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Variasi Komposisi Vermikompos Sebagai Media Tumbuh Untuk Pertumbuhan Bibit Kelapa Sawit di *pre-nursery*

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ABSTRAK

Penelitian ini bertujuan untuk mengidentifikasi respons pemberian pupuk organik vermikompos sebagai komposisi media tanam dengan subsoil pada pertumbuhan bibit kelapa sawit di pre-nursery. Penelitian dilaksanakan di kebun praktek Wedomartani, Ngemplak, Kabupaten Sleman, Yogyakarta pada bulan April – Juni 2022. Penelitian ini mengimplementasikan rancangan acak kelompok dengan faktor tunggal, yaitu pemberian vermikompos sebagai komposisi media tanam. Vermikompos yang digunakan sebagai komposisi media tanam terdiri dari lima perlakuan, yaitu: *subsoil* 100% (tanpa vermikompos/kontrol), *subsoil* (80%) + vermikompos (20%), *subsoil* (70%) + vermikompos (30%), *subsoil* (60%) + vermikompos (40%), dan *subsoil* (50%) + vermikompos (50%). Setiap perlakuan diulang sebanyak tiga kali sehingga terdapat 15 satuan percobaan. Hasil penelitian menunjukkan bahwa aplikasi vermikompos sebagai komposisi media tanam dengan *subsoil* memberikan pertumbuhan bibit kelapa sawit yang lebih tinggi dibandingkan tanpa pemberian vermikompos. Pemberian *subsoil* dengan vermikompos menghasilkan tinggi tanaman, jumlah daun, diameter batang, bobot basah dan kering tanaman yang lebih tinggi dibandingkan perlakuan kontrol. Aplikasi *subsoil* (80%) + vermikompos (20%) memberikan tinggi tanaman, jumlah daun, diameter batang, bobot basah dan kering bibit kelapa sawit yang terbaik di *pre-nursery*.

Kata Kunci: *Elaeis guineensis*, pupuk, pembibitan, pre-nursery, vermikompos

Various Compositions of Vermicompost-Based Growing Media For Growing Oil Palm Seedlings in The Nursery

ABSTRACT

The research was conducted with the aim of identifying the various compositions of vermicompost-based growing media for growing oil palm seedlings in the pre-nursery. This research was conducted in Teaching Farm Wedomartani, Ngemplak, Sleman Regency, Yogyakarta from April to June 2022 that used D x P Simalungun oil palm sprouts, subsoil, and vermicompost. This study implemented a randomized block design with a single factor. The composition of the planting media as a factor that consisted of five treatments, namely: subsoil (100%), subsoil (80%) + vermicompost (20%), subsoil (70%) + vermicompost (30%), subsoil (60%) + vermicompost (40%), and subsoil (50%) + vermicompost (50%). Each treatment was repeated three times. The results showed that the application of vermicompost as planting media composition in the pre-nursery with subsoil gave the oil palm seedlings higher growth than the control (without vermicompost). The application of subsoil with vermicompost gave the plant height, number of leaves, stem diameter, and wet and dry plant weight higher than the control. Application of subsoil (80%) + vermicompost (20%) produced the best plant height, number of leaves, stem diameter, and wet and dry weight of oil palm seedlings.

Keywords: *Elaeis guineensis*, fertilizer, pre-nursery, seedlings, vermicompost

INTRODUCTION

Oil palm is an important role in the Indonesian economy since they produce various oil for oil, industrial, and biofuel (biodiesel). Oil palm has a positive influence on economic and social growth. Palm oil as one of the largest export commodities in Indonesia has an important role as a large source of foreign exchange and taxes. In the process of industrial production and processing, oil palm plantations are also able to create opportunities and jobs, especially for rural communities while increasing people's welfare [1].

The prospects for the development of the palm oil industry are currently very rapid where there has been an increase in both the area and the increase in palm oil production in line with the increasing needs of the community. The area of oil palm plantations in 2021 is recorded at 15,081,021 hectares. Large private companies mostly cultivate the area, which is 8,417,232 hectares. People's plantation occupies the second position in their contribution to the total area of Indonesian oil palm plantations, which is 6,084,126 hectares, while a small portion is cultivated by the Large State Plantations, namely 579,644 hectares [2].

In oil palm nurseries the soil used is topsoil. Fertile land that contains a lot of topsoils has decreased, while the area planted with oil palm continues to increase. Thus, efforts are made to utilize marginal land that lacks nutrients such as subsoil. The lack of soil fertility results in a lack of quality and quantity of agricultural and plantation production. In addition, soil erosion is a layer of topsoil that contains lots of nutrients plants need, further exacerbating this condition [3][4][5]. The subsoil usually has low physical, chemical, and biological soil characteristics, but can be used as a planting medium with the application of soil amendments [6].

Planting media is the main component needed to increase the growth of oil palm seedlings because the planting media contains the nutrients needed by plants [7]. Oil palm seeds require planting media that has good chemical and physical properties. Oil palm nursery media generally consists of topsoil mixed with sand or organic matter so that a medium with good fertility and suitable for the growth of oil palm seedlings can be obtained. Until now, topsoil plays an important role in the growth of oil palm seedlings. The use of topsoil areas which are often used for nurseries makes the need for topsoil for planting media increasingly difficult to obtain. One of the planting media that can be used and is still widely available in the subsoil. According to the findings of [8], the use of topsoil mixed with subsoil as planting media increases the plant growth of oil palm seedlings. However, the problem faced is that generally, subsoil has a lower fertility value compared to topsoil, which is indicated by the low organic matter content and nutrient availability [9].

The level of subsoil fertility can be improved if the application is mixed with organic matter so that the subsoil planting medium can completely replace the role of topsoil as a planting medium for oil palm nurseries [10]. Based on the research results, it is known that when the subsoil is mixed with mixed organic matter it can be an ideal planting medium to replace topsoil media in oil palm nurseries in pre-nursery whose effect continues into the main nursery. The planting medium is very influential on the nursery process because it will directly affect the development of the roots which serve to support the plant itself. Based on the research from [11], planting medium was affected of the growth and development of oil palm. Oil palm seedlings can be increased by varying soil and cocopeat combinations [12]. To get good medium conditions according to plant needs is one that has a balanced nutrient content so that the right combination is obtained according to the growth requirements needed by oil palm seeds [13].

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In practice, in the field, a lot of planting media is needed for oil palm nurseries, especially in the pre-nursery. For this reason, an effort is needed to replace the alternative use of topsoil as a planting medium in oil palm nurseries. One of them is with using subsoil. However, the subsoil is known to be poor in nutrients. Increasing the nutrients in the subsoil can be done by providing organic matter in the form of vermicompost. [14] state that vermicompost can increase organic C, pH, available P, total P and K. Vermicompost with biochar addition result organic C, pH, and total N, P, K [15]. Therefore, the addition of vermicompost organic fertilizer from cow dung can be done to overcome the problem of shortage of organic matter as an alternative to topsoil by mixing it with subsoil. The purpose of this research is to identifying the various components of vermicompost based on for growing media on the oil palm seedlings in the pre-nursery.

MATERIALS AND METHODS

The research will be carried out at the Lembaga Pendidikan Perkebunan (LPP) Yogyakarta Polytechnic Practice Garden, Wedomartani, Ngemplak, Sleman, Yogyakarta for 4 months from April to July 2022. This study was implemented a randomized block design that consisted of five growing media composition, namely: subsoil (100%), subsoil (80%) + vermicompost (20%), subsoil (70%) + vermicompost (30%), subsoil (60%) + vermicompost (40%), and mixed of subsoil (50%) + vermicompost (50%). Each treatment was repeated three times so that there were 15 unit treatments.

D x P Simalungun oil palm sprouts from the Medan Oil Palm Research Center were used. The planting media utilized was Regosol subsoil extracted at a depth of 150 cm from the soil surface. The soil used as a planting medium is first dried and then filtered to remove any wood residue, small rocks, or other debris. The planting medium is a combination of subsoil and vermicompost. The composition of subsoil and vermicompost is treated according to a predefined ratio. Shade is created at the same time as the planting media is prepared or before the sprouts are planted. The bamboo shade measures 2 meters in height. The shade is composed of 65% paranet. Planting sprouts in polybags 22 x 14 cm in size (equal to 7.8 kg soil weight). Weeding is done by hand on a two-week cycle. If it does not rain, the seedlings are watered twice a day. Watering seedlings in pre-nursery requires 0.1-0.3 l/seedling/day [16].

The vermicompost that used in this study was produced by BL Perkasa Yogyakarta that the C-organic content, C/N ratio, total macronutrients, pH, and water content of vermicompost (Table 1) accord with the minimum technical requirements for solid organic fertilizers based on Minister of Agriculture No. 261 of 2019 concerning the minimum technical requirements for organic fertilizers, biological fertilizers, and soil conditioners.

Table 1. The chemical vermicompost

Parameter	Result	Ministry of Agriculture No. 261 of 2019
C-organic (%)	30.9	Minimum 15
C/N ratio	18,54	≤ 25
Total macronutrients: ($N + P_2O_5 + K_2O$) (%)	3,78	Minimum 2
pH H_2O	7,96	4 – 9
Water content (%)	11,25	8 – 20

The growth plant height, number of leaves, and stem diameter were measured at 2 and 3 Months After Planting (MAP), while the biomass were determined on 3 MAP. The field is also maintained with weeding and watering frequently. The data obtained was carried out by Analysis of Variance (ANOVA) testing used the SAS System for Windows ver. 9.0 software.

RESULT AND DISCUSSION

Based on a DMRT test level of 5% in Table 2 below show that the application of vermicompost fertilizer as a mixture of growing media with subsoil showed a significant effect on oil palm plant height at 2 and 3 MAP ages ($P < 0.05$). All treatments of vermicompost composition with different subsoil as a planting medium resulted in a higher oil palm plant height than the 100% subsoil treatment (without vermicompost) at the age of 3 MAP. The application of subsoil (80%) + vermicompost (20%) produced the highest oil palm plant height (1.27 times higher) against the 100% subsoil treatment, but not different from the other vermicompost treatments.

Table 2. Effect of vermicompost application on plant height of oil palm seedlings at 2 and 3 MAP

Treatment	Plant height (cm)	
	2 MAP	3 MAP
Subsoil 100% (control)	12.8b	18.0b
Subsoil (80%) + Vermicompost (20%)	14.0ab	22.8a
Subsoil (70%) + Vermicompost (30%)	13.8ab	22.4a
Subsoil (60%) + Vermicompost (40%)	15.2a	22.2a
Subsoil (50%) + Vermicompost (50%)	13.8ab	21.6a

Note: Mean followed by the same lowercase alphabet in the same column is not significantly different based on Duncan's Multiple Range Test at the level of 5 %.

Vermicompost contains essential nutrients that play a role in plant growth such as nitrogen, phosphor, and kalium. Nitrogen influences the photosynthetic process, phytohormones, plant growth, and development [17][18]. The effect of nitrogen and phosphorus on plant development and production can be demonstrated. Plant height, root collar diameter, chlorophyll content, and root shape can all be increased by combining nitrogen and phosphorus [19]. The nutrient of K^+ regulates cellular development and wood formation, xylem-phloem water content and movement, nutrition and metabolite transport, and stress responses [20]. Vermicompost also contains various metabolite for plant growth including hormone gibberellin 2.75%, cytokinin 1.05% and auxin 3.80% which play a role in increasing plant height [21].

The application of vermicompost fertilizer as a mixture of growing media with subsoil had a significant effect on the number of oil palm leaves at the age of 2 and 3 MAP ($P < 0.05$) based on a DMRT test level of 5% (Table 3). The application of subsoil (80%) + vermicompost (20%) resulted in a greater number of oil palm leaves than the 100% subsoil treatment. The application of subsoil (80%) + vermicompost (20%) gave the number of oil palm leaves 1.3 times more than the 100% subsoil treatment, but not different from the other vermicompost treatments (Table 3).

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Table 3. Effect of vermicompost application on a number of leaves of oil palm seedlings at 2 and 3 MAP

Treatment	Number of leaves	
	2 MAP	3 MAP
Subsoil 100% (control)	2.0b	4.0b
Subsoil (80%) + Vermicompost (20%)	2.0b	5.2a
Subsoil (70%) + Vermicompost (30%)	2.4ab	4.6ab
Subsoil (60%) + Vermicompost (40%)	2.4ab	4.6ab
Subsoil (50%) + Vermicompost (50%)	2.6a	4.8ab

Note: Mean followed by the same lowercase alphabet in the same column is not significantly different based on Duncan's Multiple Range Test at the level of 5 %.

The increase in the number of leaves with the application of vermicompost compared to the control treatment (without vermicompost) is because vermicompost can improve the fertility of the physical, chemical, and biological properties of the soil. In addition, it is also suspected that the addition of vermicompost can provide nutrients to the soil. The results of research from [22] show that the application of vermicompost fertilizer can increase plant height and the number of leaves of mustard plants. The provision of vermicompost that can increase plant growth and yield is also shown from the results of other studies on different plants, namely mustard greens [23], *Brassica rapa* L. [24], and *Zingiber officinale* var. rubrum [25].

The number of leaves variable has the same average number between different treatments. This is because the space for the formation of leaves is narrow. After all, it involves the process of cell differentiation and is followed by relatively small differences in nutrient availability while the nutrients in the planting medium are sufficient, so the number of leaves is relatively the same. This condition resulted in relatively the same results of assimilation through the process of photosynthesis. Photosynthesis is also influenced by nutrient content, especially nitrogen. Nitrogen is the main constituent of protein and chlorophyll which plays an important role in the process of photosynthesis [26].

Based on a DMRT test level of 5% below show that the application of vermicompost fertilizer as a mixture of growing media with subsoil showed no significant effect on oil palm stem diameter at 2 MAP ($P > 0.05$). However, the application of vermicompost and subsoil with different compositions showed a significant effect on stem diameter at 3 MAP ($P < 0.05$). The application of subsoil (80%) + vermicompost (20%) resulted in a larger diameter of the oil palm trunks compared to other subsoil and vermicompost treatments (Table 4). The application of subsoil (80%) + vermicompost (20%) gave a trunk diameter of oil palm 1.38 times greater than that of 100% subsoil treatment.

Cell division, enlargement, and differentiation are mostly influenced by the availability of N for plants (reference). Nitrogen is a component of chlorophyll, amino acids and proteins are an important part of cell plasma for plant height and number of tiller [27]. N is needed by plants at the beginning of growth or the vegetative period, N uptake can increase with the availability of N in the soil [28]. The nutrient element Phosphorus (P) can play a role in the process of respiration and plant metabolism for the better so that the formation of amino acids and proteins for the formation of new cells can occur and can increase the height of oil palm seedlings[29]. Vermicompost provides all the available nutrients (C-organic, total N,

P dan K) forming and increasing the absorption of nutrients by plants [30].

Table 4. Effect of vermicompost application on stem diameter of oil palm seedlings at 2 and 3 MAP

Treatment	Stem diameter (mm)	
	2 MAP	3 MAP
Subsoil 100% (control)	3.6a	4.8b
Subsoil (80%) + Vermicompost (20%)	4.0a	6.6a
Subsoil (70%) + Vermicompost (30%)	3.8a	5.8ab
Subsoil (60%) + Vermicompost (40%)	4.0a	6.2ab
Subsoil (50%) + Vermicompost (50%)	4.2a	6.6a

Note: Mean followed by the same lowercase alphabet in the same column is not significantly different based on Duncan's Multiple Range Test at the level of 5 %.

Figure 1 below is based on DMRT instead of ANOVA show that the application of vermicompost as a mixture of planting media with subsoil has a significant effect on the wet and dry weight of oil palm plants. The application of subsoil and vermicompost with different compositions resulted in higher wet and dry weights of oil palm plants compared to 100% subsoil treatment at the age of 2 and 3 MAP plants. The subsoil (80%) + vermicompost (20%) treatment gave the highest plant dry weight (1.8 times higher) compared to the 100% subsoil treatment, but not different from the other vermicompost treatments. Biomass is an indicator of plant growth. Vermicompost can affect plant growth in several ways. The high content of nutrients and humic acids promotes plant growth, while the increased organic matter makes the soil's physical and biological characteristics better for plant development [31].

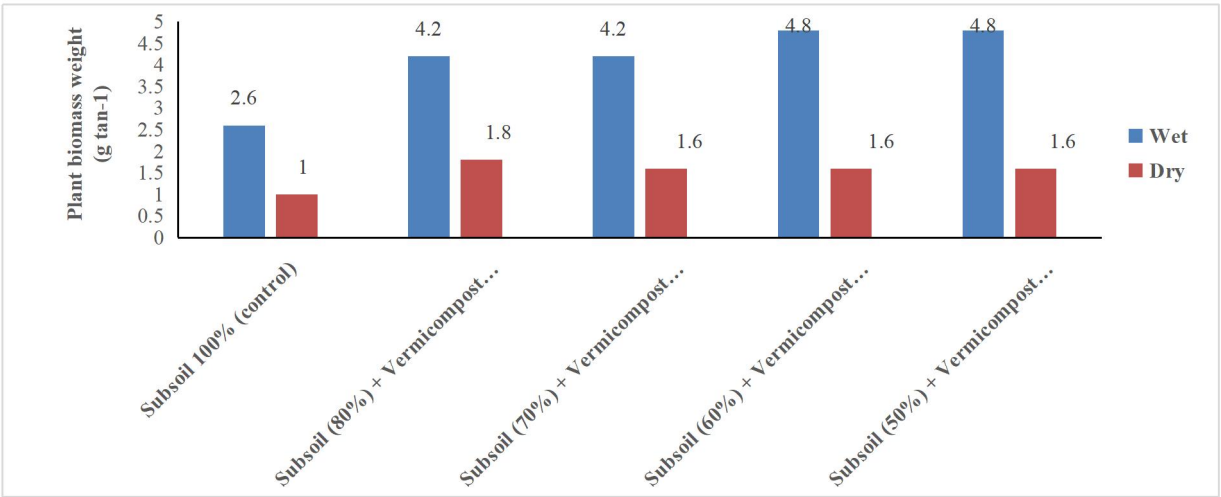

Figure 1. Effect of vermicompost application on plant biomass weight of oil palm seedlings at 2 and 3 MAP

The addition of 20%, 30%, 40%, and 50% vermicompost in the subsoil significantly increased the seedling's fresh weight and the dry weight of the oil palm seedlings even higher when compared to the wet weight and dry weight of the oil palm seedlings planted in the standard medium is subsoil although not significantly different. There is an increase in biomass because plants absorb more water and nutrients, nutrients spur the development of organs in plants such as roots so that plants can absorb more nutrients and water then the photosynthetic activity will increase and affect the increase in wet weight and dry weight of plants. The results of research on the effect of vermicompost on crop yields were also shown for different crops, namely: cabbage [32], *Sesamum indicum* L. [33], and carrots [34].

Plant wet weight is not only influenced by the availability of nutrients in the planting medium but also by the plant's ability to absorb water contained in the planting medium. A good planting medium has good soil aeration so that plant roots will develop more easily and plant root respiration will also be better. The addition of vermicompost organic matter to the sub-soil was able to improve the physical properties of the planting medium. Organic matter is an important soil component in improving and enhancing soil properties. Organic matter can improve soil's physical properties, and improve soil chemical and biological properties [35].

CONCLUSION

Application of various dose of vermicompost as growing media of oil palm seedlings grown in subsoil potted soil in the pre-nursery gave the higher oil palm seedlings than the control (without vermicompost). The used of growth media composed of subsoil with vermicompost resulted in the plant height, number of leaves, stem diameter, and wet and dry plant weight enhancement compared to the control. Growing media consisted of subsoil (80%) and vermicompost (20%) produced the best plant height, number of leaves, stem diameter, and wet and dry weight of oil palm seedlings.

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