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RESEARCH ARTICLE

THE EFFECT OF BANANA HUMPS AND TIME INTERVALS ON THE GROWTH OF PALM OIL SEEDLINGS (*Elaeis guineensis* Jacq.) IN THE PRE-NURSERY.

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Abstract

This study was aimed to recognize the effect of the banana hump and time intervals treatment on the growth of oil palm seedlings (*Elaeis guineensis* Jacq.) in the pre-nursery. This study used the experimental method with factorial randomized block design with 2 repetitions and 16 treatments. The first factor is the banana hump dose with 4 levels: 0 g (B0), 10 g (B1), 20 g (B2), 30 g (B3). The second factor is the time interval with 4 levels: 0 weeks (P0), 1 week (P1), 2 weeks (P2), 3 weeks (P3). The data were analyzed by using analysis of variance, followed by Duncan's multiple range test with a significant of 5%. The results showed that the application of 20 grams of banana humps effectively increased the leaf length growth of palm oil seedlings in the pre-nursery to reach 6.72 cm (6th WAP), the number of leaves was around 3.08 strands (9th WAP), the root weight was 1.63 grams, the fresh weight was 5.18 grams, and dry weight was 0.98 grams (11th WAP). The 3-week interval for the application of banana humps to the growing media surface effectively increased the leaves number growth of palm oil seedlings at the pre-nursery in 7 weeks after planting so that it reached the highest number of leaves around 1.79 strands. The application of banana hump interaction with time intervals did not significantly affect the growth of palm oil seedlings in the pre-nursery.

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Introduction:-

Palm oil plant (*Elaeis guineensis* Jacq.) is the dominant plantation crops in Indonesia. Palm oil plant has an important meaning in increasing the country foreign exchange and also is able to create jobs for the community. This plant has a high economic value because it is one of vegetable oil plant (Sudarso *et al.*, 2015). There are 2 kinds of oil which come from palm oil. They are from the fruit flesh (mesocarp) which is released through boiling and squeezing (press) known as Crude Palm Oil (CPO) and oil which derived from the palm kernel known as Palm Kernel Oil (PKO). Palm oil can be used for food, cosmetics, medicine, heavy and light industries, and waste utilization (Lubis, 2008). The production and area of palm oil started from 1986 to 2006 showed a significant increase, especially between 1990 and 2006. The total area at the beginning of which was 1,126,677 hectares became 6,074,926 hectares. Meanwhile, palm oil production increased from 7,000,508 tons to 16,000,211 tons/year. In addition, the value of oil export also increased from 4,110,027 tons to 12,101,000 tons/year (Lubis *et al.*, 2011). The more land of the crop area for oil palm plantation is, the higher demand of seeds is. Not only the number of seeds but also the good quality of seedlings has to be considered to fulfill the need of oil palm seeds. One of the ways to improve the quality of seedlings is the seedling selection (Sudarso *et al.*, 2015).

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The nursery of palm oil plants can be carried out through one stage (single stage) or two stages (double stage). Both of these nursery systems require topsoil to fill the polybags as a place to plant sprouts and raise oil palm seeds as planting material in the field. Nurseries provide a real contribution on the plant growth and development. Nurseries are needed as palm oil plants require continuous and constant attention at the age of 1-1.5 of the first year. Initial production in the field is significantly correlated with leaf width in the period of Non-Producing Plants (NPP). A condition that is very much determined by good nursery condition (Pahan, 2006). The right nurseries will provide high production of plantation crops. One technique to increase plant growth and production is the management of plant cultivation systems at nurseries by providing organic material in the form of plant remnants, or the parts of plants that are wasted can be used as a cover on the growing media surface (mulch). These organic materials which are placed above the soil surface are useful for maintaining the moisture and improving the soil condition, and they are environmentally friendly (Chalker-Scott, 2015). In addition, mulch organic material can be beneficial in suppressing the weed growth (Maggard *et al.*, 2012), improving root health and suppressing density of nematode population (Olaniyi, 2014), maintaining moisture at the root zone level, soil temperature, and soil water content (Kwambe *et al.*, 2015). There is a possibility that the longer the mulch of organic material given on the planting medium surface is, the more fertile of the growing media to grow is. It is completely beneficial for increasing plant seeds growth. Therefore, the time interval in the addition of organic material on the planting media surface is likely to affect the plant seeds growth. The right technique will be truly beneficial for the health of cultivated plants (ISA, 2011).

Several studies have reported that various types of organic materials used as covering on the planting media surface can increase the plant growth and production, such as rice husk (Ramli, 2017), processed waste mulch (Manyatsi and Simelane, 2017), palm oil bunches, sawdust wood (Olaniyi, 2014), grass mulch (Kwambe *et al.*, 2015), and various types of wood mulch (Maggard *et al.*, 2012). Various wasted plant remnants can be used as the organic materials which cover the surface of the planting media, including banana humps which are frequently wasted after fruit crop. Banana humps are wasted plantations which gradually increase, and it is still difficult to allocate the waste. As the matter of fact, banana humps have high nutrition with complete composition, namely carbohydrates (66%), essential water and minerals, starch (45.4%), and protein (4.35%). Thus, banana humps can be used by decomposing microorganisms as organic material (Khalimatu, 2016). Banana humps are remnants of organic material from banana plantations which are widely available and not utilized. This hump is usually used as the main ingredient in compost production because it contains complete macro and micronutrients (Kesumaningwati, 2015). Besides its characteristic as waste, it also has a high-calorie value of 3,196.29 Kcal/g (Amelia *et al.*, 2010). Banana hump also contains so much phosphorus that it can be utilized (Wahyusi, 2008) as a source of soil organic material which can be used by the plant for its growth. Unfortunately, there is still very little even no information about the use of banana hump as mulch in the planting media to determine the effect on the plant growth and production, particularly in plantation crop recently. Therefore, this research requires to be conducted with the aim to recognize the effect of the banana hump and the time intervals on the growth of palm oil seedlings in the pre-nursery.

Materials and Methods:-

This research was conducted in February until April 2018, at community land of Dusun 1 Belilir, Balai Kasih Village, Kuala Langkat District with the altitude ranging from 30 m above sea level (BPS, 2016). The materials used are palm oil sprouts obtained from PORC D x P Simalungun, banana humps, topsoil, manure, water, and polybags at the size of 14 cm x 22 cm. The tools which are used are hoes, hoops, buckets, meters, analytical scales, calipers, sieves, sample stakes, hammers, ropes, treatment boards, wood, labels, paranets, and stationery. The method used is the experimental method with a factorial randomized block design with 2 repetitions. The first factor is the dose of banana hump which consists of 4 levels, namely: 0 g/polybag (B0), 10 g/polybag (B1), 20 g/polybag (B2), 30 g/polybag (B3). The second factor is the time interval of banana hump addition (P) which consists of 4 levels, namely: 0 weeks (P0), 1 week (P1), 2 weeks (P2), 3 weeks (P3). Procedures in the study: preparing the research area and planting media, selecting seeds, planting seeds, adding banana hump doses with determined time intervals, conducting maintenance and observation from the 4th week to the 11th week. Observation on parameters of plant height, leaf length, number of leaves, stem diameter, root length, fresh weight, root weight, and plant dry weight. The data of the observation is analyzed by using analysis of variance. If it has the significant effect, it will be continued to Duncan's multiple range test with a significant of 5%. The data is processed with SAS program 9.3.1.

Results and Discussion:-

Number of leaves and length of leaves of oil palm seedlings

Based on the analysis of variance, the results showed that the application of banana hump (B) was significantly affected the number of leaves growth of oil palm seedlings at the pre-nursery at 6th week, 7th week and 9th after planting. The time interval (P) has a significant effect on the 7th week, and the interaction of the concentration of banana hump with time interval does not significantly affect the 4th to 11th week after planting. Based on statistical tests, the application of 20 g of banana hump (B2) could significantly increase the number of leaves growth at 6th week, 7th week, and 9th week after planting, in which at 9 weeks after planting could reach the best number of leaves around 3.08 strands (42.59% higher than the control). This treatment is significantly different from B1 and B0 (**Table 1**). It showed that the optimum concentration of banana hump was required to increase the growth of leaves significantly. While the time interval of 3 weeks (P3) for the application of banana hump in the growing media of oil palm seedlings effectively increased the number of leaves growth at the age of 7 weeks after planting so that it reached the highest number of leaves around 1.79 strands (38.76% higher than the control). This treatment was not significantly different from P2 but it was significantly different from P1 and P0 (**Table 2**). It showed that the longer time interval was given, there is a possibility that the number of leaves growth of palm oil seedlings in the pre-nursery was higher. The application of interaction between banana humps and time intervals has no significant effect on the number of leaves growth starting from the 4th to 11th week after planting. Although the interaction of these two factors did not significantly influence the number of leaves growth, based on average data, the application of B0P2 could increase the growth of the largest leaves number starting from the 4th week to the 11th week.

Table 1:-The effect of banana hump concentration on the growth of the number of leaves and the length of leaves of oil palm seedlings in the pre-nursery.

Treatment	Number of leaves			Length of leaves
	Week 6	Week 7	Week 9	Week 6
B0	0.37 b	1.33 b	2.16 b	2.51 b
B1	0.66 b	1.12 b	2.12 b	4.32 b
B2	1.16 a	1.96 a	3.08 a	6.72 a
B3	0.70 b	1.41 b	2.42 ab	4.47 b

Note: Numbers followed by the same letters are not significantly different at the 5% level.

Based on the analysis of variance, the application of time intervals and their interactions with banana humps did not significantly affect to the leaf length growth of oil palm seedlings in the pre-nursery from the 4th to 11th week. However, the application of banana hump (B) has a significant effect on the leaf length growth at the 6th week after planting. The result of the statistical test showed that the application of 20 grams of the banana hump (B2) could significantly increase the leaf length growth at the 6th weeks after planting until it reached the leaf length of 6.72 cm (167.73% higher than the control of 2.51 cm). This treatment was significantly different from B1 and B0 (**Table 1**).

Table 2:-Effect of time intervals on the growth of the number of leaves of oil palm seedlings in the pre-nursery at the 7th week.

Time intervals (P)	Mean
0 Weeks (P0)	1.29 b
1 Week (P1)	1.21 b
2 Weeks (P2)	1.54 ab
3 Weeks (P3)	1.79 a

Note: Numbers followed by the same letters are not significantly different at the 5% level.

Based on the average data, both of these factors could increase the leaf length growth at the pre-nursery. The best treatment which could increase the leaf length growth is the application of B3P2 combination which reached the highest leaf length from the 6th to 8th week after planting. Then, in the 9th to 11th week, the treatment was obtained B2P3 which reached the highest leaf length of 15.78 cm.

Root length, root weight, fresh weight, and dry weight of palm oil seedlings.

Based on the analysis of variance, the application of time intervals and their interactions with banana hump did not significantly influence the root length growth, root weight, fresh weight, and dry weight, but the application of banana hump (B) significantly affected root weight, fresh weight, and dry weight of palm oil seedlings at the pre-

nursery in the 11th week after planting. Application of 20 g of the banana hump (B2) effectively increased root weight growth up to about 1.63 g (66.32% higher than the control). This treatment was significantly different from B0 and B1, but it was not significantly different from B3. Application of B2 also effectively increased the growth of fresh weight and dry weight of oil palm seedlings at the pre-nursery in the 11th week after planting, so that it reached the highest fresh weight approximately 5.18 g (53.25% higher than the control) and the highest dry weight approximately 0.98 g (36.11% higher than the control). This treatment was significantly different from all treatments (Table 3).

Table 3:-Effect of banana humps on the growth of oil palm seedlings in the pre-nursery at the age of 11 weeks after planting.

Treatment	Root weight	Fresh weight	Dry weight
B0	0.98 b	3.38 b	0.72 b
B1	1.12 b	3.48 b	0.65 b
B2	1.63 a	5.18 a	0.98 a
B3	1.39 ab	4.23 B	0.79 b

Note: Numbers followed by the same letters are not significantly different at the 5% level.

Based on the average data, the best treatment which could be obtained was P0B2 which could achieve the highest root length growth approximately 22.62 cm. For the parameters of root weight, fresh weight, and highest dry weight, the best treatment was B2P3 which reached the highest root weight approximately 1.85 g, the highest fresh weight of 5.8 g, and the highest dry weight of 1.07 g. Meanwhile, the control only reached the root weight of approximately 0.77 g, fresh weight of 3.12 g, and a dry weight of 0.73 g. It also revealed that the fresh weight growth of palm oil seedlings in the pre-nursery at the 11th week after planting was directly proportionate to the dry weight growth.

Plant Height and Stem Diameter of Palm Oil Seedlings

Based on the variance analysis, the application of banana humps and time interval on the plant height and stem diameter of palm oil seedling in Pre-nursery at week-4 up to week-11 after planting did not influence significantly. However, based on the mean data, the application of banana humps and time interval could increase the plant height and stem diameter of palm oil seedling in Pre-nursery at week-4 up to week-11 after planting. The best treatment to increase the growth of plant height from week-5 to week-10 was the combination application of 30 g banana humps and two-weeks of time interval (B3P2). It could get the most height seed out of other treatments and control. The best treatment in week-11 after planting was the combination of 20 g banana humps and 3-week time interval (B2P3). The palm oil seedlings could reach 19.7 cm. The best treatment to get the most height of stem diameter in week-5 to week-11 was B1P2. It reached 1.7 cm at week-11.

Discussion:-

Mulch organic material gave some benefit as follows: to increase the soil microorganism activities which could reform the physical and chemical soil structures, to preserve the soil temperature and reduce evaporation so that the soil dampness keep balance and efficient, to suppress the weed and pest growth, to protect the soil surface from the rain, reducing surface flow, erosion and loss of soil. Plant remnants could be soil organic sources (ISA, 2011). According to Zulkarnain (2010) the use of mulch on the surface of the planting medium was to keep the soil dampness, to stabilize the soil temperature, to reduce the rate of erosion, and to suppress the weed growth so that the nutrients absorption in the soil will be more effective. Mulch was useful to modify the plant growth environment.

This research showed that the application of banana humps as a mulch on the surface of planting medium could increase the growth of palm oil seedlings significantly in pre-nursery. Dose 20 g of banana hump was effectively increase the growth of leaf number, leaf length, root weight, fresh weight, and dry weight of oil palm seedlings in the pre-nursery. This presented that banana humps used as mulch could improve soil conditions as a growing medium which gave benefit to stabilize soil temperature and soil pH, to suppress weed growth and disease pests, and to protect the soil surface of the rain, reducing surface flow, erosion, and loss of land. Besides being able to use as soil fertilizers or growing media for plants through plant cultivation techniques, it was possible that banana humps with high enough water content could keep moisture in the growing media so that it was easier for plant roots to absorb nutrients from the soil then transported through xylem and to the leaf part to be processed through the mechanism of photosynthesis. Thus, the application of banana humps had the potential to increase soil fertility

through increasing the availability of nutrients in the form needed by oil palm seedlings at the pre-nursery for growth and development.

In addition to the type and thickness of banana humps that could affect the condition of soil media, with up to 11 weeks running at the pre-nursery, it is possible that the banana humps will be broken down to increase the nutrients needed by oil palm seedlings. According to ISA (2011) organic material placed on the surface of the planting medium could increase soil fertility because certain types of mulch was decomposed. Banana humps had a fairly high nutrition with a complete composition such as carbohydrates, water, and essential minerals so that it could be used by decomposing microorganisms. The high carbohydrate content in banana humps during the fermentation process was decomposed into nitrogen needed by plants (Nisa, 2016). Organic mulch was also useful for increasing the activity of microorganisms (soil microorganisms), thereby improving the physical and chemical properties of soil (ISA, 2011). According to Moenandir (1993) the fresh weight of plants was influenced by the process of absorption of water and nutrients by plants. Absorption of water and nutrients by plants depended on water reserves and nutrients absorbed and the ability to absorb them. It was presumed that it was caused by the optimal supply of mineral for the palm oil seedlings after the application of banana humps. Then according to Gardner *et al.* (1991) the value of dry weight was the accumulation of an organic compound produced by the synthesis of organic compounds mainly water and carbohydrates that relied on the rate of photosynthesis of the plant, while photosynthesis is influenced by the speed of mineral absorption in the plant through the roots. Thus the application of banana humps dosage as the organic mulch helped to stabilize the condition of the palm oil seedling planting media so that it had the potential to maintain or even to improve the soil fertility (planting media). Eventually, it could significantly improve the growth of palm oil seedlings in pre-nursery.

In this research, it was shown that the application of interaction between the banana hump and time interval did not significantly influence on the growth of palm oil seedlings in pre-nursery, yet the mean score showed that the interaction application of those two factors could improve the growth of palm oil seedlings in pre-nursery. The interaction between the two factors possibly made the work system slow in order to improve the soil's fertility be the growth media of the palm oil seedlings in pre-nursery. In addition to the kind and dosage of the mulch, an exact timing was also needed to modify the mulch condition and comfortable soil texture for the decomposing microorganism to be active. According to Bell *et al.* (2009) every material which was spread on the soil surface would influence the soil's characteristics and plant's growth. ISA (2011) also argues that mulch thickness lead to excessive humidity in the roots zone, which then could suppress the plant. The kind of fresh mulch such as banana hump could influence the soil's pH and ultimately could cause malnutrition or poison accumulation. The right type of mulch could improve the soil's fertility and lead to a healthier plant's growth (Chalker-Scott, 2015). Then according to Maggard *et al.* (2012) soil's pH and potassium increased by using type of hardwood mulch for two years. This mulch was beneficial for the plant's growth and survival by maintaining the greater soil's humidity, reducing competition from weeds, and moderating the soil's temperature. It showed that besides dosage, the type of organic mulch used would need a certain time to control the soil's condition and mineral availability in the growth media in the form needed by the plant. Those factors were correlated each other in combining their potential to improve the plant's growth. Likewise, the growth of palm oil seedlings in pre-nursery was insignificantly influence by the interaction of the two factors of banana hump dosage and the time interval given.

Conclusion:-

1. The application of banana hump significantly influences the length growth of leaf, a number of the leaf, weight of the root, fresh weight, and dry weight of the palm oil seedlings in pre-nursery. The application of 20 g of banana hump is effective in improving the length of leaves the palm oil seedlings in pre-nursery up to 6.72 cm (the 6th WAP) (167.73% higher than the control), the number of leaves up to around 3.08 sheets (the 9th WAP) (42.59% higher than the control), the weight of the roots up to 1.63 g (66.32% higher than the control), the fresh weight up to 5.18 g (53.25% higher than the control), and the dry weight up to 0.98 g (the 11th WAP) (36.11% higher than the control).
2. The application of time interval to apply banana hump as the mulch on the growth media surface significantly influence the growth of the leaf number of palm oil seedlings in pre-nursery. The 3-week interval time of for the application of banana hump on the growth media surface is effective in improving the growth of the leaf number of the palm oil seedlings in pre-nursery in the age of 7 weeks after the planting. It can reach the highest number of leaves up to 1.79 strands (38.76% higher than the control).
3. The interaction of banana hump application and interval time does not significantly influence the growth of palm oil seedlings in pre-nursery.

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