


The Effect of Different Fertilization Frequency on Some Nutrient Content of Palm Plant Grown in Peat Swamp


Githa NOVIANA^{1*}, Fani ARDIANI², Idum Satia SANTI³, Hartono HARTONO⁴


Abstract


The lack of suitable land (S1) for oil palm plantations is the reason for the current use of marginal land (S3) in oil palm plantations, both for companies and smallholders. Peat swampland has good potential if the care and fertilization of plants is carried out according to the standards according to the conditions of the land. Peat swampland has high acidity, and land conditions are often flooded. Application of fertilizer in a timely manner and the right dose is one of the keys to the success of oil palm plantations. This study aimed to determine the effect of the frequency of fertilizer application on the nutrient content of oil palm leaves. There were three fertilization treatments, namely 1) 0.6 kg/tree was applied once a month, 2) 1.8 kg/tree was applied once per three months, and 3.6 kg/tree was applied once per six months. Data were analyzed using a completely randomized design. The results showed that the frequency of fertilization significantly affected the nutritional content of oil palm leaves. The average nutrient content of fertilization with a frequency of six months has the lowest nutrition compared to other frequencies. The best frequency of fertilization is 0.6 kg/tree, which is applied every month. Fertilization on peatlands that is carried out regularly and in a balanced dose is more important than the application of high doses of fertilizer with a long frequency of fertilization. This is related to palm oil feeding root distribution, which is limited to a swamp depth of 0-60 cm.

Keywords: Oil palm, Plant nutrition, Peatland, Frequency of fertilization, Peat swamp.

^{1*}**Sorumlu Yazar/Corresponding Author:** Githa Noviana, Institut Pertanian Stiper, Faculty of Agriculture, Yogyakarta, Indonesia. E-mail: githanoviana48@gmail.com  OrcID: 0000-0002-9292-0634.

²Fani Ardiani, Institut Pertanian Stiper, Faculty of Agriculture, Yogyakarta, Indonesia. E-mail: ardianifani@gmail.com  OrcID: 0000-0002-1889-1150.

³Idum Satia Santi, Institut Pertanian Stiper, Faculty of Agriculture, Yogyakarta, Indonesia. E-mail: idum@instiperjogja.ac.id  OrcID: 0000-0003-3809-0948.

⁴Hartono Hartono, Akademi Komunitas Perkebunan Yogyakarta, Yogyakarta, Indonesia. E-mail: hartonoindi2@gmail.com  OrcID: 0000-0002-9264-2769.

Atıf/Citation: Noviana, G., Ardiani, F., Santi, I. S., Hartono, H. The effect of different fertilization frequency on some nutrient content of palm plant grown in peat swamp. *Journal of Tekirdag Agricultural Faculty*, 20(3): 586-590.

©Bu çalışma Tekirdağ Namık Kemal Üniversitesi tarafından Creative Commons Lisansı (<https://creativecommons.org/licenses/by-nc/4.0/>) kapsamında yayımlanmıştır. Tekirdağ 2023.

1. Introduction

Peat swampland in Indonesia is quite extensive, reaching 20.6 million ha or 10.8% of Indonesia's land area. Most of the peat swampland is located on four large islands: Sumatra 35%, Kalimantan 32%, Sulawesi 3%, and Papua 30% (Wetland International, 1990). Naturally, peat swamps always experience inundation so their use for crops can be done by lowering the groundwater level. It is also intended that the plant roots above it are not flooded to absorb nutrients more optimally. Peat swampland has a low pH, so the absorption of nutrients Nitrogen, Phosphorus, Potassium, Magnesium in plants is not optimal (Amirrullah et al., 2017). However, with proper handling, this marginal land can be developed into agricultural land. One of them is oil palm plantation land. The use of peat swampland for oil palm plantations is increasing in Southeast Asia (Charters et al., 2019). This marginal land use is also due to the increasingly limited mineral land for oil palm plantations. The use of marginal land for oil palm development is carried out by companies and smallholders (Anamulai et al., 2019).

Basically, oil palm plants can grow on peat swampland that is poor in nutrients. However, fresh fruit bunches (FFB) production depends on land and plant management. According to (Mangoensoekarjo and Semangun, 2003), FFB production will decrease by 20% if planted on peatland. Just like other plants, oil palm plants need adequate nutrients for vegetative and generative growth. The research results by (Matana and Mashud, 2015) indicated that the response of oil palm plants to fertilization was different for each type of plant.

Oil palm plants need to macro plant nutrient elements such as Nitrogen, Phosphorus, Potassium, and Magnesium. The research results by Nurhayati et al. (2016) showed that the application of macro and micro fertilizers in tidal land with a dose of 5 kg macro + 5 kg micro per tree resulted in FFB production of 30.62 tons/ha/year. Thus, applying the right fertilizer on marginal land will also be able to produce good production. In addition to the dose, the frequency of fertilizer application also significantly affects the vegetative growth of oil palm plants. The frequency of fertilizer application often shows good vegetative development (Hayata et al., 2018; Syafitri et al., 2007). Previous research has shown that fertilization increases significantly yields in forage and dry matter in both floodplain and grassland areas (Altın et al., 2010).

The need for macronutrients in oil palm plants increases according to the age of the plant (Henson and Dolmat, 2003). However, the absorption of nutrients in plants depends on land conditions (Chrisye, 2020; Fajarditta et al., 2012). In bad situations, if the absorption of plants lacks nutrients, there will be an abortion of female flowers or the formation of many male flowers. If female flowers are reduced, then production will decrease. So a different technique is needed so that the nutrients can be absorbed properly. One of them is the frequency of fertilizer application. Good nutrient absorption will be seen from the nutrient content in the leaves. Thus, this study is expected to determine the frequency of the most good fertilizer application for oil palm plantations in peat swampland.

2. Materials and Methods

This research was conducted on 5 year old oil palm plants. This study was an experimental study using a completely randomized design (CRD) with 3 treatments with fertilization frequency repeated 5 (five) times. The fertilizer used is a compound fertilizer (NPKMg) containing 12% Nitrogen, 12% Phosphorus, 17% Potassium and 2% Magnesium. The treatments given were A) a dose of 0.6 kg/tree once a month B) a dose of 1.8 kg/tree every 3 months and C) a dose of 3.6 kg/tree every 6 months. The analysis of the significant difference test between treatments used the T test by comparing the data before and after the treatment.

3. Results and Discussion

Table 1 is the result of analyzing the nutritional content of oil palm leaves after fertilization treatment based on frequency (fertilization time). According to Fairhurst and Mutert (1999), nutrients in oil palm leaves are categorized as deficiency if Nitrogen < 2.3%; Phosphorus < 0.14% ; Potassium < 0.75% and Magnesium < 0.20%. The data in *Table 1*, when compared with the standard nutritional content of oil palm plants, showed potassium deficiency in all experimental plants, both at the frequency of fertilization every month, three months and every six months. However, in magnesium nutrition, all experimental plants had sufficient nutrients. When viewed as a whole and the average nutritional content, fertilization carried out at a frequency of six months has the lowest nutritional value compared to other frequencies.

Table 1. Results of laboratory analysis of nutrient content in leaves after treatment

Frequency	% Nutrition			
	Nitrogen	Phosphorus	Potassium	Magnesium
1 month	2.26*	0.15	0.30*	0.62
	2.69	0.18	0.26*	0.38
	2.96	0.12*	0.20*	0.50
	2.78	0.17	0.46*	0.47
	2.43	0.16	0.54*	0.62
Average	2.62	0.15	0.35	0.51
3 Month	2.43	0.16	0.66*	0.53
	2.54	0.16	0.69*	0.50
	2.68	0.17	0.62*	0.63
	2.65	0.18	0.69*	0.52
	2.60	0.18	0.69*	0.52
Average	2.58	0.17	0.67	0.54
6 Month	2.44	0.15	0.44*	0.63
	2.55	0.16	0.36*	0.47
	2.15*	0.14*	0.64*	0.50
	1.90*	0.12*	0.31*	0.58
	1.67*	0.15	0.46*	0.31
Average	2.14	0.14	0.44	0.49

The sign (*) indicates low nutrition when compared to nutritional standards in oil palm plantations
 Analysis Nitrogen used Kjeldahl with Spectrophotometer
 Analysis Phosphorus used Dry ashing # HNO# with Spectrophotometer
 Analysis Potassium used Dry ashing# HCl # with AAS
 Analysis Magnesium used Dry ashing# HCl # with AAS

Table 2. Significant difference test of fertilizer frequency

Frequency	% Nutrition			
	Nitrogen	Phosphorus	Potassium	Magnesium
1 Month	2.624	0.156	0.352	0.518
3 Month	2.580	0.170	0.670*	0.540
6 Month	2.142*	0.144	0.442	0.498

* : there is a significant difference in the frequency of fertilization on the nutrient content in the LSD significant difference test ($\alpha = 5\%$)

Based on the results of the t test analysis (Table 2), shows that the effect of fertilization frequency on the nutrient content of oil palm leaves. The analysis results showed that there was a significant effect on the frequency of fertilization on the nutrient content. Significant differences occurred in nitrogen nutrition in the frequency of fertilization every six months. Meanwhile, the potassium nutrition was significantly different in the frequency of three months of fertilizer. Overall, the best nutritional value occurred at the frequency of fertilization carried out per month.

Fertilizer application on S3 land should use compound fertilizer at a 6 kg/tree/year (Goh and Buloh, 2005; Mangoensoekarjo and Semangun, 2003; Sakata et al., 2015). The chemical and physical properties of the soil affect the absorption of nutrients in plants. According to Bornø et al. (2019) and Rehman et al. (2020), the soil's grip that can hold water can increase the absorption of good nutrients for plants so that their growth is better.

Tables 1 and 2 show that the frequency of fertilization once a month is considered to have better nutrition than other treatments. According to Goh and Buloh (2005), Mangoensoekarjo and Semangun (2003), and Noviana and Ardiani (2020), regular fertilization on peatlands and balanced doses is more important than the application of high amounts of fertilizer with infrequent fertilization frequency. This is because the distribution of palm oil feeding roots is limited to a depth of 0-60 cm.

N levels in peat soils are relatively high ranging from 1% - 2% due to weathering of plants that become an organic matter on the top of the soil (Noor, 2016). However, the addition of N fertilizer is still recommended with

the right dose and frequency. In general, the peatlands in the study area have an acidity (pH) of 4-5.5. This can result in inhibited absorption of very low potassium nutrients. Based on research (Ollagnier, 1987; Roca and Vallejo, 1995; Römheld and Kirkby, 2010) high Ca content in soil results in low plant response to K fertilization. In addition, chemical fertilizers are very important for high and economical yield levels (Turhan and Özmen, 2021).

4. Conclusions

The frequency of fertilization applied to peatlands significantly affects the nutrient content of oil palm leaves. The average nutrient content of fertilization with a frequency of six months has the lowest nutrition compared to other frequencies. In contrast, the best nutrition is found in fertilization with a frequency of once a month. It is recommended that fertilizer application on S3 land be carried out routinely and balanced compared to the application of high doses of fertilizer with infrequent frequency (6 months).

Acknowledgment

All author thank to Institut Pertanian Stiper Yogyakarta for supporting in this research.

References

- Altın, M., Tuna, C. and Gür, M. (2010). Tekirdağ Taban ve Kıraç Meralarının Verim ve Botanik Kompozisyonuna Gübrelemenin Etkisi. *Journal of Tekirdag Agricultural Faculty*, 7(2), 191–198.
- Amirullah, J., Andriani, R. and Prabowo, A. (2017). Status Hara Tanah di Lahan Rawa Pasang Surut Kabupaten Banyuasin. *Sinergi Dan Sinkronisasi Program Litkaji Dan Diseminasi Mendukung Pencapaian Swasembada Pangan, Buku 2*: 478–485.
- Anamulai, S., Sanusi, R., Zubaid, A., Lechner, A. M., Ashton-Butt, A. and Azhar, B. (2019). Land use Conversion from Peat Swamp Forest to Oil Palm Agriculture Greatly Modifies Microclimate and Soil Conditions. *PeerJ - Life and Environment*, 7: e7656.
- Bomø, M. L., Müller-Stöver, D. S. and Liu, F. (2019). Biochar properties and soil type drive the uptake of macro- and micronutrients in maize (*Zea mays* L.). *Journal of Plant Nutrition and Soil Science*, 182(2): 149–158.
- Charters, L. J., Aplin, P., Marston, C. G., Padfield, R., Rengasamy, N., Bin Dahalan, M. P. and Evers, S. (2019). Peat swamp forest conservation withstands pervasive land conversion to oil palm plantation in North Selangor, Malaysia. *International Journal of Remote Sensing*, 40(19): 7409–7438.
- Chrisye, R. (2020). Kuantifikasi Hara N, P, K dan Fraksi Liat pada Lahan Perkebunan Kelapa Sawit PT. Cangkul Bumi Subur Kabupaten Musi Banyuasin. Universitas Sriwijaya.
- Fairhurst, T. H. and Mutert, E. (1999). Interpretation and Management of Oil Palm Leaf Analysis Data. *Better Crops International*, 13(1): 48–51.
- Fajarditta, F., Sumarsono, S. and Kusmiyati, F. (2012). Serapan unsur hara nitrogen dan fosfor beberapa tanaman legum pada jenis tanah yang berbeda. *Animal Agriculture Journal*, 1(2): 41–50.
- Goh, K. J. and Buloh, P. (2005). Fertilizer recommendation systems for oil palm: estimating the fertilizer rates. *Proceedings of MOSTA Best Practices Workshops: Agronomy and Crop Management, Malaysia*, 57(3): 235–268.
- Hayata, Defitri, Y. and Renaldi, W. (2018). Respon bibit kelapa sawit (*Elaeis Guineensis* Jacq) asal multi embrio terhadap frekuensi waktu pemberian pupuk NPK (16:16:16) di pembibitan utama. *Jurnal Media Pertanian*, 3(1): 10–15.
- Henson, I. E. and Dolmat, M. T. (2003). Physiological analysis of an oil palm density trial on a peat soil. *Journal of Oil Palm Research*, 15(2): 1–27.
- Mangoensoekarjo, S. and Semangun, H. (2003). Manajemen Agrobisnis Kelapa Sawit. In UGM-Press. Yogyakarta.
- Matana, Y. R. and Mashud, N. (2015). Respons pemupukan N, P, K dan Mg terhadap kandungan unsur hara tanah. *Buletin Palmae*, 16(1).
- Noor, M. (2016). Lahan Gambut: Pengembangan, Konservasi, dan Perubahan Iklim. Gadjah Mada University Press.
- Noviana, G. and Ardiani, F. (2020). Respon Produksi Kelapa Sawit (*Elaeis guineensis* Jacq.) terhadap Solum Dangkal (Studi Kasus: Kabupaten Kutai Timur). *Jurnal Berkala Penelitian Agronomi*, 8(2): 1–6.
- Nurhayati, Masganti, and Widyanto, H. (2016). Kajian Pemupukan Mikro Majemuk pada Kelapa Sawit di Lahan Pasang Surut Provinsi Riau. *Buletin Inovasi Teknologi Pertanian*, 2(2).
- Ollagnier, M. (1987). The influence of climate and soil on potassium critical level in oil palm leaf analysis. *Food and Agriculture Organization of the United Nations*, 42(12): 435–449.
- Rehman, A., Nawaz, S., Alghamdi, H. A., Alrumman, S., Yan, W. and Nawaz, M. Z. (2020). Effects of manure-based biochar on uptake of nutrients and water holding capacity of different types of soils. *Case Studies in Chemical and Environmental Engineering*, 2: 100036.
- Roca, M. C. and Vallejo, V. R. (1995). Effect of Soil Potassium and Calcium on Caesium and Strontium Uptake by Plant Roots. *Journal of Environmental Radioactivity*, 28(2): 141–159.
- Römheld, V. and Kirkby, E. A. (2010). Research on potassium in agriculture: needs and prospects. *Plant and Soil*, 335(1): 155–180.
- Sakata, R., Shimada, S., Arai, H., Yoshioka, N., Yoshioka, R., Aoki, H., Kimoto, N., Sakamoto, A., Melling, L. and Inubushi, K. (2015). Effect of soil types and nitrogen fertilizer on nitrous oxide and carbon dioxide emissions in oil palm plantations. *Soil Science and Plant Nutrition*, 61(1): 48–60.
- Syafitri, E. D., Hermansyah, H. and Marlin, M. (2007). Pertumbuhan Bibit Kelapa Sawit (*Elaeis Guineensis* Jacq) di Pembibitan Utama Akibat Perbedaan Konsentrasi dan Frekuensi Pemberian Pupuk Pelengkap Cair. Universitas Bengkulu.
- Turhan, A. and Özmen, N. (2021). Effects of chemical and organic fertilizer treatments on yield and quality traits of industrial tomato. *Journal of Tekirdag Agricultural Faculty*, 18(2): 213–221.
- Wetland International. (1990). Maps of Area of Peatland Distribution and Carbon Content in Sumatera (1st ed.). Wetland International - Indonesia Programme.