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(RESEARCH ARTICLE)

The effect of water volume on growth of several oil palm varieties (*Elaeis guineensis* Jacq.) aged of 8-14 months in main nursery

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Abstract

Oil palm plantation has an important role for the development of national plantation in Indonesia, in purpose to create job opportunities that lead to community welfare and also become the source of foreign exchange or tax for the country. Over the last four years, the area of oil palm plantation in Indonesia has increased from 10.4 million hectares since 2013 and continued to 12.30 million hectares in 2017 with total production 34.47 million tons of Crude Palm Oil (CPO). This research was conducted using experimental research by applying the form of the two-stage nested plot with the treatment arrangement of factor 2 into factor 1. The first factor was oil palm variety which includes of 3 levels, namely V1: Tenera DxP Marihat variety, V2: Tenera DxP Topaz 3 variety, and V3: Tenera DxP Socfindo Lame variety. The second factor was the volume of water supply which consists of 4 levels, namely A1 = 1000 ml per day per plant, A2 = 1500 ml per day per plant, A3 = 2000 ml per day per plant, and A4 = 2500 ml per day per plant. The Observation parameters are photosynthetic rate, leaf area, seedling height, and diminutive diameter of trunk, number of leaves, wet weight, plant roots, root crown ratio, and seed quality index. The results showed that the volume of water affected all growth components of several varieties of oil palm seedlings, both on the variables of photosynthesis rate, leaf area, seedling height, and diminutive diameter of trunk, number of leaves, wet weight, plant root volume, root crown ratio, and seed quality index.

Keywords: Growth; Palm oil; Varieties; Volume of water

1. Introduction

Oil palm (*Elaeis guineensis* Jacq.) is one type of edible oil-producing plant and has the potential to be planted and managed and can create job opportunities that lead to community welfare and become a source of foreign exchange earnings for the country. The area of oil palm plantations in Indonesia over the last four years has continued to increase from 10.4 million hectares in 2013 to 12.30 million hectares in 2017 with production reaching 34.47 million tons of Crude Palm Oil (CPO). Riau Province Indonesia is the area with the largest oil palm plantation area in Indonesia reaching 2.26 million hectares and for production reaching 7.43 million tons of CPO (BPS, 2018), of the total area of oil palm plantations that exist will be replanted because it has reached age is 25 years. According to the Plantation Fund Management Agency [1] the government will replanting 25,423 hectares of smallholder oil palm plantations for Riau Province in 2018. In 2019, the area of Indonesian oil palm plantations will be 14.60 million hectares (Central Bureau of Statistics, 2020).

Quality oil palm seeds do not only come from superior seeds but other factors of cultivation techniques play an important role such as watering, at the time of seedling the availability of water for watering is often an obstacle so that the alan seedlings experience drought so that it will affect growth. Suhartono (2008) states that water is one of the most important components and is needed in large quantities for plant growth and development. Approximately 85-90% of

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the fresh weight of cells and tissues consists of water and serves as a stabilizer of plant temperature. [2], Lack of water in plant tissues can reduce cell turgor, affect cell membranes and potential chemical activity of water in plants. Lack of water can result in disruption of plant metabolic processes, which ultimately affects the rate of plant growth and development.

The availability of sufficient water to meet plant needs is very important, because water acts as a nutrient solvent, transports nutrients to all parts of the plant, and maintains plant temperature stability. [3] In the Pre Nursery nursery, the volume of watering is not determined, it is enough to do it every morning and evening while in the Main Nursery nursery the water needs must be fulfilled, which is 3.4 mm per day or 2250 ml per polybag so that there is no potential to experience water stress (Effendi and Widanarko, 2011).

Currently in Indonesia there are 15 oil palm seed producers, three of which are the object of research from the Palm Oil Research Center (PPKS) PT. Tunggal Yunus Estate and PT. Socfindo Indonesia. [5] The advantage of Marihat PPKS seeds is that they produce sand fruit at the age of 2.8 to 3 years. Production of fresh fruit bunches and crude palm oil produces 20-30%, with an average oil production of 7.53 tons per hectare per year (Directorate of Seeds, 2004). The advantages of Topaz 3 oil palm seeds are that they flower quickly, produce high FFB, and can adapt to marginal lands, while the advantages of D x P Socfindo Lame oil palm seeds are tolerant to disease attacks (Ministry of Agriculture, 2004). [6] The response of each plant to the availability of water is different even from the same plant species. This study aims to see the response of several oil palm varieties to the application of several volumes of water aged 8-14 months so that it is expected to be used as a study material on the water requirements of several oil palm varieties during plant growth in the main nursery.

2. Material and Methods

The research was carried out in the experimental garden screen house, Faculty of Agriculture, Riau University, Bina Widya Campus, Simpang Baru Village, Tampan District, Pekanbaru City. This research lasted for 7 months starting from May to December 2019. The materials used in this study were oil palm essds of Tenera DxP Marihat, Tenera DxP Topaz 3, and Tenera DxP Lame which were months old, humus oil, chicken manure, NPK fertilizer (12:12:17), insecticide Sevin 85 WP, and fungicide Dithane M-45. The tools used are hoe, analytical scale, meter, measuring cup, ruler with centimeter unit, caliper, oven, knife, 30 x 40 cm polybag with 0.2 mm thickness, and handsprayer.

This research was conducted experimentally in the form of a two-stage nested plot with the treatment arrangement of factor 2 nested in factor 1.

Factor I: oil palm varieties, which consist of 3 levels, namely: V1: Tenera DxP Marihat Varieties, V2: Varieties of Tenera DxP Topaz 3, and V3: Varieties of Tenera DxPSocfindo Lame. Factor II: volume of water supply, consisting of 4 levels, namely: A1 = 1000 ml per day per plant, A2 = 1500 ml per day per plant, A3 = 2000 ml per day per plant, and A4 = 2500 ml per day per plant. Based on the above treatment, 12 treatment combinations were obtained and each treatment combination was repeated 3 replications so that there were 36 experimental units. Each experimental unit consisted of 3 plants so that 108 oil palm seedlings were obtained. The data obtained from this study were analyzed statistically by analysis of variance. The results of the analysis of variance were continued with Duncan's new multiple range test (DNMRT) at the 5% level and processed using SAS version 9.1. Parameters observed were Photosynthetic rate, Leaf area, Increase in plant height, Number of oil palm seedling leaves (strands), Diameter of oil palm seedling bulbs (cm), Wet weight of oil palm seedlings (g), Root volume of oil palm seedlings (ml), Root crown ratio, and Quality index.

3. Results

The numbers in the column followed by the same lowercase letter are not significantly different according to Duncan's new Multiple Range Test (DNMRT) advanced test at 5% level.

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Table 1 Photosynthetic rate of oil palm seedlings with the volume of water applied to several oil palm varieties

Water Supply (ml per day per seedling)	Palm Oil Seed Varieties		
	Marihat	Topaz 3	Socfindo
1000	26,23b	24,49bc	23,10bc
1500	26,49b	26,22b	20,64c
2000	31,68a	26,48b	23,81bc
2500	32,87a	31,49a	26,55b
Average	29,32a	27,17b	23,53c

Table 2 Leaf area of oil palm seedlings (cm^2) with the volume of water applied to several oil palm varieties

Water Supply (ml per day per seedling)	Palm Oil Seed Varieties		
	Marihat	Topaz 3	Socfindo
1000	6465b	6124b	6074b
1500	6696b	6941b	5137b
2000	8216ab	7027b	6217b
2500	10265a	8201ab	7170b
Average	7910,50a	7073,00ab	6149,30b

Table 3 Increase in plant height of oil palm seedlings (cm) with the volume of water applied to several oil palm varieties

Water Supply (ml per day per seedling)	Palm Oil Seed Varieties		
	Marihat	Topaz 3	Socfindo
1000	105,13cd	98,66d	109,83cd
1500	109,83cd	113,90cd	100,30d
2000	136,50ab	121,30bc	110,10cd
2500	147,40a	135,50ab	122,63bc
Average	124,71a	117,34ab	110,71b

Table 4 Number of oil palm seedling leaves (strands) with the volume of water applied to several oil palm varieties

Water Supply (ml per day per seedling)	Palm Oil Seed Varieties		
	Marihat	Topaz 3	Socfindo
1000	7,00bc	5,68cd	5,33d
1500	7,33b	7,01bc	5,66cd
2000	8,33ab	7,33b	5,66cd
2500	9,67a	9,66a	7,34b
Average	8,08a	7,41a	6,00b

Table 5 Diameter of oil palm seedling bulbs (cm) with volume of water applied to several oil palm varieties

Water Supply (ml per day per seedling)	Palm Oil Seed Varieties		
	Marihat	Topaz 3	Socfindo
1000	1,83def	1,46f	2,20cdef
1500	2,02def	2,22cdef	1,66ef
2000	3,46ab	2,57bcde	2,18cdef
2500	4,29a	3,13bc	2,75bcd
Average	2,90a	2,34b	2,19b

The numbers in the column followed by the same lowercase letter are not significantly different according to Duncan's new Multiple Range Test (DNMRT) advanced test at 5% level.

Table 6 Wet weight of oil palm seedlings (g) with the volume of water applied to several oil palm varieties

Water Supply (ml per day per seedling)	Palm Oil Seed Varieties		
	Marihat	Topaz 3	Socfindo
1000	835,00cde	846,70cde	961,70bcde
1500	923,30bcde	893,30cde	656,70e
2000	1286,70ab	1076,70bcd	706,70de
2500	1470,00a	1181,70abc	973,30bcde
Average	1128,75a	999,58a	824,58b

The numbers in the column followed by the same lowercase letter are not significantly different according to Duncan's new Multiple Range Test (DNMRT) advanced test at 5% level.

Table 7 Root volume of oil palm seedlings (ml) with the volume of water applied to several oil palm varieties

Water Supply (ml per day per seedling)	Palm Oil Seed Varieties		
	Marihat	Topaz 3	Socfindo
1000	135,00cde	188,33bcd	142,67d
1500	228,33abc	188,00bcd	121,33d
2000	275,33a	179,33bcd	145,33cd
2500	299,33a	239,33ab	159,33bcd
Average	241,42a	198,75b	142,17c

The numbers in the column followed by the same lowercase letter are not significantly different according to Duncan's new Multiple Range Test (DNMRT) advanced test at 5% level.

Table 8 Root crown ratio of oil palm seedlings with the volume of water applied to several oil palm varieties

Water Supply (ml per day per seedling)	Palm Oil Seed Varieties		
	Marihat	Topaz 3	Socfindo
1000	8,11bcd	8,59bc	7,76cd
1500	8,75bc	9,94b	6,55d
2000	9,38bc	9,21bc	7,77cd
2500	11,82a	9,74b	8,98bc
Average	9,51a	9,37a	7,76b

The numbers in the column followed by the same lowercase letter are not significantly different according to Duncan's new Multiple Range Test (DNMRT) advanced test at 5% level.

Table 9 Quality index of oil palm seedlings with water supply volume for several oil palm varieties

Water Supply (ml per day per seedling)	Palm Oil Seed Varieties		
	Marihat	Topaz 3	Socfindo
1000	30,04abc	31,69abc	26,82c
1500	32,87abc	34,63abc	24,14c
2000	36,28abc	41,16ab	28,98bc
2500	44,21a	31,59abc	31,85abc
Average	35,85a	34,77a	27,05b

The numbers in the column followed by the same lowercase letter are not significantly different according to Duncan's new Multiple Range Test (DNMRT) advanced test at 5% level.

4. Discussion

4.1. Photosynthesis rate

Table 1 shows that the application of several volumes of water significantly increased the rate of photosynthesis in the three oil palm varieties. The Tenera DxP Marihat variety showed the highest photosynthetic rate, namely 32.87 giving 2500 ml of water per day per plant was significantly different from giving 1000 - 1500 ml per day per plant and giving 2000 ml per day per plant showed a high rate of photosynthesis, not significantly different by giving 2500 ml per day per plant. [7] The Tenera DxP Topaz 3 variety with 2500 ml of water per day per plant resulted in the highest photosynthetic rate of 31.49, which was significantly different from 1000 - 2000 ml per day per plant. The Tenera DxP Socfindo Lame variety with a volume of 2500 ml of water per day per plant showed the highest photosynthetic rate of 26.55 not significantly different from 2000 ml of water per day per plant. The provision of water volume of 2500 ml per day per plant in the three varieties is the provision of water that meets the needs of the plant, this can be seen from the high rate of photosynthesis of the three varieties of oil palm seedlings. [8] Diversity of plant appearance due to genetic makeup is always possible even if the plant material used is of the same type. Ruchjaningsih et al. (2000) stated that the genetics of a plant has certain properties and characters that cause differences between plants from one another.

Availability of sufficient water affects cell turgor pressure, stomata opening, solubility and nutrient transport. The amount of available water can dissolve the nutrients provided, namely NPK 12:12:17 fertilizer and become available to plants so that plants can use them for growth and development. According to Jumin (2002), water functions in transporting nutrients from roots to plant tissues, as a solvent for mineral salts and as a constituent of plant tissues. [9] The availability of water will increase the rate of photosynthesis and the resulting photosynthate is translocated to the parts of the plant that need it and become a respiration substrate.

4.2. Leaf area

Table 2 shows that the application of several volumes of water significantly increased the leaf area of the three oil palm varieties. The application of 2500 ml of water per day per plant on the Tenera DxP Marihat variety showed the highest leaf area of 10265 cm2 which was significantly different from the provision of 1000 - 1500 ml per day per plant and was not significantly different from the application of 2000 ml per day per plant. The Tenera DxP Topaz 3 variety with 2500 ml of water per day per plant showed the highest leaf area of 8201 cm2 which was not significantly different from 1000-2000 ml of water per day per plant. The Tenera DxP Socfindo Lame variety with 2500 ml of water per day per plant showed the highest leaf area of 7170 cm2 which was not significantly different from 1000-2000 ml per day per plant. [10] The application of 2000 ml of water per day per plant on the Tenera DxP Marihat variety still showed a high leaf area of 8216 cm2 compared to the Tenera DxP Topaz 3 variety given 2500 ml per day per plant, and significantly different from the Socfindo variety in the application of 2500 ml per day per plant. plant. This shows that the rate of photosynthesis (Table 1) affects the amount of photosynthate produced which is translocated to plant parts that need for growth and development as well as cell differentiation in forming plant organs such as leaves, stems, and roots (Sarawa and Baco, 2014). [11] Photosynthate is used by plants to produce energy that is used for plant growth and development, including leaf area. According to Setyani et al. (2013) the addition of leaf area will determine the rate of photosynthesis per unit plant so that it can increase the photosynthate used for the growth of plant organs, including leaves.

4.3. Plant height increase

Table 3 shows that the application of several volumes of water significantly increased the increase in plant height. The application of 2500 ml of water per day per plant on the Tenera DxP Marihat variety showed the highest increase in plant height, namely 147.40 cm, which was not significantly different from the provision of 1000 - 1500 ml per day per plant and was not significantly different from the application of 2000 ml per day per plant. [12] The Tenera DxP Topaz 3 variety when given a volume of 2500 ml of water per day per plant showed the highest height increase of 135.50 cm which was not significantly different from giving 2000 ml per day per plant but significantly different from giving water with a volume of 1000-1500 ml of water per plant. day per plant. The Tenera DxP Socfindo Lame variety with 2500 ml of water per day per plant was not significantly different from that of 1000 - 2000 ml per day per plant. [13] Broad leaves will produce large amounts of chlorophyll so that it allows the absorption of more sunlight which can increase the rate of photosynthesis. The availability of sufficient water causes a high rate of photosynthesis which will produce high photosynthate, and is used as a respiration substrate to produce energy in cell division and elongation. Harjadi (2009) stated that the availability of water greatly affects the growth of plant height and the development of meristem tissues at the point of plant growth. [15] The application of 2000 ml of water per day per plant on the Tenera DxP Marihat variety showed the highest increase in height compared to the Tenera DxP Topaz 3 variety and the Tenera DxP Socfindo Lame variety at 2500 ml of water per day per plant. This shows that the Tenera DxP Marihat variety still showed a good increase in plant height when the amount of water was reduced by 500 ml, compared to the other two varieties. The difference in height gain of the three varieties of oil palm seedlings is thought to be influenced by the genetic characteristics of each variety of oil palm seedlings. Differences in genetic traits can cause variations in plant appearance. Genetic traits can be expressed in various plant traits that include plant forms and functions that produce plant growth diversity.

4.4. Increase the number of leaves

Table 4 shows that the application of several volumes of water significantly increased the number of leaves of the three oil palm varieties. The application of 2500 ml of water per day per plant on the Tenera DxP Marihat variety showed the highest increase in the number of leaves, namely 9.67 strands which was not significantly different from the provision of 2000 ml per day per plant and significantly different from the provision of 1000 - 1500 ml of water per day per plant. [16] The Tenera DxP Topaz 3 variety with a volume of 2500 ml of water per day per plant showed the highest increase in the number of leaves, namely 9.66 leaves, which was significantly different with the addition of 1000-2000 ml per day per plant. The application of 2500 ml of water per day per plant on the Tenera DxP Socfindo Lame variety showed the highest increase in the number of leaves, namely 7.34 strands, which was significantly different from the provision of 1000 - 2000 ml per day per plant. [17] This indicates that the availability of water will affect the number of leaves. According to Soemartono (1990), water is needed by plants in physiological processes including cell division and the process of leaf formation. Firda (2009) added that plants that are able to produce higher photosynthate will have many leaves, because the photosynthate results will be used to form plant organs such as leaves and stems.

4.5. Increase in hump diameter

Table 5 shows that the application of several volumes of water significantly increased the increase in the diameter of the oil palm seedling. The application of 2500 ml of water per day per plant on the Tenera DxP Marihat variety showed

the largest increase in weed diameter, which was 4.29 cm, which was not significantly different from giving 2000 ml per day per plant and significantly different from giving 1000-1500 ml per day per plant in the varieties with same. [18] Provision of water volume of 2500 ml per day per plant on the Tenera Topaz 3 variety showed the largest increase in wee diameter of 3.13 cm which was significantly different from giving 1000 ml per day per plant and not significantly different from giving 1500 - 2000 ml per day per plant. . The Tenera DxP Socfindo Lame variety with a water volume of 2500 ml per day per plant showed the largest increase in diameter, namely 2.75 cm which was not significantly different from giving 1000 - 2000 ml per day per plant. [19] The availability of water in plants will support the smooth process of plant metabolism. The role of water is as a means of plant transportation, regulating plant turgidity, transpiration, solvent, as a basic material for the formation of glucose from photosynthetic activity. The increase in the diameter of the hump is closely related to the high rate of photosynthesis (Table 1) and leaf area (Table 2). will increase. Photosynthate produced by plants in the leaves will be translocated to parts of the plant that need it, including the plant stem (bulk) which is a sink. Cell division, cell elongation, and cell differentiation are three important processes associated with the vegetative phase (Handoko and Rizki, 2020).

4.6. Wet weight

Table 6 shows that the application of several volumes of water significantly increased the wet weight of the three oil palm varieties. The application of 2500 ml of water per day per plant on the Tenera DxP Marihat variety showed the highest wet weight of 1470 g which was significantly different from the provision of 1000 - 1500 ml per day per plant and was not significantly different from the application of 2000 ml per day per plant. [20] The Tenera DxP Topaz 3 variety with 2500 ml of water per day per plant showed the largest wet weight of 1181.70 g which was not significantly different from 1000 - 2000 ml per day per plant. The application of 2500 ml of water per day per plant on the Tenera DxP Socfindo Lame variety showed the largest wet weight of 973.30, which was not significantly different from the provision of 1000 - 2000 ml per day per plant. This shows that the difference in the level of water availability affects the wet weight of the plant. Suraya (2002) stated that the wet weight of the plant is one indicator of plant growth, where a high value of the wet weight of the plant indicates an increase in the photosynthetic process because the required nutrients are sufficiently available. [21] The application of 2000 ml of water per day per plant for the Tenera DxP Marihat variety still showed a high wet weight compared to the Tenera DxP Topaz 3 variety and the Tenera DxP Socfindo Lame variety with 2500 ml per day per plant. This indicated that the Tenera DxP Marihat variety still showed high wet weight when the amount of water was reduced by 500 ml per day per plant. The difference in wet weight in each variety can be caused by genetic factors in each variety.

4.7. Volume of plant roots

Table 7 shows that the application of several volumes of water significantly increased the root volume of the plant. The administration of 2000 ml of water per day per plant and 2500 ml per day per plant on the Tenera DxP Marihat variety showed the highest root volume of 299.33 ml which was significantly different from the administration of 1000-1500 ml per day per plant and was not significantly different from the administration of 2000 ml. per day per plant. [22] The application of 2500 ml of water per day per plant on the Tenera DxP Topaz 3 variety showed the highest root volume of 239.33 ml which was not significantly different from the administration of 1000 - 2000 ml per day per plant. The Tenera DxP Socfindo Lame variety with 2500 ml of water per day per plant showed the highest root volume of 159.33 ml which was significantly different from 1000-2000 ml per day per plant. [23] This shows that water is an important component to increase root volume, if the available water is less then the root volume will also be disturbed. Taiz and Zeiger (2002) stated that the limited amount of water causes stunted root development, thus interfering with the absorption of nutrients and water by plant roots. The imbalance between water absorption by roots and water loss due to transpiration causes the rate of water and nutrient transport to decrease and causes a decrease in root volume in oil palm seedlings. [24] The root system of plants is better at sufficient water content. According to Salisbury and Ross (1995) that the availability of sufficient ground water for plant life will lead to the availability of nutrients for plants because water serves as a carrier of nutrients from the soil to plants. When there is a shortage of water, the process of transporting nutrients from the soil to the plants is disrupted.

4.8. Root crown ratio

Table 8 shows that the application of several volumes of water significantly increased the root crown ratio of the three oil palm varieties. The application of 2500 ml of water per day per plant on the Tenera DxP Marihat variety showed the highest root crown ratio of 11.82 which was significantly different from the provision of 1000 - 2000 ml per day per plant. The Tenera DxP Topaz 3 variety with 2500 ml of water per day per plant showed the highest root crown ratio of 9.74 which was not significantly different from 1000 - 2000 ml per day per plant. [25] The application of 2500 ml of water per day per plant on the Tenera DxP Socfindo Lame variety showed the highest root crown ratio of 8.98 which was not significantly different from the application of 1000 - 2000 ml per day per plant. This shows that the available

water can dissolve nutrients that can be utilized by plants to produce photosynthate in forming plant organs such as leaves and roots. The root crown ratio describes the proportion of photosynthetic division between the crown and the roots. [26] The value of the root crown ratio in each treatment in this study was more than 1, meaning that the proportion of photosynthate was more to the shoot than to the root. According to Ariyanti et al. (2018) Plants in the canopy tend to transmit photosynthate to the top of the plant, because these plants require more energy to grow supporting vegetative organs when entering the generative phase. Suardi (2002) stated that the availability of water will affect the canopy and roots, where the lower the availability of water, the ratio of crown and roots will decrease.

4.9. Seed quality index

Table 9 shows that the application of several volumes of water shows a fairly good effect on the quality index of oil palm seeds. The application of 2500 ml of water per day per plant on the Tenera DxP Marihat variety showed a good seed quality index of 44.21 which was not significantly different from the provision of 1000 - 2000 ml per day per plant. The Tenera DxP Topaz 3 variety with 2000 ml of water per day per plant showed a good seed quality index of 41.16 which was not significantly different from 1000 - 1500 ml and 2500 ml per day per plant. [27] The provision of 2500 ml of water per day per plant on the Tenera DxP Socfindo Lame variety showed a good seed quality index of 31.85 which was not significantly different from the administration of 1000 - 2000 ml per day per plant. and overall did not show a significant difference. The seed quality index in the treatment of giving volume of water to the three varieties of oil palm has met the requirements for a high level of resistance to be transferred to the field, because the value is above 0.09. [28] Based on research Sari (2021) reported that the seed quality index of oil palm seedlings at the age of 10 months was 14. This was due to the fact that the provision of water to plants was in accordance with the actual water needs of the plant, because lack or excess of water had an adverse effect on plants. According to Leopold and Kriedemann (2003), water is an important factor for plants, acting as a raw material for the photosynthesis process, as a solvent, and as a maintainer of plant turgor. Oil palm varieties showed different seed quality index between the three varieties. The difference in seed quality index for each variety can be caused by genetic factors in each variety.

5. Conclusion

Based on the research results obtained, it can be concluded as follows.

- Provision of several volumes of water significantly affected the growth of the three varieties of oil palm seedlings aged 8-14 months in the main nursery.
- Giving 2500 ml of water to the three varieties of oil palm gave good growth on all parameters observed.
- The provision of 2000 ml of water per day per plant is the minimum amount of water required for optimal growth by oil palm seedlings in the main nursery phase.
- The Tenera DxP Marihat variety showed a good response compared to the Tenera DxP Topaz 3 variety and the DxP Tenera Socfindo Lame variety to water application because the DxP Marihat variety still showed high growth in all parameters with reduced water supply conditions by 500 ml per day per plant.

Compliance with ethical standards

Disclosure of conflict of interest

All authors declare there is no conflict of interest in this paper.

References

[1] Ansyah, A. 2019. The response of three varieties of oil palm (Elaeis guineesis Jacq.) in the main nursery to the application of water volume. Thesis (Unpublished). Faculty of Agriculture, University of Riau. Pekanbaru.

[2] Ariyanti, M., C. Suherman, S. Rosniawaty, and A. Franscyscus. 2018. Effect of volume and frequency of rice washing water on the growth of rubber plant seeds (Hevea brasiliensis Muell.) GT 1 clone. Scientific Journal of Agriculture. 6(2): 114-123.

[3] Plantation Fund Management Agency. 2018. https://www.bpdp.or.id/id/. Retrieved 01 January 2020.

[4] Central Bureau of Statistics. 2020. Indonesian Palm Oil Statistics. Indonesian Central Statistics Agency. Jakarta.

[5] Dartius. 1991. Fundamentals of Plant Physiology. USU Press. Medan.Dickson. A, A.L. Leaf, dan J.F. Hosner. 1960. Quality Appraisal of White Spruce and White Pine Seedling Stock in Nurseries. Forest Chronicle, 36, 10-13.

[6] Directorate of Seeds. 2004. Information on Oil Palm Plantation Seeds. Directorate General of Plantation Production Development. Jakarta.

[7] Dwiyana, SR., Sampoerno, Ardian. 2015. Time and volume of water supply to oil palm (Elaeis Guineensis Jacq) seedlings in the main nursery. Faculty of Agriculture, University of Riau. Pekanbaru.

[8] Effendi, R. 2009. Methods and characters of maize genotype tolerance selection against drought stress. Thesis (Unpublished). FMIPA. Bogor.

[9] Effendi, R and A. Widanarko. 2011. Palm Oil Smart Book. Agromedia Library. Jakarta.

[10] Fitter, A. H and R. K. M. Hay. 1991. Environmental Physiology of Plants. (translated Andini, S. and E. D. Purbayanti from Ecvironmental Physiology of plants). Gajah Mada University Press. Yogyakarta.

[11] Firda, Y. 2009. Response of soybean (Glycine max (L.) Merril) to stress of water shortage and potassium fertilization. Thesis (Unpublished). Faculty of Agriculture, University of Riau. Pekanbaru.

[12] Hamdani, J. S. 2009. Effect of mulch type on growth and yield of three potato cultivars (Solanum tuberosum L.) grown in medium plains. J. Agron. Indonesia. 37(1):14 – 20.

[13] Hanafiah, K. A. 2007. Fundamentals of Soil Science. Rajawali Press. Jakarta.

[14] Handoko, A and A. M. Rizki. 2020. Plant Physiology. UIN Raden Intan Lampung. Lampung.

[15] Harjadi, S.S. 2009. Introduction to Agronomy. grammar. Jakarta.

[16] Hidayat T.C., I.Y. Harahap, Y. Pangaribuan, Rahutomo, W.A. Harsanto, and W.R. Fauzi. 2013. Water and Palm Oil. Popular Oil Palm Series 12. Palm Oil Research Center.

[17] Jumin, H. B. 2002. Plant Ecophysiology A Physiological Approach. Rajawali Press. Jakarta.

[18] Ministry of Agriculture, 2004. Release of DP Socfindo Oil Palm Varieties as Superior Varieties. Minister of Agriculture No. 440/Kpts/LB. 320/7/2004: Jakarta.

[19] Lakitan. 2001. Physiology of Plant Growth and Development. Rajawali Press. Jakarta.

[20] Lakitan. 2013. Fundamentals of Plant Physiology. King Grafindo Persada. Jakarta.

[21] Leopold AC and P.E. Kriedemann. 2003. Plant Growth and Development. 2nd Edition Translation. University of Agriculture Malaysia. Serdang. Selangor.

[22] Lubis, A.U. 2008. Oil palm (Elaeis guineensis Jacq.) in Indonesia (2nd Edition). Palm Oil Research Center. Medan.

[23] Mangoensoekarjo, S and H. Semangun. 2005. Palm Oil Agribusiness Management. Gadjah Mada University Press. Yogyakarta.

[24] Noor, M. 2010. Strategies for using peatlands for sustainable agricultural development. Center for Research and Development of Agricultural Land Resources. Bogor. J. Agricultural Innovation Development 2(4):295-298.

[25] Pahan, 2012. Complete Guide to Palm Oil. Self-Help Spreader. Jakarta.

[26] Pangaribuan, Y. 2001. Study of morphological characters of oil palm plants in nurseries against drought stress. Thesis (Unpublished). Bogor Agricultural Institute. Bogor.

[27] Prawiratna, W. S and H. P. Tjondronegoro. 1995. Fundamentals of plant physiology II. Faculty of Agriculture, Bogor Agricultural University. Bogor.

[28] Palm Oil Research Center. 2009. Oil Palm Nurseries. Palm Oil Research Center. Medan.

[29] Raisawati, T. 2006. The Problem of Oil Palm Seeds. Infotama Media. 1(3) :40-46.

[30] Ruchjaningsih, A., Imran, M. Thamrin., and M.Z. Kanro, 2000. Phenotypic Appearance and Some Genetic Parameters of Eight Peanut Cultivars in Rice Fields. Zuriat Communications Breeding Indonesia Jatinangor, Sumedang.

[31] Salisbury, F.B. and C.W. Ross. 1995. Plant Physiology Volume I. Fourth Edition. ITB Publisher. Bandung.

[32] Sarawa and A.R. Baco. 2014. Photosynthate partitioning of several soybean cultivars Glicine max. (L.) Merr.) on ultisols. J. Agrotechnos. 4(3): 152-159.

[33] Sari, M. 2021. Growth of Oil Palm Seeds (Elaeis guineensis Jacq.) Under Hypoxic Conditions Given Leaf Fertilizer and Growth Regulators. Thesis (Unpublished). Faculty of Agriculture, University of Riau. Pekanbaru.

[34] Sastrosayono, 2003. Cultivation of Oil Palm Plants. Faculty of Agriculture, Gadjah Mada University. Yogyakarta.

[35] Setyani, Y.H., S. Anwar, and W. Slamet. 2013. Photosynthetic characteristics and phosphorus uptake of alfalfa forage (Medicago sativa) at different cutting heights and nitrogen fertilization. Journal of Animal Agriculture. 2(1): 86-96.

[36] Sitompul, S.M and B. Guritno. 1995. Plant Growth Analysis. Gadjah Mada University Press, Yogyakarta.

[37] Suardi, D.K. 2002. Rice Rooting in Relation to Plant Tolerance to Drought. Agricultural R&D Journal.21(3).

[38] Suhartono. 2008. Effect of water application interval on growth and yield of soybean (Glycine max (L) Merril) on various soil types. J. Embryo. Vol, 5 (1):108.

[39] Soemartono, A.S. 1990. Quantitative Genetics and Molecular Biology. PAU-UGM.Yogyakarta.

[40] Sunarko. 2014. Cultivation and Processing of Oil Palm. Agromedia Library. Jakarta.

[41] Suraya (2002). The effect of the combination of p fertilizer and compost on the growth of tea plants (Camellia sinensis (L.) O. Kuntze) has not yet produced a gambang clone 7. Research Report of UNPAD Young Researchers. PPTK Join.

[42] Syahputra, E. 2011. Weeds Assessment in peatland oil palm plantations. J. Tech. Plantation & PSDL 1, (1):37-42.

[43] Taiz, L. and E. Zeiger. 2002. Plant Physiology. Third edition. Sinauer Associates. Sunderland. 33-67 pp.

[44] Tjitrosomono, H. S. S. 1990. General Botany 2. Angkasa. Bandung.

[45] Wardiana, E and Z. Mahmud, 2003. Intercropping between oil palm plantations. Plantation Interplant Research Workshop. Horse Parrot. West Java.