Attractive : Innovative Education Journal
Vol. 5 No. 1, March 2023

The Relationship Between Peat Water Content to Physical Properties of Peat at Various Ages of oil Palm Plant and Year Products in Mekar Jaya Village

Hasriati Nasution[1], Yusfaneti[2], Asmadi Saat[3]
[1,2,3]*Universitas Jambi, Indnesia*

Corresponding Author: hasriati.nasution@gmail.com

ARTICLE INFO
Article history:
Received
February 01, 2023
Revise
March 06, 2023
Accepted
March 27, 2023

ABSTRACT

The study aims to determine the water content of peat on the physical properties of peat soil planted with palm oil at various ages in the village of Mekar Village. The study was conducted by survey using the Proportional Random Sampling Method on oil palm plants aged 5-10 years, 11-15 years, 16-20 years. The parameters observed were physical properties of peat, peat thickness, organic matter content, C-organic content, volume of weight, total pore, soil moisture content and decrease in peat soil water level. Data were analyzed by the Unpaired Center Value Test at the level of 5% and analyzed using a multiple regression test. The results showed the relationship of soil water content at the age of 5-10 years of palm oil, affected by C-organic and pH with R2 = 0.855. For oil palms aged 11-15, soil moisture content is affected by soil volume weight, organic matter content, water level with R2 = 0.869, oil palms aged 16-20 years, soil moisture content of peat affected by unit weight, organic material, water table and pH with = 0.757. The relationship between oil palm production and soil water content is 0.809R^2.

Keywords: *Moisture Content, Palm Oil, Peat Soil, Physical Properties*

Journal Homepage https://www.attractivejournal.com/index.php/aj/

Published by CV. Creative Tugu Pena

PENDAHULUAN

Jambi Province has the charm of peatlands with a million benefits in a complete ecosystem structure. However, currently there are many forest peatlands that are used as land for plantation crops so that many peat soils are threatened with land degradation and are at risk of drought.This is because a lot is done in the utilization of peat soil by removing the water that is in the peat soil by means of excessive drainage. In general, peat soil is in a state of water saturation. Because the formation of peat soil comes from the accumulation, weathering and decomposition of organic matter from plant residues in a water-saturated state, the process of forming peat soil again takes quite a long time (Soil Survey Staff, 2014).

In forest peatlands, as time goes by and the population increases and there is limited land, the conversion of peatland into plantation land is carried out in order to support farmers' income to make ends meet by cultivating oil palm plants (Nora and Carolin, 2018). Peatland is land resulting from the accumulation of organic matter which is the result of weathering of the vegetation that grows around it and forms naturally in the soil of the basins (Noor, 2001). Where the area of peat in Indonesia reaches 21 million ha spread across the island of Kalimantan 32%, Papua 30% Sumatra 35% and other islands 3% (Wahluyo et al, 2011). The area of peat land in Jambi

Province is 554,902 ha which is spread across 6 districts, one of which is Tanjung Jabung Barat Regency which has a peat area of 85,242 ha (Center for Agricultural Land Resources BBSDLP, 2016)

The conversion of peat forest for plantations is carried out for drainage by making large and small ditches along several lines of oil palm plantations with different depths and widths of the drainage ditches. So that water easily disappears from the location of the oil palm plantations. But this area is also drained by large rivers and tidal overflows. And the result is that the height of the groundwater level is getting deeper, as a result, the water content absorbed by the peat material will be lost and a little. Actually, natural peat can store water up to 5 to 15 times its weight (Putra, 2018). Because of that, the water content of peat is a reflection of the activity of other peat properties, including volume weight, organic matter content, water level, C-organic content and fiber content.

Water content is the amount of water contained in an object, here the object is organic material that is undergoing decomposition of organic matter. Where the water content is expressed in percent. That is the amount of water that can be held by heavy base peat and bolume (Dariah et al, 2014). Based on research on peat soil moisture content (Najiyati et al., 2005), the average water content in the first 0-5 cm layer was 65%, the average water content in the second 10-15 cm layer was 71.39% and the peat water content in layer of 20 cm peat soil moisture content of 71.07%.

success in pengThe management of peatlands is in terms of water management, this has to do with the water content of the peat which will occur if the water on peatlands is lost, the peat's ability to hold water will decrease. In this peatland has fiber that divides the pore space into macropores and micropores, namely the smallest part that is found between the pore spaces where peat can absorb water and hold water more than 2 times the weight of peat (Setiadi, 2019).

Peat soil that has been drained undergoes changes in natural ecosystems and anaerobic conditions to become aerobic conditions and mineralized organic matter. The occurrence of land drainage will cause dry symptoms to return to the peat material so that it is unable to absorb nutrients and retain water, peat soil compaction occurs and land subsidence occurs (Berglund et al., 20011).One of the locations that manages peatland as a plantation business is the Mekar Jaya Village, which is located in Betara District, West Tanjung Jabung Regency. In general, Mekar Jaya Village is seen as an area that is flowed by the Betara River and the Bram Itam River. Based on the profile book for Mekar Jaya Village, in Mekar Jaya Village many people plant oil palm because this area was a transmigration area 25 years ago.

Based on interviews with farmers, the average production of oil palm plants in Mekar Jaya Village is 1-1.5 t / ha in a month. Harvesting is done once in 15 days. Some farmers do not apply fertilization but some do. While the average production of palm oil should be able to reach 20 t/ha/year. According to Siadi (1999), oil palm production can reach 20 to 25 t/ha/year as long as peat cultivation involves water management, fertilization and soil compaction as well as some balanced soil physical properties.

To increase oil palm production, peat water management needs to pay attention to the peat water level so that the peat does not dry out quickly and canal blocks are needed to maintain the ground water level (Nugroho and Budi, 2012). The people of Mekar Jaya Urban Village made drainage ditches in mutual cooperation. The trench that is made is a primary ditch with an average depth of 3 meters while the width is 6 to 8 meters, the size of this trench is made narrower towards the downstream. This primary ditch is also considered as a drainage ditch which is the final disposal site for

water from peatlands. This primary ditch generally empties into the Bram Itam Kiri and Betara Rivers. While in making secondary ditches made with a size of 2 to 3 meters in width and with a depth of 2 meters made between 4 rows of plants. For worm trenches made with a width of 50 to 60 cm with a depth of 1 meter between the plant paths. This condition is done to be able to plant oil palm plants (Setiadi, 1990)

The existence of these three ages of oil palm plants on peat soil is expected to play a role in the nature of peat soil resulting from the presence of oil palm plants, which can function for the benefit of peat soils, namely from the shape of the crown, the percentage of land cover, the return of organic matter from leaves and twigs that are fall or die. Meanwhile, there is a working power of the roots that can hold the grains of peat soil and the creation of pores by the working power of the roots and fruit production to be achieved (Napitu and Mudiantoro, 2015).

In order for peatlands to remain productive, management of peat soils must be in accordance with the characteristics of peat soils and there is a need for conservation of peat soils so that it does not easily decrease the carrying capacity of peatlands and the fertility of peat soils from peat forests that have been converted to plantation crops. As in the research conducted by Tahjri (2020), that as a result of planting oil palm the maturity level becomes sapric, the volume weight is 0.21 gr/cm3, and the C-organic content becomes 51.6%.

While in land cover shrubs the maturity level is sapric, the volume weight is 0.20 gr/cm3 and the C-organic content is 47.70% and in rubber plants with the sapric maturity level, the volume weight is 0.21 gr/cm3 and C-organic is 56 ,5 %. While research by Yuniwati and Suhartana (2013), that peatland that has been exposed will increase in temperature, which will speed up the decomposition process, high volume weight values will cause a decrease in the peat soil surface and the release of CO2 into the air. The purpose of this study was to look at the relationship between peat moisture content and the physical properties of peat at various ages of oil palm plants and yields in Mekar Jaya Village, Betara District, Tanjung Jabung Barat Regency.

METHOD

This research is a field research that has been carried out in Mekar Jaya Village, Betara District, West Tanjung Jabung Regency. The research was carried out for 4 months in 2023. Soil analysis was carried out at the Soil Laboratory, Faculty of Agriculture, Jambi University. The materials used were soil samples at various ages of oil palm plants, aquades and other substances. chemistry in the laboratory, . The tools used are peat drills, sacks, hoes, plastic soil maps, peat soil sample rings, peat drills, knives, shovels, and others.

The research method is a survey with a purposive random sampling method on plantsoil palm aged 5-10 years, 11-15 years, 16-20 years. Samples were taken from each age of the oil palm plant for 15 repetitions at a soil depth of 0 – 20 cm. Peat parameters observed were organic matter content, organic C content, fiber content, ash content, groundwater level, soil water content, soil volume weight and pH and oil palm yields

Plant parametersThe observed oil palm content was organic matter content, organic C, fiber content, ash content, pH, moisture content, water level, peat depth at the age of oil palm plants 5-10 years, 10-15 years old and 16-20 years old. analyzed with the unpaired mean test (Steel and Torrie, 1995). To see the relationship, do the Multiple Linear Regression Test with the formula

$$\bar{y} = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5$$

Where y is the water content and b_1 x_1 = organic matter, x_2 b_2 = fiber content, b_3 x_3 = ash content, b_4 x_4 = pH, x_5 b_5 = groundwater level, (Walpole, 1982). In addition, the relationship between water content and average yield of palm oil production (tonnes/ha/month) is tested using statistical tests using Spearman's rank correlation (Riadi, 2014).

RESULTS AND DISCUSSION

1. Organic ingredients, C-organic, fiber content, ash content in peat soil

The results of the analysis of the unpaired mean test on organic matter content, C-organic, , fiber content, ash content in oil palm plants aged 5-10 years, oil palm aged 11-15 years and oil palm plants aged 16-20 years in Mekar Jaya village Batara District can be seen in Table 1.

Table 1. Organic matter, C-organic, fiber content, ash content in peat soil at various ages of oil palm

Palm Age (years)	Organic matter (%)	C-organic (%)	Fiber Content (%)	Ash Content (%)
5- 10	74.2016 a	37,625 a	10,562a	11,249a
11- 15	49,260b	33,913b	9,497a	14,663b
16- 20	56,367 a	28,816c	11,525b	12,749c

Note: Numbers followed by the same letter are not significantly different according to the unpaired mean test at the 5% level

Table 1 shows that the soil organic matter content at the age of the oil palm plants 5-10 years and 16-20 years is the same but significantly different from the soil organic matter content at the age of 11-15 years. Meanwhile, C-organic content and ash content were significantly different at various ages of oil palm plants. For fiber content at the age of oil palm plants 5-10 and 11 -15 years are the same but different at the age of oil palm plants 16-20 years. Table 1. Organic matter, C-organic, fiber content, ash content

From Table 1 there is no difference in the soil organic matter content at the age of the oil palm plants 5 – 10 years and 16 – 20 years because at the age of the young palms there are still many vegetation plants on the floor of the oil palm plants because the light still enters the light and also the process of decomposing peat material is still slow With the nature of the peat, it is still fibric, marked by intact peat fiber and at the age of 16-20 years, there is a return of organic matter from vegetation that has fallen or died from the plants under the oil palm.

The occurrence of differences in fiber content, ash and soil pH at various ages of oil palm plants is due to the implementation of drainage so that differences in the results of organic matter decomposition play a role in peat soil changes or peat maturity. Where in oil palm plants aged 5-10 years it is still in the form of fibric, and oil palm aged 11-15 years is in hemic form and at the age of 16-20 years the oil palm has a sapric decomposition level. According to Djainuddin et al (2003) the maturity level of sapric peat coarse material is <15% and hemic peat is 15-75% and fibric peat maturity level has a total fiber content of >75%.

When viewed from the ash content for the three age groups of oil palm plants, this is significantly different. This is due to the length of time the intensity of land use can increase the soil ash content because it neutralizes the peat material. This is in line

with Agus et al., Bachia (2008) ash contenth Peat ranges from 5 – 65% and the higher the ash content the higher the minerals it contains.

2. Water level, volume weight, moisture content and pH of peat soil

Based on the unpaired mean test for the parameters water level, volumetric weight, moisture content and peat soil pH in oil palm plants aged 5-10 years, 11-15 years, 16-20 years old can be seen in

Table 2

Table of water table height, volume weight, peat water content, PH on peat soil at various ages of oil palm plants

Oil palm age (year)	Water Level Height (cm)	Water content (%)	Volume weight (gram/Cm)	pH	Peat maturity
5- 10	9.00 a.m	306,17a	0.23a	3.53 a	Fibrik
11- 15	29.10 b	226.79b	0.48b	3.92 b	Hemic
16- 20	52.45c	269.72b	0.62 b	3,724b	Saprik

Note : Numbers followed by the same letters are not significantly different according to the Unpaired Median Value Test at the 5% level

From Table 2 it can be seen that the height of the water table in oil palm plants at various ages is different. While the soil water content, unit weight and pH of oil palm aged 11-15 years are the same as those aged 16-20 years but different from those aged 5-10 years. . The difference is the height of the peat soil water level at various agesoil palm plantations due to the construction of drainage ditches so that a lot of water comes out of the peatlands besides the age of the plants and the evapotranspiration process from the oil palms as a result the higher the groundwater table the older the old oil palm plants the higher the groundwater level. in accordance with the opinion of Harun et al, (2018) that the fluctuation of the groundwater level is strongly influenced by the type of plant, rainfall and rain pattern as well as the physical properties of peat soil. The water content of the peat soil is the same at the ageoil palm 11-15 with ages 16-20 years because the water capacity retained by peat soils has begun to decrease from hemic to sapric so that the roots of the groundwater are lower at ages 5-10 years (Sawierianto et al, 2018). This is according to Suandi et al, (2015), that the maximum water binding capacity in hemic and sapric peat is less than 200%.

If seen from the volume weight and different pH of the oil palm, the age of the coconut plant is 5-10 years compared to the age of the oil palm plant which is more than 11 years. According to Noor et. al., (20 14). that the soil used for oil palm plantations aged 5 – 10 years included a lower fibric maturity level than the hemic and sapric maturity levels where generally the volume weight of peat soils was <2 g/cm 3 and hemic and sapric peat ranged >.0.2 – 0.3 gram / cm3 . Meanwhile, according to Dariah and Nurzakiah (2014), the water content of peat soil is strongly influenced by the content of organic matter, volume weight and is also influenced by the maturity level of the peat with fibric maturity having a high water content value because the peat acts as a nest so that the space between the peat soil masses is filled with water. .

3. Relationship of Soil Water Content in Oil Palm Plants

1 . Relationship of Soil Water Content in Oil Palm Plants at the age of 5 -10 years

The relationship between water content in peat soil in Mekar Jaya Village, Batara District where oil palm plants aged 5-10 years are based on organic matter

factors, b, fiber content, c-organic, ash content, pH and water table height, a partial relationship can be obtained. effect is on the age of oil palm 5-10 years with multiple limier regression is the content of peat water

$$Y = 0{,}66 + 0{,}044\ C_{Organik} - 2{,}17\ pH^2\ \ dengan\ R^2\ 0{,}855$$

From the multiple regression equation, there is a relationship between the soil water content and the C – organic factor and the squared PH. Meanwhile, other properties have no relationship to soil water content in oil palm aged 5-10 years. If you look at the effect of organic matter on the water content of peat soil, this is because the material contained in the water content of peat soil is a lot of organic matter and it is also because the soil of the oil palm plant is 5 – 10 years old at the finric maturity level. This is because C – 0 is organic This is higher on peat soils so there is still a lot of high organic matter because there is still a level of fibric decomposition so that the C-organic content is still high so that the water holding capacity of peat soils is also quite high.

In addition, on the land planted with oil palm that is still young under five years there are still many plants that can grow on the sidelines or between the row spacing because the soil is not yet covered by the crown of oil palm leaves so there is still a lot of litter from dead or pruned plants. Where the function of litter is to hold rainwater or hold water on the soil surface. Based on research by Magasti et. al . , (2015), that litter production is strongly influenced by plant density which is a source of soil organic matter. According to Suswati et al (2011), soil water content is influenced by organic matter content, volume weight and is also influenced by the maturity level of peat with fibric maturity having a high water content value because the peat acts as a nest so that the space between the peat soil masses is filled with water.

2. Relationship between peat soil water content and oil palm plants aged 11-15 years

The results of the multiple regression analysis based on the physical properties of the peat associated with the water content of the peat obtained the equation for the water content

Y = - 2598.722 ** - 2673.98BV ** + 2419.695** BV2- 22.98 BO** + 12 BO ** 2 + 2-08.710 TMA**-3.79 ** TMA 2+ 82.101 PH** (R2 = 0.869)

From the relationship between peat soil moisture content at the age of oil palm plants 11-15 years, it is strongly influenced by the volume weight factor, water table height and soil pH. This is due to the existence of drainage ditches which cause a better decomposition process from an anaerobic to aerobic atmosphere so that the soil volume weight becomes high as well as the groundwater level in this plant has reached an average groundwater depth of 29.10 . So the decomposition process is fast so that the C-organic content is large. This is in line with Meling and Hartono (2010), aerobic peatland conditions encourage active miocro organisms to change organic matter in the soil with not much C – organic

A very real effect of the relationship between soil organic matter content and water level on oil palm plants aged 11-15 years is because oil palm plants aged 11-15 are the maximum harvest age so that water is needed for the formation of photosynthesis and plant transpiration in producing fruit the maximum (Fitriani et al 2014). That's why the availability of water at the age of maximum growth is needed to be sufficient. Because this peat area is traversed by two major rivers and there are tidal waters, the water availability is at an optimum condition. Meanwhile, in the opinion of Suratman et al (2019), even though the peat soil has been drained, water will still be available due to the addition of river water, water tides and rainfall so peat water remains stable

3 Relationship between soil water content and peat on oil palm plants aged 16-20 years

From the Multiple Regression Test the soil water content is strongly influenced by the age of the oil palm plant 16-20 years which is influenced by the organic matter content and soil pH with a partial equation, namely water content
Y = 1051.981 + 2.968 BO - 122.036 pH with a regression coefficient R = (0.757 **) .

Organic matter factors can affect the water content of this peat soil because of the drainage that is carried out so that the soil water content is quite low from the age of oil palm plants under 15 years. According to Agung et al., (2021), that the properties of peat soil are greatly influenced by the content of organic matter, organic C content and soil pH and the height of the peat soil water table. Where the roots of oil palm plants absorb a lot of water because the root system is fibrous roots and spreads up to the surface of the soil (Nora et al, 2018) / as a result the peat soil becomes dry so that the process of decomposition of organic matter is very high. The high water level causes a decrease in the groundwater level and results in low soil in oil palm plantations because the age of the oil palm plants is quite long, almost 20 years and when the organic matter is dry, it is no longer easy to store peat water. This is in line with the opinion of Agus and Subiksa (2008) . Peat that has dried up with a moisture content of less than 100% is no longer easy to absorb water anymore if it is wetted. This peat dries up and is flammable when dry.

4. Relationship between peat soil water content and oil palm production

The average production of oil palm in one hectare with various age levels of oil palm plants is presented in Table 4 as follows:

Table4. Average Production of Palm Oil (Tons / Ha / Month) at Various Ages of Palm Oil Plants in Mekar Jaya Village

Palm Age	Production average (tonnes / ha / year
5-10	11, 28 a
11-15	12,9a
16 - 20	9.0b

Note: Numbers followed by the same letter are not significantly different according to the unpaired mean test at the 5% level

Based on Table 4, it can be seen that the production of oil palm per hectare per year at the age of 5-10 years is the same as the age of 11-15 years and significantly different from the age of 16-20 years. And the highest yield is found in oil palm aged 11-15, this is optimal production.

If seen from the production of oil palm plants, the production of oil palm plants is still quite low, where the average national production is 20-25 tons / day per year. Where many factors are low on peatlands, this is in accordance with the opinion of Dariah et al (2014), where oil palm production on peat soils is highly dependent on water management, peat moisture content, organic matter, level of fertility, nutrient availability and fertilization factors.

Based on the production of oil palm plants, there is a correlation between water content and a significance value of 0.003, where 0.003 <0.05. Then there is a correlation between soil water content and oil palm production . The correlation coefficient value is 0.809, which means that there is a very strong correlation or relationship between peat moisture content and palm oil production. Where the correlation coefficient value

is positive, then there is a strong relationship, although there are limiting factors, for example, there must be fertilization and rainfall climate. This is in accordance with the opinion of Magesti et al (2015). , that the utilization of peatlands must be accompanied by good water management so that groundwater in the peat remains available so that the yields of oil palm plants are maximized

CONCLUSION

Based on the relationship between soil water content at the age of oil palm plants 5-10 years, C – organic matter and pH play a role. For oil palm plants aged 11-15, the relationship between soil water content is influenced by soil volume weight, organic matter content, water level, In oil palm plants aged 16-20 years, the influences on soil water content are unit weight, organic matter, water level, peat soil pH with a relationship between water content. The relationship between oil palm production and soil water content is $0.809R^2 =$

REFERENCES

Agus, F. and IGM Subiksa. 2008. Peatland: Potential for Agriculture and Environmental Aspect. Soil Research Center and World Agroforestry Center (ICRAF), Bogor Indonesia.

Center for Agricultural Land Resources BBSDLP, 2016. Research and Development Center for Agricultural Land Resources, Agency for Agricultural Research and Development: Bogor. pg 154

Berglund, O & Berglund K. 2011 Influence of Water Table Level and Soil Properties on Emissions of Greenhouse Gases from Cultivated Peat Soil. Soil Biology & Biochemistry 43:923-931.

Dariah A and S Nurzakiah. 2014. Peatland Water Management. Guide to the Sustainable Management of Degraded Peatlands. Soil Research Institute. Bogor. pp 30-46

Heriyanto, Asrol, Detry Karya, and VY Ningsih. 2018. Analysis of Factors of Production People's Oil Palm According to Land Typology in Indragiri Hilir Regency

Riau Province. Journal of Suboptimal Land.

Riau.lal . I. K Nugroho, and A Hidayat 2008. Peatland Utilization Strategy for Sustainable Land Development . Journal of Agricultural Innovation Development 2(4): 295-298.

Masganti, Nurhayati, Rachmiwati Yusuf, and Hery Widyanto. 2015.Environmentally Friendly Technology in Palm Oil Cultivation in Degraded Peatlands. REVIEW paper. ISSN 1907-0799

Melling, L., Hatano, R. 2010. Sustainable utilization of tropical peatland for oil palm plantation Proceedings of Palangkaraya International Symposium & Workshop on Tropical Peatland. Department of Soil Science and Land Resources Building Bogor Agricultural University.

Najiyati, S., Lili Muslihat and I Nyoman N. Suryadiputra. 2005. Guide Management of Peatlands for Sustainable Agriculture. Project Climate Change, Forests and Peatlands in Indonesia. Wetlands – International – Indonesia Program and Wildlife Habitat Canada. Bogor. Indonesia.

Napitu, MS and Mudiantoro. 2015. Management of Water Resources in Sustainable Peatlands. Journal of Annual Civil Engineering Seminar M2015, Pekanbaru

Noor M, Masganti, and F Agus. 2014. Formation and Characteristics of Indonesian

Tropical Peat. Agency for Agricultural Research and Development (Revised Edition). Jakarta.

Nora, S and Carolina DM 2018. Cultivation of Oil Palm Plants. Education Center Agriculture . Agency for Extension and Development of Agricultural Human Resources. Ministry of Agriculture. Jakarta, Indonesia

Nora H. Panjaitan and Soedodo 2018 . Study of the Physical Characteristics of Deep Peatlands Relationship with drainage for Bulitin agricultural land engineering Agriculture Vol 13 No. 6 2018.

Nurhalimah, Muhammad R., Suryanto. 2021. Analysis of Groundwater Height and Its Mapping in Peatlands in the Liang Anggang Protected Forest Area, South Kalimantan. Sylva Scientae Journal Vol 4. No 4

Puswandita, H. 2018. Study of Water Management and Oil Palm Productivity on the Land
Peat. Journal of Weather Modification Science and Technology Vol.19 (1):41-45

Riadi. E. 2014. Parametric & Non-Parametric Statistical Methods. Independent Library Publisher. Tangerang

Ronaldo 1995 . Introduction to Statistics . Alhli Bahsa Bambang Sumantri 3rd Edition . Publisher PT Gramedia Pustaka Indonesia . Jakarta

rossie . W N. Rinto M. Ismahan U. Stella P . Umi L. 2023 . Impact of Canal Blocking Against Peat Water Level Fluctuations in Kubu Raya Regency, Province West Kalimantan. Archives . Journal of Environmental Sciences Vol 21 No 2

Sarah M. J., and Hariyadi. 2016. Peat Land Management in Plantations
Palm Oil Land in Riau . Bul . Agronomy 4 (3): 312- 320

Sasongko, PE 2010. Potential Land Suitability Study for Coconut Plants palm 1 in Blitar Regency. J. MAPETA Agriculture Vol. 12(2):72-144.

Setiadi, B. 1999. Peatland Utilization Technology for Agriculture. In Setiadi B and Nugrahai D. Problems and Prospects of Peat Utilization. In Barchia,

Soil Survey Staff 2014. Key Soil Taxonomy. National Resources Conservation Services. United States Department Of Agriculture (USD). Washington DC

uandi, Oksana, Ahmad T A., 2015. Analysis of Peat Physical Properties in Peat Forest in Tambang District, Kampar Regency, Riau Province. Journal of Agroecotechnology . Vol. 5 No.2 .February 2015 : 23-28

Suratman W. Paramdya . B. Yanuar M,. Purwanto J. Agus F. 2019 . Variation Biophysical Characteristics of Peatlands with Several Land Uses in Kampar Peninsula, Riau Province. Research and Development Center for Resources Agricultural land . Agricultural Research and Development Agency and Postgraduate IPB University > Bogor Journal of Soil 43 (2): 97 – 108.

Suhatman Y, A Suryanto and L Setyobudi. 2016. Factor Conformance Study Environment And Morphological Characteristics of Productive Oil Palm Plants (Elaeis guineensis). J . Production of Plants Vol. 4(3):192-198.

Suswanti, D,. Hendro, BS, Siddieq., D., and Dewa., DI. 2011 . Character Identification Physical Peatland of Rasau Jaya III Regency of Kubu Raya For Development of Corn Soil Science, Faculty of Agriculture, Gadjah University mad . Yogyakarta\

Steel .RGD and Torrie J. H. 1994. Statistical Principles and Procedures. A Biometric Approach. Published by PT Gramedia Jakarta.

Vebrianti . N. 2018. Peat Water Level Modeling Based on Physical Properties Peatlands . Journal of Soil and Environmental Sciences 20 (2) : 70-76 October 2018.

Wahid . N . Siti N. Nurita Z. 2018 Dynamics of Water Level and Soil Temperature Peat In El Niño Years . Journal Agric Vol. 30 . December 2, 2018: 103-110