

## EFFECT OF AMELIORANT MATERIAL APPLICATION ON LEAF NUTRIENT UPTAKE OF OIL PALM (*Elaeis guineensis* Jacq.) SEEDINGS IN PEAT PLANTING MEDIA IN THE MAIN NURSERY

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### ABSTRACT

The aim of this study was to obtain a combination of types and doses of ameliorant materials including dolomite, rock phosphate, and mineral soils used on nutrient uptake of leaves of oil palm seedlings on peat planting media in the main nursery. The study was conducted for one year (May 2015 to April 2016) in the experimental garden in the Sijambi village, Tanjung Balai city, North Sumatra, Indonesia. The study used a non-factorial randomized block design consisting of three treatments, each treatment had three different doses, including: dolomite (A1 = 0.45 kg polybag<sup>-1</sup>; A2 = 0.90 kg polybag<sup>-1</sup>; A3 = 1.35 kg polybag<sup>-1</sup>), rock phosphate (A4 = 0.45 kg polybag<sup>-1</sup>; A5 = 0.90 kg polybag<sup>-1</sup>; A6 = 1.35 kg polybag<sup>-1</sup>), and mineral soil (A7 = 0.45 kg polybag<sup>-1</sup>; A8 = 0.90 kg polybag<sup>-1</sup>; A9 = 1.35 kg polybag<sup>-1</sup>). The results showed that mineral soil dose of 1.35 kg polybag<sup>-1</sup> (A9) in oil palm seedlings aged 16 months after planting (MAP) could increase the N, K, and Mg nutrient uptake of leaves. The highest P content of oil palm seedlings was found in dolomite treatment with a dose of 1.35 kg polybag<sup>-1</sup> (A3) which was 0.51% P. The P content in the leaves is in excessive condition in supporting plant growth, while other treatments are in optimal condition. The highest Ca nutrient uptake of leaves of oil palm seedlings were found in the treatment of dolomite and rock phosphate dose of 1.35 kg polybag<sup>-1</sup> (A3 and A6), which was 0.30% Ca.

**Key words:** ameliorant, dolomite, rock phosphate, mineral soil, peat, oil palm seedlings, nutrient uptake

### INTRODUCTION

Peatlands in Indonesia are spread in coastal swamp ecosystems, tidal swampland and non-tidal swamps (swamp swamps/inland swamps/swampy land), each of which has different characteristics of peat properties. The characteristics of these peat soils are very much determined by the composition of the original material, type, and variety of plants and their forming environment factors (climate, hydrology, topography and time). The factors of peat formation influence and interact with each other so as to produce specific and distinct characteristics of peatlands (Mutalib, et al., 1992; Mawardi, et al., 2013).

Tropical peat soils generally have low fertility rates and high levels of acidity. Fadli, et al., (2006) reported that the physical properties of peat soil are generally dark brown, high water holding capacity (15-30 times of dry weight), high soil porosity (70-95%), low bulk density (BD) ( 0.1-0.2 g cm<sup>-3</sup>) so that the soil support power is low. In dry conditions, peat soils are very light, easily separated, fragile and damaged if disturbed. Poor drainage,

irreversible drying, usually located above marine alluvial deposits, quartz sand and clay. The chemical properties of peat include having high acidity,  $\text{pH} < 3.5$ , rich in organic matter, high total N content but not available for plants with  $\text{C/N} > 30$ . Soil fertility is low with low P and K levels. The content of Ca and Mg varies, as well as for peat ash content parameters. The micronutrient content such as Cu, Zn, and B is low, sometimes followed by Fe and Mn, high water buffering capacity (90% of volume weight), high cation exchange capacity (CEC) (100-300 me 100 g<sup>-1</sup>) due to pH-dependent negative charge derived from carboxylic groups (COOH) and phenolics (OH-phenolic) (Barchia, 2006; Noor, 2010).

The use of peat land for plantation field has been carried out in various regions in Indonesia, especially in Sumatra, Kalimantan and Papua. The area of peatland in Indonesia are currently estimated at 20 million ha (10.48% of land area). In Southeast Asia, the area of peatlands is estimated at around 27 million ha and has been used as an oil palm plantation area of 20% spread across Indonesia and Malaysia. In Indonesia, the area of peatland that can be used as agricultural field is around 9.50 million ha, an area of 4.2 million ha has been reclaimed, including 0.5 million ha for agricultural crops and 1.7 million ha for oil palm plantations (Rieley et al., 1996; Sabiham and Sukarman, 2012). In accordance with Indonesia Minister of Agriculture Regulation No.14/Permentan/PL.110/2/2009 concerning guidelines for the use of peatland for oil palm cultivation, it is explained that peat land that can be used for oil palm cultivation must meet the following criteria/requirements: (1) peatland is within the cultivation area including community land, released forest area or another use area, (2) thickness of peatland must be  $\leq 3$  m, with the proportion of land at least 70% of the cultivated area, deep peat and very in not recommended to be opened but directed as a protected area, (3) the layer of mineral soil under peat (substratum) must not consist of quartz sand and marine clay deposits containing sulfidic material, (4) the maturity level of the reclaimed peat is mature peat (sapric) and hemic peat, (5) soil fertility including eutrophic/fertile categories with sufficient macro and micronutrients for plant cultivation, because their fertility is affected by river water overflows and tides (Noor, 2010; Subardja, et al., 2010). Saragih, et al., (2013) added that other factors that need to be considered are: (6) the making of drainage ditches on peatland is intended for ground water table management by maintaining the water surface at a position of 50-70 cm from the ground, (7) to opening the peat land for agricultural business is done without burning, and (8) the existence of new innovations and agricultural technology, it is very possible for the management of peatlands that have a high level of acidity ( $\text{pH} \leq 3.5-4.0$ ) and fertility rates low, both macronutrients (N, P, and K), and low micronutrients (Cu, Zn, B, sometimes Fe and Mn) can be overcome by giving appropriate ameliorants and fertilizers. Ameliorants commonly used include mineral soil, rock phosphate, and dolomite, while fertilizing doses follow recommendations from research centers, one of which is the Medan Palm Oil Research Center (PPKS). Ameliorants, besides acting to increase soil pH, can also provide nutrient ions in the form of Ca, Mg and Fe (dolomite), Ca, P, Fe and other metal cations (rock phosphate), and sources of polyvalent cations (mineral soils). Based on the above description, research on the use of ameliorant and fertilizing materials in oil palm nursery to improve vegetative growth in the main nursery on peat media is carried out.

## RESEARCH METHODS

### Place and Time

The study was conducted for one year, from May 2015 to April 2016. The research site was conducted in the experimental garden of the Sijambi village, Tanjungbalai city, North

Sumatra province, Indonesia. Elevation of 3 m above sea level, with a climate type C2, having a 2-3 dry month and 5-6 wet months (Oldeman) (Indonesian Central Bureau of Statistics, 2007). Peatland as a planting medium originates from the peatland of Grahadura Company garden located in Sukarame Baru village, Kualuh Hulu Aek Kanopan sub-district, while Ultisol mineral soil from Kongsu Enam village, Aek Natas sub-district, both from Labuhanbatu Utara district, North Sumatra province, Indonesia. Dolomite and rock phosphate/natural phosphate were obtained from fertilizer trading in the Kisaran city. Samples of peat soil and ultisol mineral soil before treatment were analyzed at the Soil and Fertilizer Laboratory, PPKS Medan-Indonesia, while analysis of dolomite, rock phosphate and nutrient uptake of leaves of oil palm seedlings were carried out at the Asian Agri Company Laboratory, Bahilang Tebing Tinggi, North Sumatra, Indonesia.

### Experimental design

The study used a single factor/non factorial randomized block design consisting of three treatments, each treatment had three different doses, including: dolomite ( $A_1 = 0.45 \text{ kg polybag}^{-1}$ ;  $A_2 = 0.90 \text{ kg polybag}^{-1}$ ;  $A_3 = 1.35 \text{ kg polybag}^{-1}$ ), rock phosphate ( $A_4 = 0.45 \text{ kg polybag}^{-1}$ ;  $A_5 = 0.90 \text{ kg polybag}^{-1}$ ;  $A_6 = 1.35 \text{ kg polybag}^{-1}$ ), and mineral soil ( $A_7 = 0.45 \text{ kg polybag}^{-1}$ ;  $A_8 = 0.90 \text{ kg polybag}^{-1}$ ;  $A_9 = 1.35 \text{ kg polybag}^{-1}$ ). The materials used are four-month oil palm seedlings, black polybag size 40 cm x 45 cm, 0.20 mm thick (10 kg capacity peat soil, 30% moisture content), multi fertilizer (15:15: 6: 4 and 12: 12: 17: 2) and kieserite (27% MgO, 22% S). Ameliorants consist of dolomite (19% MgO; 34% CaO and 0.1% Fe<sub>2</sub>O<sub>3</sub>); rock phosphate (22.5% P<sub>2</sub>O<sub>5</sub>; 33.5% CaO and 2.47% Fe<sub>2</sub>O<sub>3</sub>), mineral soil. Variables observed in this study included nutrient uptake of N, P, K, Ca and Mg leaves of oil palm seedlings in the main nursery aged 16 MAP on peat planting media in a polybag. The results of leaf nutrient uptake analysis were analyzed statistically using analysis of variance (F test). If the results of the F test treatment show a noticeable difference, it will be followed by the Duncan Multiple Range Test (DMRT) (Gomez and Gomez, 1995).

### Technical of research

Fields used for nursery areas are cleaned of all rocks, weeds/stumps, and other impurities, then the leveled area can support the stand/upright polybag. Furthermore, drainage ditches are created around it to prevent the occurrence of stagnant water in the research area. Each research plot consisted of four polybag palm oil seedlings so that in one replication there was 36 polybag (4 x 3 types of ameliorant x 3 dose levels). The study consisted of three replications, with a total of 144 polybag seedlings. Seedlings are planted with a distance between 90 cm x 90 cm. Peat planting media mixed with dolomite, rock phosphate and mineral soil according to the type and dose of each treatment. The media is loaded into the polybag, carried up to 2- 3 cm from the lip of the polybag by rocking the polybag so that the soil becomes solid and full. The filled polybag is arranged according to the trial chart in the area provided. Transfer of seedlings from pre-nursery to the main nursery is carried out at 4-5 months (4-5 leafy seedlings). Preparation of planting holes in polybag in the main nursery is done with the same size as the large pre-nursery polybag. Then the seedlings are inserted into the planting hole after the small polybag has removed. The soil around the hole is pressed so that the density is evenly distributed, then the addition of soil to the base of the roots or as high as 2-3 cm from the lip of the polybag is left empty as a place to put fertilizer and watering.

### Maintenance

Watering has done twice a day, morning and afternoon. If there was rain >10 mm day<sup>-1</sup> watering was not done. Watering was carried out evenly on all seedlings using a measuring

cup as large as 1 liter polybag<sup>-1</sup> aged 4-6 months. Water requirements increase with increasing seedling age. For the age of seedlings >6 months were given 1.5 liters polybag<sup>-1</sup> per day. Weed control was done by manually removing weeds in polybags, while weeds outside the polybag were cleaned by scratching with hoes. The application of fertilization in the main nursery was carried out using multi-nutrient fertilizer formulations 15:15:6:4 and 12:12:17:2 and Kieserite according to recommendations from fertilization in the main nursery. The fertilizer was spread evenly in the polybag with a distance of 5 cm from the seedling hump. Pests that often attack seeds in the main nurseries are *Lepidiotia*, *Apogonia*, *Psychidae*, *Setothosea*, and grasshoppers. To avoid the attack of *Apogonia* sp seeds, spray with Sevin 45 WP (85% carbaryl active ingredient). For *Lepidiotia* it was controlled with Decis 2.5 EC (Deltamethrin 2.5% active ingredient) with a concentration of 5-10cc seedling<sup>-1</sup>. Common diseases include *Curvularia*, *Helminthosporia*, and *Anthraco*se. The fungicides used were Dithane-M 45 (Mancozeb active ingredient) or Daconil (chlorothalonil active ingredient), or Antracol (propineb active ingredient) with concentrations of 0.1-0.2% with a frequency of 10-14 days (Darmosarkoro et al., 2008).

The criteria for seedlings taken as sample plants are not inserted plants, not border plants and grow normally, not affected by the disease. Leaflet samples were taken from the nursery (age <2 years) came from the fourth midrib leaflet, as much as the number of leaflets needed. Two leaflets were taken on the left and right sides, then cleaned. A third part of the tip of the leaflet and the lower third was removed. The part that was taken was the middle third leaflet blade. Sticks from leaflet removed. Strands of leaflets from the unity of leaflet samples were bound and made into one sample, then put into a plastic bag/perforated envelope to be sent to the laboratory. Leaflet samples were taken in the morning until noon around 07.00-13.00. The kinds of leaf nutrient uptake analysis are N nutrient uptake (Kjeldahl method), P (spectrophotometry method), K (Flame photometry method), Ca and Mg (Atomic Absorption Spectrophotometer/AAS method).

## DISCUSSION

### N-nutrient uptake (%)

The results of the analysis of variance of N nutrient uptake in peat planting media in a polybag for one year showed that there was an effect of treatment of the three types and doses of ameliorant materials used on nutrient uptake of N leaves of palm oil seedlings in the main nursery. The average analysis of nutrient uptake of N leaves of oil palm seedlings aged 16 MAP on peat planting media is presented in Table 1.

Table 1. Results of analysis of N nutrient uptake (%) of palm oil seedlings in the main nursery aged 16 MAP due to the type and dosage treatment of ameliorant materials on peat planting media in polybag

| Treatment of ameliorant material      | N nutrient uptake (%) | Nutrient condition of leaves |
|---------------------------------------|-----------------------|------------------------------|
| A1 (0.45 kg dolomite polybag-1)       | 1.98 b                | deficiency                   |
| A2 (0.90 kg dolomite polybag-1)       | 2.31 a                | deficiency                   |
| A3 (1.35 kg dolomite polybag-1)       | 2.54 a                | deficiency                   |
| A4 (0.45 kg rock phosphate polybag-1) | 2.33 a                | deficiency                   |
| A5 (0.90 kg rock phosphate polybag-1) | 2.54 a                | deficiency                   |
| A6 (1.35 kg rock phosphate polybag-1) | 2.58 a                | deficiency                   |
| A7 (0.45 kg mineral soil polybag-1)   | 2.48 a                | deficiency                   |
| A8 (0.90 kg mineral soil polybag-1)   | 2.58 a                | deficiency                   |
| A9 (1.35 kg mineral soil polybag-1)   | 2.56 a                | deficiency                   |

**coefficient of variation (CV) = 6.48 %**

Explanation:

1. Numbers followed by the same letters in the same column show no significant difference at the level of 5% according to the Duncan Multiple Range Test.
2. Criteria for analysis of nutrient content of oil palm plant aged <6 years by Von Uexkull and Fairhurst (1991).

Table 1 showed that there are effects of the application of the three types and doses of ameliorant materials used on N nutrient uptake in the leaves of oil palm seedlings in the main nursery aged 16 months after planting for all treatments of the three types and doses of ameliorant materials used: dolomite (A2-A3), rock phosphate (A4-A6), and mineral soil (A7-A9). Except on the dolomite treatment with a low dose of 0.45 kg polybag<sup>-1</sup> (A1) showed no effect. The highest N leaf content of oil palm seedlings was found in the treatment of mineral soil and rock phosphate giving each dose of 1.35 kg polybag<sup>-1</sup> and 0.90 kg polybag<sup>-1</sup> (A8 and A6) which was 2.58% N. because it has to do with the supply of a number of nutrient ions, both from mineral soil and rock phosphate. In addition there are also additional nutrients N, P, K and Mg that come from fertilizer recommendations in the main nursery that comes from multi-fertilizer (15:15:6:4 and 12:12:17:2) which were given twice in each month, kieserite fertilizer (source of Mg and S ions) and suspected addition of N organic from decomposition of organic matter/plant tissue originating from peat soil.

When compared with the lowest amount of N leaf nutrient uptake of oil palm seedlings in the dolomite treatment a dose of 0.45 kg polybag<sup>-1</sup> (A1) which is 1.98% N with nutrient concentrations of oil palm leaves aged <6 years proposed by Von Uexkull and Fairhurst (1991), which is <2.5% N, then the growth of oil palm seedlings planted in polybags are all categorized in deficiency conditions. Likewise for the types and dosages of higher ameliorant materials, each in the dolomite treatment dose of 1.35 kg polybag<sup>-1</sup> (A3), rock phosphate in the dose of 0.90 kg polybag<sup>-1</sup> to 1.35 kg polybag<sup>-1</sup> (A5-A6) and mineral soil with a dose of 0.90 kg polybag<sup>-1</sup> to 1.35 kg polybag<sup>-1</sup> (A8-A9). It appears that N nutrient uptake in leaves is generally >2.50% N, but no one has reached 2.60% N, which means the condition of the plant is in N deficiency condition. Von Uexkull and Fairhurst (1991) explained that there was a relationship between nutrient status in oil palm leaves aged <6 years with the condition of plant growth. If N in the leaves of oil palm seedlings contains <2.5% N the plant is in N deficiency condition. If it contains 2.6-2.9% N, the plant is in optimal/normal growth conditions, and if it contains >3.1% N, the plant is in excessive condition.

### **P-nutrient uptake**

The results of the analysis of variance on the analysis of P nutrient uptake in peat planting media in a polybag for one year showed that there was a treatment effect of the three types and doses of ameliorant materials on P nutrient uptake of leaves of oil palm seedlings in the main nursery aged 16 MAP. The average analysis of P nutrient uptake of leaves of oil palm seedlings aged 16 MAP on peat planting media is presented in Table 2.

Table 2. Results of analysis of P nutrient uptake (%) leaves of oil palm seedlings aged 16 MAP due to the type and dosage treatment of ameliorant materials in peat media in a polybag

| Treatment of ameliorant material | P nutrient uptake (%) | Nutrient condition of leaves |
|----------------------------------|-----------------------|------------------------------|
| A1 (0.45 kg dolomite polybag-1)  | 0.17                  | optimal                      |
| A2 (0.90 kg dolomite polybag-1)  | 0.18                  | optimal                      |
| A3 (1.35 kg dolomite polybag-1)  | 0.51                  | excessive                    |

|                                        |      |         |
|----------------------------------------|------|---------|
| A4 (0.45 kg rock phosphate polybag-1)  | 0.21 | optimal |
| A5 (0.90 kg rock phosphate polybag-1)  | 0.22 | optimal |
| A6 (1.35 kg rock phosphate polybag-1)  | 0.25 | optimal |
| A7 (0.45 kg mineral soil polybag-1)    | 0.19 | optimal |
| A8 (0.90 kg mineral soil polybag-1)    | 0.22 | optimal |
| A9 (1.35 kg mineral soil polybag-1)    | 0.20 | optimal |
| coefficient of variation (CV) = 7.32 % |      |         |

Explanation:

1. Numbers followed by the same letters in the same column show no significant difference at the level of 5% according to the Duncan Multiple Range Test.
2. Criteria for analysis of nutrient content of oil palm plant aged <6 years by Von Uexkull and Fairhurst (1991).

Table 2 showed that there was no effect on the treatment of ameliorant material on P nutrient uptake of oil palm seedlings in the main nursery aged 16 MAP. However, in general, the average P nutrient uptake in the leaves of oil palm seedlings in polybags from the lowest to the highest is 0.17% P (A1) up to 0.51% P (A3). In other words, the three types and doses of ameliorant used can provide optimal growth of oil palm seedlings in a polybag. This is supported by the acquisition of P-available levels in incubated soils on moderate to very high with a range of P-available of 23.0 ppm P (A1/moderate) to 1,314.9 ppm P (A6/very high), except on the dolomite application dose of 0.45 kg per polybag (A1) in the application of ameliorant materials to changes/improvements in soil chemical properties after the implementation of the main nursery ended, obtained P-available of 380.38 ppm, where the P-available status was classified very high. Von Uexkull and Fairhurst (1991) reported that there was a correlation between nutrient status in oil palm leaves aged <6 years with the condition of plant growth. If P in the leaves of oil palm contains <0.15% the plant is in a deficiency condition. When containing 0.16-0.19% P, the plants are in optimal/normal growth conditions. Whereas if it contains, 13.1% P, the P status in the plant is in excessive condition.

#### K-nutrient uptake (%)

The results of the analysis of variance on the analysis of nutrient uptake in peat planting media in a polybag for one year showed that there was an effect of treatment of the three types and doses of ameliorant materials on K nutrient uptake in the leaves of oil palm seedlings in the main nursery. The average analysis of K nutrient uptake of palm oil seedlings aged 16 MAP on peat planting media is presented in Table 3.

Table 3. Results of analysis of K nutrient uptake (%) leaves of oil palm seedlings aged 16 MAP due to the type and dosage treatment of ameliorant materials in peat media in a polybag

| Treatment of ameliorant material       | K nutrient uptake (%) | Nutrient condition of leaves |
|----------------------------------------|-----------------------|------------------------------|
| A1 (0.45 kg dolomite polybag-1)        | 1.60 e                | optimal                      |
| A2 (0.90 kg dolomite polybag-1)        | 1.69 de               | optimal                      |
| A3 (1.35 kg dolomite polybag-1)        | 1.78 cd               | optimal                      |
| A4 (0.45 kg rock phosphate polybag-1)  | 1.63 e                | optimal                      |
| A5 (0.90 kg rock phosphate polybag-1)  | 1.76 cd               | optimal                      |
| A6 (1.35 kg rock phosphate polybag-1)  | 1.96 ab               | excessive                    |
| A7 (0.45 kg mineral soil polybag-1)    | 1.69 de               | optimal                      |
| A8 (0.90 kg mineral soil polybag-1)    | 1.86 bc               | optimal                      |
| A9 (1.35 kg mineral soil polybag-1)    | 2.00 a                | excessive                    |
| coefficient of variation (CV) = 3.26 % |                       |                              |

Explanation:

1. Numbers followed by the same letters in the same column show no significant difference at the level of 5% according to the Duncan Multiple Range Test.

- Criteria for analysis of nutrient content of oil palm plant aged <6 years by Von Uexkull and Fairhurst (1991).

Table 3 showed the mineral soil application dose of 1.35 kg polybag<sup>-1</sup> (A9) was increased K nutrient uptake, which is 2.00%, significantly different from all other treatments except with the treatment given rock phosphate at a dose of 1.35 kg polybag<sup>-1</sup> (A6). The pattern of the distribution of the level of dose of ameliorant material is directly proportional to the increase in the K nutrient content of oil palm seedlings in a polybag. Generally the average K nutrient uptake on the leaves of oil palm seedlings was due to the three types of ameliorant material treatment from the lowest to the highest dosage which was 1.78% K, or was in optimal growth condition. In treatment A6 (1.96% K), A8 (1.86% K), and A9 (2.00% K) the concentration of K nutrient in leaves were excessive. Von Uexkull and Fairhurst (1991) reported that if K nutrient in oil palm leaves containing <1.00%, the plant is in nutrient deficiency condition. If it contains 1.00-1.30% K the plant is in optimal/normal condition, and if it contains >1.80% K, the K status in the plant is in excessive condition.

### Ca-nutrient uptake (%)

The results of the analysis of variance on the analysis of nutrient uptake in peat planting media in a polybag for one year showed that there was an effect of treatment of three types and doses of ameliorant materials on Ca nutrient uptake of leaves of oil palm seedlings in the main nursery. The average analysis of Ca nutrient uptake of palm oil seedlings aged 16 MAP on peat planting media is presented in Table 4.

Table 4. Results of analysis of Ca nutrient uptake (%) leaves of oil palm seedlings aged 16 MAP due to the type and dosage treatment of ameliorant materials in peat media in a polybag

| Treatment of ameliorant material        | Ca nutrient uptake (%) | Nutrient condition of leaves |
|-----------------------------------------|------------------------|------------------------------|
| A1 (0.45 kg dolomite polybag-1)         | 0.28 ab                | deficiency                   |
| A2 (0.90 kg dolomite polybag-1)         | 0.27 abc               | deficiency                   |
| A3 (1.35 kg dolomite polybag-1)         | 0.30 a                 | deficiency                   |
| A4 (0.45 kg rock phosphate polybag-1)   | 0.20 c                 | deficiency                   |
| A5 (0.90 kg rock phosphate polybag-1)   | 0.28 ab                | deficiency                   |
| A6 (1.35 kg rock phosphate polybag-1)   | 0.30 a                 | deficiency                   |
| A7 (0.45 kg mineral soil polybag-1)     | 0.22 bc                | deficiency                   |
| A8 (0.90 kg mineral soil polybag-1)     | 0.24 abc               | deficiency                   |
| A9 (1.35 kg mineral soil polybag-1)     | 0.24 abc               | deficiency                   |
| coefficient of variation (CV) = 13.31 % |                        |                              |

Explanation:

- Numbers followed by the same letters in the same column show no significant difference at the level of 5% according to the Duncan Multiple Range Test.
- Criteria for analysis of nutrient content of oil palm plant aged <6 years by Von Uexkull and Fairhurst (1991).

Table 4 showed the application of the three types and doses of ameliorant material to have an effect on Ca nutrient uptake of palm oil seedlings in the main nursery aged 16 MAP. The highest Ca nutrient uptake was found in the dolomite and rock phosphate treatment doses of 1.35 kg polybag<sup>-1</sup> (A3 and A6), which was 0.30% Ca. The increase in the dose of ameliorant material was directly proportional to the increase in the level of Ca nutrient content in the leaves of oil palm seedlings in the main nursery aged <6 years. The higher the dose of the three types of ameliorant material the higher Ca nutrient uptake. Increasing of the Ca nutrient uptake on dolomite and rock phosphate high doses of 1.35 kg polybag<sup>-1</sup> (A3 and A6) because both treatments of the ameliorant material supply Ca nutrient cations into the soil

solution, in addition to nutrients P and Mg which can be absorbed plants in relatively large quantities. Von Uexkull and Fairhurst (1991) reported that Ca concentrations in oil palm oil leaves contained <0.30% Ca the plant is in nutrient deficiency condition. When containing 0.50-0.75% Ca the plant is in optimal/normal condition. When containing >1.00% Ca the plant is in excessive condition. Based on the reference, Ca nutrient due to the treatment of the three types of ameliorant materials still cannot provide optimal Ca levels.

### Mg nutrient uptake (%)

The results of the analysis of variance showed that the treatment of the three types and doses of ameliorant material had an effect on Mg nutrient uptake in the leaves of oil palm seedlings aged 16 MAP (Table 1). The highest Mg nutrient uptake was found in the mineral soil treatment doses of 1.35 kg polybag<sup>-1</sup> (A9) which is 1.98%. The pattern of distribution of effects between mineral soil doses treatments were directly proportional to Mg nutrient uptake, the higher the mineral soil dosage the higher the Mg nutrient uptake, but it does not apply to dolomite and rock phosphate applications.

Table 5. Results of analysis of Mg nutrient uptake (%) leaves of oil palm seedlings aged 16 MAP due to the type and dosage treatment of ameliorant materials in peat media in a polybag

| Treatment of ameliorant material        | Mg nutrient uptake (%) | Nutrient condition of leaves |
|-----------------------------------------|------------------------|------------------------------|
| A1 (0.45 kg dolomite polybag-1)         | 0.27 c                 | deficiency                   |
| A2 (0.90 kg dolomite polybag-1)         | 0.28 c                 | deficiency                   |
| A3 (1.35 kg dolomite polybag-1)         | 0.32 c                 | optimal                      |
| A4 (0.45 kg rock phosphate polybag-1)   | 0.20 c                 | deficiency                   |
| A5 (0.90 kg rock phosphate polybag-1)   | 0.23 c                 | deficiency                   |
| A6 (1.35 kg rock phosphate polybag-1)   | 0.25 c                 | deficiency                   |
| A7 (0.45 kg mineral soil polybag-1)     | 0.26 c                 | deficiency                   |
| A8 (0.90 kg mineral soil polybag-1)     | 1.28 b                 | excessive                    |
| A9 (1.35 kg mineral soil polybag-1)     | 1.98 a                 | excessive                    |
| coefficient of variation (CV) = 13.15 % |                        |                              |

Explanation:

1. Numbers followed by the same letters in the same column show no significant difference at the level of 5% according to the Duncan Multiple Range Test.
2. Criteria for analysis of nutrient content of oil palm plant aged <6 years by Von Uexkull and Fairhurst (1991).

Increasing of Mg nutrient uptake due to the addition of mineral soil dose of 1.35 kg polybag<sup>-1</sup> (A9) because in mineral soils there are a number of alkaline cations (K, Ca, Mg), presumably there are also Mg-minerals and hard-to-dissolve compounds react with organic acids to release a number of nutrients, including nutrient Mg. The level of Mg in peat soil is high. Addition of mineral soil will add a number of colloidal minerals to the peat so that it can absorb alkaline cations, including Mg and prevent the occurrence of alkaline cation bleaching. Mg nutrient supply can also come from the decomposition of organic matter/plant tissue. Based on the criteria for the nutrient concentration of oil palm leaves aged <6 years, only the dolomite treatment (A3) was classified as optimal in supporting plant growth based on the reference of Von Uexkull and Fairhurst (1991). If oil palm leaves contain <0.20% Mg the plant is in nutrient deficiency. When containing 0.30-0.45% Mg the plant is in normal/optimal condition. If it contains >0.70% Mg, Mg is in excessive condition.

## CONCLUSION

1. Addition of mineral soil dose of 1.35 kg polybag<sup>-1</sup> (A9) in oil palm seedlings in the main nursery aged 16 MAP on peat planting media can increase nutrient absorption of N, K, and Mg in the leaves.
2. The highest P content on leaves of oil palm seedlings aged 16 MAP on peat media was found in the addition of dolomite dose of 1.35 kg polybag<sup>-1</sup> (A3) which is 0.51% P, but not different from all other treatments.
3. Ca nutrient uptake of leaves of oil palm seedlings aged 16 MAP is highest in addition of dolomite and rock phosphate doses of 1.35 kg polybag<sup>-1</sup> (A3 and A6) which is 0.30% Ca.

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