (Pod) of Soybeans Against the Provision of POC Apu - Apu and Various Soil Reformers

Sk	F. Calculate	F. Table 0.05	F. Table 0.01
Group	1.28 tn	4,54	8,68
Factor A	3,47 *	3,29	5,42
Factor P	4,51 *	3,29	5,42
AP Treatment	0.22 tn	2,59	3,89
KK	2,08%		

Description: tn = Not Real * = Real

7. Seed Weight Per Plant Sample (g) That the seed weight per plant sample soybean plant (Glycine max (L.) Merril) due to the application of liquid organic fertilizer (POC) apu-apu is significantly different, this is because the elements N, P and K in the treatment of liquid organic fertilizer are absorbed by plants and used for metabolic processes in plants, especially the formation of pods and seeds. Furthermore, Suprapto (1992) emphasized that soybean plants will use P to the maximum when the plant is in the pod formation period until approximately 10 days before the seeds fully develop. That the weight of seeds per plant sample of soybean plants (Glycine max (L.) Merril) due to the provision of various soil reformers is significantly different,

this is because the function of soil reformers should be able to increase the activity of microorganisms in the soil which is necessary to improve the physical properties of the soil, where the soil will become more friable, the soil's ability to retain water will increase, soil aeration and drainage will be better and also lead to increased availability of P elements in the soil. According to the results of research by Suharjo (2001) in Nihayati, et al (2018) in pod filling and seed formation are very dependent depending on the availability of N, both N taken by Rhizobium bacteria from the air and N available in the soil and are also affected by the availability of P elements. If the availability of N is in a balanced state, it will result in the formation of amino acids and proteins increasing in seed formation so that the pods are fully filled. For more details, a summary of the variety fingerprints the weight of the seeds per sample plant can be seen in table 7.

Table 7. Summary of Fingerprints of Variety of Seed Weight Per Plant Sample (g) Soybeans Against Giving POC Apu - Apu and Various Soil Reformers

Sk	F. Calculate	F. Table 0.05	F. Table 0.01
Group	3.30 tn	4,54	8,68
Factor A	3,42 *	3,29	5,42
Factor P	3,84 *	3,29	5,42
AP Treatment	0.10 tn	2,59	3,89
KK	10,44%		

Description: tn = Not Real * = Real

8. Seed Weight Per Plot (g)

That the weight of seeds per plot of soybean plants (Glycine max (L.) Merril) due to the application of liquid organic fertilizer (POC) Apu-Apu is significantly different, this application of fertilizer application through using liquid fertilizer leaves containing the main nutrients N, P and K in soybean, corn, wheat, chickpeas and peas plants can increase plant growth and production as well as seed protein content (Novizan, 2002). The application of apu-apu POC can supply nutrient needs, especially phosphorus. Phosphorus is indispensable for plants in seed formation. Suryawaty's research (2014) the addition of POC can increase the weight productivity of dry beans. By height of weight Dry seeds are positively correlated with the amount of seed production per hectare.

That the seed weight per plot of soybean plants (Glycine max (L.) Merril) due to the provision of various soil reformers differs markedly. According to Agustina (1990), if the amount of nutrients given is sufficient to meet the needs of plants, it will be able to increase the uniformity of plant growth and development. In accordance with the opinion of Hidayat (2008), the increasing supply of phosphorus in the plant body will increase metabolism so that the seed filling process is optimal

and the seed weight increases. For clarity, a summary of the fingerprints of the variety of grain weights per plot can be seen in table 8.

Table 8. Summary of The Results of Fingerprints of Various Grain Weights Per Plot (g) Soybeans Against The Provision of POC Apu - Apu and Various Soil Reformers

Sk	F. Calculate	F. Table 0.05	F. Table 0.01
Group	0.81 tn	4,54	8,68
Factor A	3,48 *	3,29	5,42
Factor P	4,44 *	3,29	5,42
AP Treatment	0.31 tn	2,59	3,89
KK	6,20%		

Description: tn = Not Real * = Real

9. Weight of 100 Dried Seeds (g)

That the weight of 100 dry seeds of soybean plants (Glycine max (L.) Merril) due to the application of liquid organic fertilizer (POC) Apu-Apu is significantly different, this is because the need for sufficient nutrients can improve the quality and quantity of crop production, this is supported by Indrakusuma (2000), liquid organic fertilizer can improve the physical, chemical, and biological properties of the soil, so as to increase crop production, improves the quality of plant products and reduces the use of inorganic fertilizers. According to Nyakpa et al. (2006) P elements can increase the high yield of crops, increase yields and accelerate the ripening period of fruits. The increased availability of nutrients, especially P elements, serves for seed formation.

That the seed weight per plant sample plant soybean (Glycine max (L.) Merril) due to the provision of various soil reformers is significantly different, this is because soil reformers play a role in improving soil structure, maintaining soil moisture, and increasing the nutrient content in the soil, so that plant roots are easy to grow and increase the area of root absorption in the soil. The increase in seed weight is due to the translocation of photosynthetic to fruits and seeds. Photosynthetes produced in leaves and other photosynthetic cells are transported to other organs or tissues in order to be utilized by these organs and tissues for growth or stockpiled as backup material (Lakitan, 2002). For more details, a summary of the weight variety of 100 dried seeds can be seen in table 9.

Table 9. Summary of Fingerprints of 100 Dry Seeds (g) Soybeans Against Giving POC Apu - Apu and Various Soil Reformers

Sk	F. Calculate	F. Table 0.05	F. Table 0.01
Group	0.22 tn	4,54	8,68
Factor A	3,78 *	3,29	5,42
Factor P	3,90 *	3,29	5,42

AP Treatment	0.40 tn	2,59	3,89
KK	7,61%		

CONCLUSION

The application of Apu-Apu liquid organic fertilizer (POC) differs markedly from the number of branches of plants aged 6 MST, the number of dompolan per sample plant, the number of dompolan per plot, the number of pods per plant, the number of pods per plot, the seed weight per sample, the weight of seeds per plot and the weight of 100 dried soybean seeds. There is no noticeable difference in the height of plants aged 2 to 6 MST, the number of branches aged 2 to 4 MST and the age of flowering.

The provision of various soil reformers differs very markedly from the number of branches of plants aged 4 to 6 MST, the number of dompolans per sample plant, the number of dompolans per plot. The difference is markedly different from the height of plants aged 4 to 6 MST, the number of pods per sample plant, the number of pods per plot, the weight of seeds per sample plant, the weight of seeds per plot and the weight of 100 dried soybean seeds. No noticeable difference to the height of plants aged 2 to 2 to
3 MST, number of branches 2 MST and flowering age.

The combination of liquid organic fertilizer (POC) treatment of Apu-Apu plants and various soil reformers did not differ markedly from all observation parameters.

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