Effect of Types and Application of Organic Ingredients against Soybean Results (*Glycine max (L.) Merrill*) on Peat Planting Medium

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Abstract: Soybeansare one of food crops thatgrow with shallow roots that can be cultivated on peat soil, but there are still many obstacles, one of which is due to poor peat nutrients. Therefore, there needs to be an effort to overcome it by providing organic material for plant waste that can help in increasing nutrients in peat soil. The study aimed to determine the interaction and the best combination between the type organic matters and application method to the yield of soybeans in peat soil. The study was conducted in the form of a trial using a Completely Randomized Design (CRD) consisting of 2 factors and 3 replications. The first factor was the provision of organic matter of rice straw, soybean litter, oil palm empty fruit bunches (OPEFB), and the second factor was application byimmersing and spreading. The results showed that the components of yield of soybean through application of rice straw with application spread and soy litter with immersed application show high yields on the total number of pods per plant, number of pithy pods per plant, number of pithy seeds per plant and seed weight dry per plant. Furthermore, the combination of OPEFB with two applications does not show good effect on the yield parameters of soybean plants.

1 INTRODUCTION

The limitation of productive land causes agricultural extensionleading to marginal lands. Peatlands are one type of land that include criteria marginal land that has the potential to be used as agricultural land. Riau is one of the provinces that has extensive peatlands and has enough potential to be developed as agricultural land (Suwondo, 2002).

Damage to the peat ecosystem is resulted from wrong land management and the selection of commodities that are not in accordance with the characteristics of peatland. Government Regulation No 57 of 2016 concerning amendments to Government Regulation No. 71 of 2014 concerning the protection and management of peat ecosystems article 23 paragraph 3 which reads the peat ecosystem with a cultivation function declared to be damaged if it meets the standard criteria for groundwater damage on peat land more than 0.4 meters below the surface of the peat at the point of arrangement. Therefore, it is necessary to determine which plants are suitable for cultivation on peat lands for the sake of the sustainability of the peat ecosystem.

Soybean plants are included in the legume group which has shallow roots and can be cultivated on peat soil. The use of peatland as a growing medium for legume plants turns out to meet many limiting factors in its exploitation, such as poor nutrient and high evaporation which causes peat soil to dry out like charcoal so that the soil is no longer productive. Therefore, there needs to be an effort to overcome the problems found on peat soil, one of which is by providing organic matter from plant waste. The role of giving organic matter to the soil is related to changes in soil properties, namely the physical, biological, and chemical properties of the soil.

Rice straw, soybean litter and oil palm empty fruit bunches (OPEFB) are organic materials of plant waste that have good potential as a source of nutrients for plants, energy sources for soil fauna and microorganisms and as soil cover to maintain soil temperature and humidity. Nevertheless organic matter is often not utilized by farmers due to its unknown function.

Composting organic matter such as Lignocellulose-containing OPEFB requires a long time. To overcome this, an alternative is needed that can speed up the composting process. Huang et al. (Huang et al.2009) stated that the use of microorganism inoculants aims to accelerate composting and improve the final product.

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Microorganisms that can accelerate the decomposition process are cellulolytic microorganisms Azhari (Azhari, 2000). Cellulolytic microorganisms are microorganisms that are able to degrade cellulose enzymatically through the activity of cellulase enzymes, one of which is bacteria.

In addition to organic matter which can affect the nature of peat soil and the yield of soybean plants, the way the application also influences it. Giving organic matter to the soil can be done by mixing organic matter into the soil and also as mulch (Pauza, 2016). Mulch has been reported to increase yield by creating soil temperature and a favorable moisture regime (Han and Ma, 1995). Mulch is a crop residue, plastic sheet, or stone arrangement that is spread on the ground. Mulch is the right strategy to reduce evaporation, accelerate plant development, reduce erosion and help control weeds. As a result of reduced evaporation, mulch-treated soils improve water conservation, especially in the soil at the top (Godawatte and Silva, 2014). This study aims to determine the interaction and determine the best combination between the type and method of application of organic matter to the yield of soybeans in peat planting medium.

2 METHOD

This research was conducted at the Experimental Garden of the Faculty of Agriculture, University of Riau Campus Bina Widya Km 12.5 SimpangBaru Village Panam, Tampan District, Pekanbaru, Riau. This study lasted for 4 months starting from August to November 2017.

The experiment was conducted experimentally which was arranged in a completely randomized design (CRD) factorial pattern consisting of 2 factors. First factor: organic matter of plant waste (O), namely: O1 (125 g^{-1} medium rice straw), O2 (soybean litter 125 g^{-1} medium), O3 (oil palm empty fruit bunches (OPEFB) 125 g^{-1} medium) and the second factor: how to apply organic matter (C), namely: C1 (immersed) and C2 (spread).

Parameters observed in this study were plant height, number of productive branches, age of flowering, total number of pods per plant, number of potted pods per plant, number of empty pods per plant, number of seeds per plant, and dry seed weight of each plant.The data obtained were statistically analyzed using statistical analysis system (SAS) Version 9.1 program, then further testing was carried out by duncan multiple distance test's new multipe range test (DNMRT) at the level of 5%.

3 RESULTS AND DISCUSSION

3.1 Plant Height, Number of Productive Branches, Age of Flower Emergence, Total Number of Pods per Plant, Number of Pods Containing Each Plant, Number of Empty Pods per Plant, Number of Seeds per Plant and Dry Seed Weight of Each Plant

Table 1 shows that the treatment of organic matter, the ways of application of organic matter and a combination of both give different results not significant to plant height, number of productive branches and the age of flowering of soybean plants. This is influenced by genetic factors such as the use of the same variety and also the ability of soybean plants to be symbiotic with Rhizobium to tether N2 from the air.

Zainal et al. (Zainal et al.2014) explained that Nitrogen is an essential nutrient that is needed by plants in quite a lot. Vegetative growth such as plant height growth and formation of productive branches formed are influenced by N availability. N nutrients are needed by plants to produce protein and chlorophyll and maintain photosynthetic efficiency, so that the process of plant physiology runs well. The number of productive branches produced is likely to be a lot of flowers.

Flowering age or when the first flower emerges from varieties planted at the same time and environment the age of flowering in plants is also almost the same. Research uses the same variety but the organic material given as a different treatment by means of application is also different, so it can be expected that genetic factors predominantly affect the age of flowering. Lakitan (Lakitan, 2007) states that a flowering plant is also influenced by its variety. Varieties play an important role in determining the components of soybean products because to achieve high productivity is very much determined by the potential power yield of the superior varieties planted (Irwan, 2006).

Table 1: Growth of soybean plants after being given several organic ingredients and their application ways.

Treatment	Soybean Plant Growth		
	Plant height Number of Productive Branches Flowers appear		
	(Cm)	(Branch)	(Dap)
Organic material (O)			
Rice straw (O1)	56,67	6,00	41,17
Soybean litter (O2)	55,50	6,33	41,17
OPEFB (O3)	58,67	5,67	40,67
Application method (C)			
Immersed (C1)	55,00	5,89	41,33
Spread (C2)	58,00	6,11	40,67
Organic ingredients & application ways			
O_1C_1	55,67	5,67	41,33
O_1C_2	56,67	6,33	41,00
O_2C_1	50,00	7,00	41,67
O_2C_2	61,00	5,67	40,67
O_3C_1	59,33	5,00	41,00
O_3C_2	58,00	6,33	40,33

Table 2: Components of yield and yield of soybean plants after being given organic matter and the application method.

Treatment	Components of Results for each Plant				The results of each plant
	TNPNPPNEPNSP				DSW
	(Pod)	(Pod)	(Pod)	(Seed)	(g)
Organic material (O)					
Rice straw (O1)	80,83	78,67	2,16	162,83	15,86
Soybean litter (O2)	77,83	75,50	2,33	156,00	14,88
OPEFB (O3)	65,83	64,33	1,50	124,67	12,10
Application method (C)					
Immersed (C1)	76,67	73,89	2,78	145,44	13,85
Spread (C2)	73,00	71,78	1,22	150,22	14,71
Organic ingredients & application ways					
O_1C_1	68,00	66,00	2,00	130,67	13,36
O_1C_2	93,67	91,33	2,33	195,00	18,36
O_2C_1	93,00	89,33	3,67	179,00	16,03
O_2C_2	62,67	61,67	1,00	133,00	13,73
O_3C_1	69,00	66,33	2,67	126,67	12,16
O_3C_2	62,67	62,33	0,33	122,67	12,03

Keterangan:
- TNP (Total number of pods),
- NPP (Number of pithy pods),
- NEP (Number of empty pods), - NSP (The number of seeds is pithy), dan - DSW (Dry seed weight).

A plant will give a different response to different environments. The data in Table 2 provides information about the role and function of the treatment given. The data in Table 2 show that the combination of organic matter of rice straw by means of distributed application produces the total number of pods per plant (93.67 pods), the number of seeds per plant (91.33 pods), the number of seeds per plant (195.00 seeds) and dry seedweight for each plant 18.36 g) highest compared to other combinations. It is suspected that rice straw that is spread on the surface of peat soil serves to protect the soil surface from direct sunlight which can cause evaporation so that the water content in the soil can be maintained and the water needs for plants are fulfilled. Comparison of planting medium after being given organic matter by means of the application spread shown in Figure 1.

Figure 1: medium of application of rice straw spread (a), soybean litter application medium spread (b),the media planted the OPEFB application is spread (c).

The provision of organic matter to the planting medium gives an influence on the yield and yield components of soybean. Figure 1 shows the difference in soil surface given organic matter with the application spread.

The organic matter of rice straw by means of spread (Figure 1.a) gives higher yields, this is because the organic matter of rice straw spread on the soil surface is able to cover the soil perfectly compared to organic soybean litter and OPEFB. This condition is caused by the organic matter of soybean litter being spread on the surface of peat soil (Figure 1.b) unable to cover the soil properly due to soybean litter exposed to sunlight and rainwater which are easily weathered and wrinkled so that the soil surface is more open. This condition causes excessive evaporation of peat soil is still happening, this is no different from the provision of OPEFB. Tie and Lim (Tie and Lim, 1992) state that peat has irreversible drying properties which means that once there is excessive dryness the nature of peat colloids will become damaged so that the peat cannot return to hold water. Peat which is already dry changes its properties like charcoal and can no longer absorb nutrients (Chotimah, 2002).

Subhan and Sumana (Subhan and Sumana, 1994) in Marliah et al. (Marliah et al.2011) stated, the use of organic mulch such as straw will provide a good growth environment for plants because it can reduce evaporation, prevent direct sunlight from excessive exposure to soil and moisture can be maintained so that plants can absorb nutrients and water properly. Besides that the organic material of rice straw which has been chopped and then spread on the ground surface is very strong to hold water compared to other organic materials. Irfany et al. (Irfany et al.2016) states that high soil moisture indicates that the water contained in the soil is also high so that the need for water for plants can be fulfilled. The availability of enough water to meet the water needs of plants is very important. If the availability of ground water is less for the plants as a result of water as photosynthetic raw material, the transportation of the nutrient will be hampered so that it will affect the production produced (Felania, 2017).

Water capacity is less available causing plant development to be disrupted so that the formation of pods and filling of pods will be inhibited. In addition to water, nutrients also affect the development of soybean plants. Comparison of the total number of pods and the number of seeds pithy after being given organic matter and the application method are shown in Figures 2 and 3.

Figures 2 and 3 show a comparison of the total number of pods and the number of seeds of p plants per soybean in each treatment. The provision of rice straw with the spread application (O1C2) showed the highest total number of pods and number of pithy seeds followed by the provision of soybean porridge with the Immersed application. The provision of soybean litter organic material (O2C1) in Immersed shows high yields after the combination of organic matter of rice straw with the application spread over other treatments.

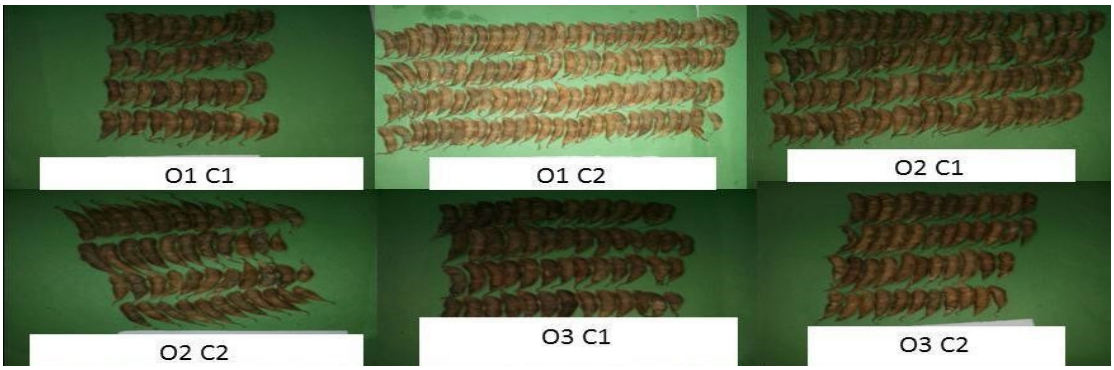

Figure 2: Total pods per soybean plant:immersed rice straw (O_1C_1), spread rice straw (O_1C_2),immersed soy litter (O_2C_1), spread soy litter (O_2C_2), immersed OPEFB (O_3C_1), and spread OPEFB (O_3C_2).

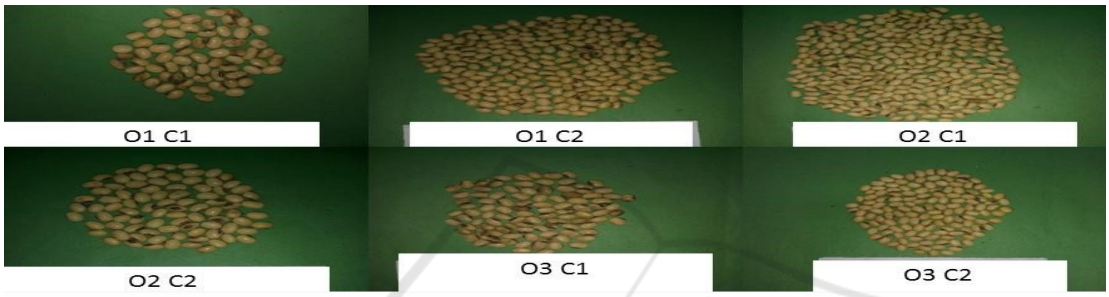

Figure 3: Pithy seed:immersed rice straw (O_1C_1), spread rice straw (O_1C_2),immersed soy litter (O_2C_1), spread soy litter (O_2C_2), immersed OPEFB (O_3C_1), and spread OPEFB (O_3C_2).

The data in Table 2 shows that the combination of organic matter of soybean litter by means of application is immersed to produce the total number of pods per plant (93.00 pods), number of pithy pods per plant (89.33 pods), number of pithy seeds per plant (179.00 seeds) and the highest dry seed weight per plant (16.06 g) compared to the treatment of rice straw in immersed, soybean litter was spread and the OPEFB was immersed or spread. This condition is due to the embedded soy litter containing high nutrients, especially N and easily decomposed. This condition causes the soaked soy litter to provide more nutrients and faster than other treatments.

Nitrogen acts as a constituent of chlorophyll and chlorophyll which controls the ability of plants to carry out photosynthesis (Setyanti et al., 2013). Photosynthesis results will be translocated by the plant to the branch of the plant.

The data in Table 2 shows the number of empty pods produced by each crop, namely the average of 2-3 planted pods. The lowest number of empty pods is in the OPEFB growing medium. Although the total number of pods produced is small, but when associated with total pods, the application of OPEFB is still less able to show high yields, this is suspected when the pods are blocked due to water and nutrients needed by the plants are not available.

Formation of pods, seed formation and increase in soybean seed weight are influenced by the availability of water and nutrients, if water and nutrients are less available it can cause the formation of pithy seeds to be disturbed so that the seeds produced are few. This condition is not different from the provision of OPEFB organic matter.

The combination of OPEFB which was applied in the method of Immersed (O3C1) or spread (O3C2) did not show a tendency for high yields even though the vegetative phase showed the same growth but in the generative phase showed differences in results. This is because the organic matter of OPEFB contains high lignin which causes the duration of decomposed organic matter compared to other organic materials.

The length of decomposed organic OPEFB organic matter causes nutrients available in the soil to be used by soil organisms as energy to remodel organic matter that causes nutrients needed by plants less available. Whereas the Immersed organic matter of OPEFB is not able to cover the soil perfectly and is very weak in holding water which can cause high evaporation of peat soils can occur.

Insufficient nutrients and water can inhibit the formation of pods and fill pods so that the yield and yield components of soybean plants decrease.

4 CONCLUSIONS

The provision of various organic materials and the application method gives no different results on growth parameters such as plant height, number of productive branches and age of flowering, but on the yield components of soybean plants through the provision of rice straw with application spread and soy litter with immersed applications tend to show high yields on the total number of pods per plant, number of pithy pods per plant, number of pithy seeds per plant and dry seed weight of each plant.

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