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The application of a Combination of Coconut Water and a Growth Regulator as (Effective Microorganisms) for Boosting Arabica Coffee Seedlings' Growth

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ABSTRACT

The objective of the study was to obtain information regarding the effects of adding an accurate dosage of coconut water and EM4 mixture to Arabica coffee seedlings' growth. The research design used was a completely randomized design, which comprised of two factors and five repetitions. Of the two factors, the first factor comprised of treatment with coconut water (K1) and without coconut water (K2), while the second factor involved the application of dosages of EM4, whereby E1 for 0 ml dosage, E2 for 5ml dosage, E3 for 10 ml dosage, and E4 for 15 ml dosage. The observation results were analyzed using ANOVA (Analysis of Variance). Upon finding a real difference between treatments. The findings show that there were increases in growth rate, the number of leaves, and canopy width in sample plants treated with coconut water and Effective Microorganisms at 15ml dosage, which was not significantly different from the results obtained in sample plants treated with coconut water and Effective Microorganisms at 5 ml dosage. However, observation of destructive effects, which is indicated by plant total weight, root weight, root length, and leaf width, shows that there was no difference between sample plant treated with no coconut water and 15ml Effective Microorganisms and sample plant treated with coconut water and 15ml Effective Microorganisms.

Keywords *: Growth regulator, Effective Microorganisms, Coconut water, Arabica coffee seedlings*

Introduction

Coffee is one of the most important commodities in the world, whereby Brazil, Vietnam, and Columbia have become the three biggest producers of this plant. Additionally, it is the main export commodity for countries, such as Uganda, Burundi, Rwanda, and Ethiopia. On a larger scale, international coffee trading involves around 500 million individuals, managing various aspects of production, starting from cultivation to consumption (Da Matta, 2007). Based on the statistical data published in 2019, the Indonesian coffee export volume has been fluctuating in the past nine years, ranging from (-) 40.15 percent to 12.82 percent. In 2011 the total export volume reached 346.49 thousand tons, amounting to US$ 1036.67 million in value, followed by a growth in 2013, reaching 534.02 tons and a total value of US$ 1200 million. In 2019, the export value dropped significantly to 359.05 thousand tons or equal to US$ 883.12 million worth of an export commodity.

Since coffee benefits from constant supplies of minerals, effective fertilization methods (type, dosage, time, and technique) will result in economical,

technical, social, and environmental benefits. Sabihan and Anas (2000) indicated that proper fertilization recommendation which complements the soil fertility status is important considering that inaccurate application of fertilizer and ratio (such as Nitrogen, Phosphorous, and Potassium) which is done in a long run will result in the decrease of mineral contents in the soil, such as Ca, Mn, S, Cu and Zn (Adnyana, 2011). Reflecting on the global coffee demand, there needs to be an awareness from farmers so that coffee cultivation can become sustainable without affecting the environment for a better future. While farmers' awareness of better practices in cultivation technique and soil management which aims to improve the production means have been raised, the increase of coffee production is not complemented with the awareness of reducing the use of chemical fertilizers which affects the quality of soil (Martins *et al*., 2015).

The application of a growth regulator can speed up the process of root growth and germination because physiologically the compound can increase the growth rate (Manurung *et al.,* 2017). Furthermore, Yeni and Sularno (2019) stated that there are natural and chemical growth regulators. One type of natural growth regulator is coconut water, which can boost the growth of plants and speed up the growth of seedlings (Manurung *et al.,* 2017)

The application of coconut water as fertilizing compound can help improve the growth of coffee seeds. Kiral (2019) suggested that coconut water contains a high Potassium level, whereby 240 ml coconut water contains 600mg Potassium. Potassium is an important macro primer mineral, along with Nitrogen and Phosphorous, which is needed for plants in a large quantity. Furthermore, coconut water is an endosperm liquid that contains bioactive compounds. Coconut water also contains a unique chemical composition that includes minerals, vitamins, sugar, amino acid, phytohormones, which all have significant effects on plant growth (Darlina *et al*., 2016). Moreover, coconut water contains a large number of cytokinins hormones, in addition to auxin and gibberellin hormones and abscisic acid in a small quantity. All of the four hormones are commonly found in growth regulators for plants (Kiral, 2019). Since coconut water contains minerals and phytohormone, this natural ingredient has the potential to be applied to coffee vegetative growth to fulfill the function of efficient mineral absorption.

Effective Microorganisms (EM4) is a type of soil biological compound that functions as a booster for the decomposition process of organic matters due to its lactate bacteria content which can ferment organic matters to be absorbed by plant roots. The use of Effective Microorganisms can increase the production of and can balance the soil microorganism composition (Fitria *et al.,* 2017). Additionally, Effective Microorganisms can increase the decomposition rate of waste and organic matters, increase the availability of nutrients, suppress pest and pathogenic microorganism growth, and speed up the decomposition process (Rahmah *et al.,* 2013).

Decomposition can be conducted conventionally using Effective Microorganisms, which is biologically controlled so that organic matters in an aerobic state (containing oxygen) or in an anaerobic state (not containing oxygen) are changed to become similar to soil (Ekawandani and Arini, 2018). However, until this paper is written, research on the effect of coconut water and Effective Microorganisms to boost the growth of Arabica coffee seeds has never been conducted.

Research Methodology

The study was conducted at the plantation belonging to the Assessment Institute of Agricultural Technology (BPTP) of East Java in Kepuharjo, Karangploso district, for 3 months (November, 15th 2015 to May, 28th 2016). The pieces of equipment used in the study were a cellphone camera, measuring device, bucket, calculator, measuring tape, measuring glass, oven, digital measuring device, brown envelopes, labeling paper, and stationery. The materials were soil and fertilizer, polybag, Arabica coffee seedlings which were 6 months old from the seed planting time and had two to three leaves in a polybag, coconut water, distilled water, Effective Microorganisms as a growth regulator, urea, NPP, and Antracol fungicide. Initially, 500 ml coconut water was mixed into 500 ml water in a bucket and then poured into five separate sample plants. Next, three different dosages of Effective Microorganisms (5 ml, 10 ml, and 15 ml) were added to a 500 ml coconut water mixture in each measuring glass and then poured into the five sample plants. There were forty (40) plants that were given the mixtures.

This study employed a completely randomized design factorial as the experiment design, employing two factors and five repetitions, as follows.

The first factor is adding coconut water;
K0 = without coconut water;
K1 = adding coconut water
The second factor is Effective Microorganisms (EM4) dosages (E), which are:
E1= 0 ml;
E2= 5 ml;
E3= 10 ml;
E4= 15 ml.

The observations of the plant growth were conducted every 2 weeks (week 26, 28, 30, 32, 34, and 36 weeks after the planting period). The observation included measuring the growth parameters, such as plant height, number of leaves, canopy width, and destructive observation, which included the plant's total dry weight (g), plant root dry weight (g), root length (cm), and leaf width (cm^2). The results of the observation were analyzed for variance using ANOVA. After a real difference was found, the test continued with DMRT (Duncan Multiple Range Test) at a 5% level of trust. The data analysis was calculated using DSTAAT A NEW EXCEL VBA macro software.

Results and Discussion

Based on the results of variance analysis, there was no interaction between the treatment of adding coconut water and Effective Microorganisms against the height of the coffee plant, starting from the first observation (26 weeks) up to the sixth observation (36 weeks after planting). Table 1 indicates that there was no effect caused by applying coconut water on the height growth of the plant, starting from the first observation up to the sixth. However, adding Effective Microorganisms affected the height of the plant.

Based on the first, second, third, and fourth observations, the treatment of adding 10ml EM4 also did not show a significant difference with the treatment of adding 15 ml Effective Microorganisms. At the fifth observation, there was no significant difference between treatments of adding Effective Microorganisms. At the sixth observation, however, higher height growth was observed in plants with the treatment of adding 15 ml Effective Microorganisms compared to plants without Effective Microorganisms and plants with the treatment of adding 5ml Effective Microorganisms. Effective Microorganisms activator contains varieties of beneficial microorganisms such as yeast, *Lactobacillus* sp., phosphate solvent bacteria, and *Azospirillum* sp. These microorganisms actively modulate other microorganisms in the soil that can help improve soil fertility. *Azospirillum* sp. is a type of bacterium that can be found in the root and multiplies especially in the root and reed (Nuryatin *et al.*, 2018), resulting in the stimulation of roots in absorbing the minerals that can significantly boost the plant's height growth.

The results of variance analysis shows that there was an interaction between a plant with the treatment of adding coconut water and Effective Microorganisms and the number of leaves, starting from the first observation (week 26 after planting). In the first observation, adding coconut water and 5 ml Effective Microorganisms resulted in a higher number of leaves and it was not significantly different with the treatments of adding 10 ml Effective Microorganisms and 15 ml Effective Microorganisms. Regarding the average number of coffee seedling

Table 1. Averages of coffee seedling height

Treatment	TT 1	TT 2	TT 3	TT 4	TT 5	TT 6
Adding Coconut Water						
K0 (Without Coconut Water)	15,79	17,92	15,65	17,36	18,47	18,88
K1 (Adding Coconut Water)	17,36	15,64	16,8	17,92	18,85	19,58
LSD (5%)	tn	tn	tn	tn	tn	tn
Dosage of Effective Microorganisms (EM4) (E)						
E1 = 0 ml	15,01 a	15,9 ab	14,92 a	16,68 ab	19,41	19,19 a
E2 = 5 ml	13,56 a	13,82 a	13,65 a	14,93 a	15,78	16,62 a
E3 = 10 ml	18,39 b	18,46 b	17,57 b	18,48 bc	17,84	18,52 a
E4 = 15 ml	19,34 b	18,94 b	18,77 b	20,48 c	21,62	22,59 b
LSD (5%)	2,94	3,98	2,51	2,87	tn	2,97

Notes: Nominals that are accompanied by a similar character in the same column show no significant difference based on the LSD test at a 5% trust level. LSD= Least Significant Difference; CV= Coefficient Variance, ns = not significant

leaves treated with the addition of coconut water, the number of leaves in the plant with the treatment of adding coconut water was higher than the plant without coconut water treatment. From the second to the fifth observation, it can be seen that the addition of coconut water and 5 ml Effective Microorganisms in coffee seedlings resulted in a higher number of leaves and it was not significantly different with coffee seedlings with the treatment of adding 10 ml and 15 ml Effective Microorganisms. This shows that the addition of coconut water and 5 ml is already sufficient to increase the number of leaves (results are similar with adding 10 ml or 15 ml Effective Microorganisms). On the other hand, plants treated with 15 ml Effective Microorganisms and no addition of coconut water showed similar results. Muslimah *et al.* (2016) claimed that coconut water contains sugar, alcoholic sugar, organic acid, vitamin, phytohormones, amino acids, and other inorganic elements, in addition to other growth regulator substances such as cytokinin, auxin, and gibberellin (Saefas *et al*., 2017). Furthermore, Nurhasanah (2020) also suggested that Effective Microorganisms contains microorganisms that are beneficial for plants because they can boost growth and increase the population of microorganisms. Additionally, Effective Microorganisms have the properties to speed up the decomposition of wastes and functions as a bio activator against liquid fertilizer production (Marlinda, 2015). Adding coconut water and 5ml Effective Microorganisms was sufficient to increase the number of leaves (resulting in the same results as adding 15 ml Effective Microorganisms). This is because growth regulators as biostimulants can speed up the plant absorption that stimulates the protoplasmic flow and speeds up germination and root growth, resulting in the increased speed of the tissue development biochemically, including the growth of stem and leaves (Intan *et al.*, 2020). During the sixth observation, the number of leaves in plants treated with coconut water and 5ml and plants treated with adding 15 ml Effective Microorganisms (with and without coconut water) produced more leaves and it did not show a significant difference to seedlings treated with coconut water and no Em4 and seedlings treated with 10 ml Effective Microor-

Table 2. Total leaves in coffee seedlings

Treatment	E1 (0 ml)	E2 (5 ml)	E3 (10 ml)	E4 (15)
Observation I				
K0 (without coconut water)	9,6 bcdA	7,0 abA	5,6 aA	8,4 bcA
K1 (adding coconut water)	7,4 abA	11,8 dB	10,2 cdB	11 cdB
LSD (5%) = 2,56 CV (%) = 22,39				
Observation II				
K0 (without coconut water)	7,2 aA	6,8 aA	6,8 aA	9,6 abA
K1 (adding coconut water)	9,4 abA	11,8 bB	9,4 abA	11,4 bA
LSD (5%) = 3,37 CV (%) = 28,97				
Observation III				
K0 (without coconut water)	10 bcA	7,0 aA	7,0 aA	9,6 bcA
K1 (adding coconut water)	8,4 abA	11,4 cB	9,2 abcB	11,0 cA
LSD (5%) = 2,19 CV (%) = 18,47				
Observation IV				
K0 (without coconut water)	10,6 cA	7,0 aA	7,2 abA	10 bcA
K1 (adding coconut water)	9,6 abcA	11,6 cB	9,4 abcA	10,4 cA
LSD (5%) = 2,66 CV (%) = 21,82				
Observation V				
K0 (without coconut water)	9,8 dB	7,6 bA	7,0 aA	10,2 dA
K1 (adding coconut water)	8,4 bcA	12,4 eB	9,4 cdB	10,4 dA
LSD (5%) = 1,1 CV (%) = 9,14				
Observation VI				
K0 (without coconut water)	11,4 bA	7,4 aA	8,4 abA	11,2 bA
K1 (adding coconut water)	9,4 abA	11,6 b B	10 abA	11,2 bA
LSD (5%) = 2,8 CV (%) = 21,6				

Notes: Nominals that are accompanied by a similar character in the same column show no significant difference based on the LSD test at a 5% trust level. LSD= Least Significant Difference; CV= Coefficient Variance, ns = not significant

ganisms and without coconut water.

The results of the variance analysis show that there was an interaction between plants treated with coconut water and Effective Microorganisms and the width of the canopy, starting at the first observation (week 26 after planting) up to the sixth observation (week 36 after planting) (Table 3). From the first observation to the third observation, treatment of adding coconut water and Effective Microorganisms resulted in increased canopy width and it was not significantly different with the treatment of adding 5ml Effective Microorganisms and coconut water and treatment of adding 10 ml Effective Microorganisms and addition of coconut water and without the addition of coconut water. The effects were not visible since coconut water and Effective Microorganisms are natural organic matters. The canopy width of plants treated with the addition of coconut water with no Effective Microorganisms resulted in wider canopy width compared to plants treated without coconut water and Effective Microorganisms. At the fourth, fifth, and sixth observations, plants treated with 15 ml Effective Microorganisms and no coconut water resulted in canopy width which was not significantly different from the canopy width of plants treated with coconut water and without Effective Microorganisms. The treatment that resulted in the smallest canopy width was the treatment of adding 10 ml Effective Microorganisms and no coconut water, which was not significantly different, as well with the control treatment (no treatment) and treatment of adding 5 ml EM4 and 10ml Effective Microorganisms without coconut water.

Table 4 illustrates the results of destructive measurements of the coffee seedlings. There was an interaction between the treatment of adding coconut water and the treatment of adding Effective Microorganisms. The average leaf width at week 36 after planting shows that treatment of adding coconut water and no Effective Microorganisms resulted in high leaf width and it was not significantly different from the treatment of adding 15 ml Effective Microorganisms and no coconut water and treatment of adding coconut water and 10 ml Effective Microorganisms. The leaf is an important organ involved in

Table 3. The averages of canopy width

Treatment	E1 (0 ml)	E2 (5 ml)	E3 (10 ml)	E4 (15ml)
Observation 1				
K0 (without coconut water)	73,4 abA	132 cdA	79,4 abcA	129 cdA
K1 (adding coconut water)	143 dB	99 bcdA	45,2 aA	104 bcdA
LSD (5%) = 48,38 CV (%) = 37,32				
Observation II				
K0 (without coconut water)	109,22 abA	200,3 dA	119,6 abcA	196 cdA
K1 (adding coconut water)	217,62 dB	151,16 bcdA	66,34 aA	158,5 bcdA
LSD (5%) = 72,74 CV (%) = 37,06				
Observation III				
K0 (without coconut water)	117,21 aA	164,392 abA	130,5 aA	232,48 cA
K1 (adding coconut water)	163,75 abB	200,02 bcA	129,84 aA	237,908 cA
LSD (5%) = 45,46 CV (%) = 21,87				
Observation IV				
K0 (without coconut water)	146,78 aA	201,36 abA	156,41 aA	299,43 cB
K1 (adding coconut water)	243,34 bcB	205,9 abA	180,34 abA	192,64 abA
LSD (5%) = 58,84 CV (%) = 22,47				
Observation V				
K0 (without coconut water)	184,06 abA	160,9 aA	178,77 abA	351,82 cB
K1 (adding coconut water)	383,64 cB	229,63 bB	202,94 abA	217,11 abA
LSD (5%) = 58,92 CV (%) = 19,17				
Observation VI				
K0 (without coconut water)	174,04 abA	185,15 abcA	160,59 aA	394,91 dB
K1 (adding coconut water)	462,78 dB	230,05 abcA	253,7 cB	239,02 bcA
BNT (5%) = 67,28 CV (%) = 19,89				

Notes: Nominals that are accompanied by a similar character in the same column show no significant difference based on the LSD test at a 5% trust level. LSD= Least Significant Difference; CV= Coefficient Variance, ns = not significant

Table 4. The averages of leaf width, root length, root dry weight, and total dry weight

Treatment	E1 (0 ml)	E2 (5 ml)	E3 (10 ml)	E4 (15)
Leaf width Observation				
K0 (without coconut water)	19,98 aA	23,2 abA	31,5 cdA	41,4 efB
K1 (adding coconut water)	43,68 fB	27,2 bcA	36,1 deA	28,9 bcA
LSD (5%) = 5,92 CV (%) = 14,6				
The root length Observation				
K0 (without coconut water)	13,5 aA	13,7 aA	14,6 aA	17,1 abA
K1 (adding coconut water)	19 bB	19 bB	23 cB	23,8 cB
LSD (5%) = 3,36 CV (%) = 14,52				
The root dry weight Observation				
K0 (without coconut water)	0,6 aA	1,35 abA	0,43 aA	3,0 cA
K1 (adding coconut water)	0,92 aA	3,0 cB	2,0 bB	4,0 cB
LSD (5%) = 0,6 CV (%) = 36,26				
Total dry weight Observation				
K0 (without coconut water)	5,0 abcA	5,0 abcA	3,0 aA	10 eA
K1 (adding coconut water)	7,0 bdB	9,0 deB	8,0 deB	9,0 deA
LSD (5%) =1,95 CV (%) = 21,72				

Notes: Nominals that are accompanied by a similar character in the same column show no significant difference based on the LSD test at a 5% trust level. LSD= Least Significant Difference; CV= Coefficient Variance, ns = not significant

the photosynthesis process. Some dicotyledonous plants have a blade and stem, whereby a leaf forms a primordium at the tip of apical meristem which is caused by auxin hormone in the plant. Apical meristem grows bigger when cells split (Hafsan *et al.*, 2018). The addition of thiamin causes a maximum callus growth, causing the root and bud to grow, and also functions as the cofactor of enzymatic reaction (Abrahamian and Kantharajah, 2011). The addition is necessary especially when the cytokinin level on the soil is low. Cytokinin deficiency impedes cell division and shoots development and proliferation (Hussain *et al.*, 2012). Coconut water is one of the natural sources of cytokinin and contains 1.3 diphenyl urea, zeatinglucoside, and zeatinriboside. Zeatinglucoside and zeatinriboside are active cytokinins (Mutryarny, 2007).

There was an interaction between the treatment of adding coconut water and Effective Microorganisms against the changes in root length. Treatment of adding coconut water and 10 ml Effective Microorganisms was not significantly different and resulted in root length which was not significantly different with the treatment of adding coconut water and 15ml EM4. Following that, the treatment of adding coconut water and 5ml Effective Microorganisms which was not different from the treatment of adding coconut water and no Effective Microorganisms. Treatments of no coconut water and 5ml, 10 ml, or 15 ml Effective Microorganisms were not significantly different and resulted in shorter root lengths compared to the control treatment (no coconut and no Effective Microorganisms).

There was an interaction between the treatment of adding coconut water and Effective Microorganisms against the root dry weight. Treatment of adding coconut water and 5 ml Effective Microorganisms resulted in higher root dry weight and it was not significantly different with the treatment of adding coconut water and 15 ml Effective Microorganisms and treatment without coconut water and 15 ml EM4. Increased cytokinin level in the coconut water, altogether with the auxin, boosts cell division and tissue differentiation to develop bud and root. Additionally, cytokinin also stimulates the development of the lateral root (Fodhil, 2011).

There was an interaction between the treatment of adding coconut water and Effective Microorganisms and the total dry weight. Treatment of adding coconut water and 5 ml Effective Microorganisms resulted in higher total dry weight and it was not significantly different with the treatment of adding coconut water and 15 ml Effective Microorganisms and treatment of no coconut water and 15 ml Effective Microorganisms.

Conclusion

The results of the study show that there were increases in plant height, the number of leaves, and

canopy width resulting from the addition of coconut water and 15 ml Effective Microorganisms and it was not significantly different with the treatment of adding coconut water and 5 ml EM4. Meanwhile, in destructive observation, the plant total weight, root weight, root length, and leaf width show that treatment of coconut water and 15 ml Effective Microorganisms was not significantly different from the treatment of adding coconut water and 15 ml Effective Microorganisms.

References

Abrahamian, P. and Kantharajah, A. 2011. Effect of vitamins on in vitro organogenesis of plant. *American Journal of Plant Sciences.* 2 : 669-674. DOI: 10.4236/ajps.2011.25080.

Adnyana, I. M. 2011. Aplikasianjuranpemupukantanaman kopi berbasisujitanah di desa Bongancina Kabupaten Buleleng. *Udayana Mengabdi.* 10 (2): 64 – 66. https://ojs.unud.ac.id/index.php/jum/article/download/2098/1287.

Da Matta, F. M., Ronchi, C. P., Maestri, M. and Barros, R. S. 2007. Ecophysiology of coffee growth and production. *Braz. J. Plant Physiol*. 19(4) : 485-510. https://www.researchgate.net/publication/250024350_Ecophysiology_of_coffee_growth_and_production/link/0046352352eaf3af7c000000/download.

Darlina, Hasanuddin, and Hafnati Rahmatan. Pengaruh Penyiraman Air Kelapa (C*ocos nucifera* L.) Terhadap Pertumbuhan Vegetatif Lada (*Piper nigrum* L.) *Jurnal Ilmiah Mahasiswa Pendidikan Biologi.* 1 (1) : 20-28. https://media.neliti.com/media/publications/187137-ID-pengaruh-penyiraman-air-kelapa-cocos-nuc.pdf

Davies A.P., Govaerts R., Bridson D.M. and Stoffelen, 2006. An annotated taxonomic conspectus of genus Coffea (Rubiaceae). *Bot. J. Linn. Soc*. 152 : 465-512. https://www.researchgate.net/publication/272389_An_annotated_taxonomic_conspectus_of_genus_Coffea_Rubiaceae/link/5b31f6ffaca2720785e8562e/download

Ekawandani, N. and Arini Anzi Kusuma, 2018. Pengomposansampah organic (kubisdan kulitpisang) denganmenggunakan EM4. TEDC. 1 (2) : 38-43. https://ejournal. poltektedc. ac.id/index.php/tedc/article/view/129/91

Fassio, L. H. and Silva, A. E. S. 2007. Importância econômica e social do café conilon. In: Ferrão RG, Fonseca AFA, Bragança SM, Ferrão MAG, De Muner LH (eds), Café Conilon, pp.37-49. Seag/Incaper, Vitória. https://biblioteca.incaper.es.gov.br/digital/bitstream/item/694/1/livro2007cafeconilon1.pdf

Fitria, E. L., Sumiya, W., Yamika, D. and Santosa, M. 2017. Pengaruhbiourin, EM 4 danpupukterhada ppertumbuhandanhasilbawangmerah (*Allium ascalonicum* L.) Padakondisiternaungi. *Jurnal Produksi Tanaman.* 5 (3): 475 – 483. https://media.neliti.com/media/publications/190704-ID-pengaruh-biourin-em4-dan-pupuk-terhadap.pdf.

Fodhil. 2011. Pengaruhkonsentarsi air kelapapadapembibitantanamanbuahnaga. https://media.neliti.com/media/publications/200711-pengaruh-konsentrasi-air-kelapa-pada-pem.pdf

Hafsan, Muhammad KhalifahMustamib, Masrianya, IsnaRasdianah Aziza, danMustakim. 2018. The Utilization of Coconut Water Waste As a Growth Media of the *In vitro* Potato Cutting. Scientiae Educatia: *Jurnal Pendidikan Sains.* 7 (2) : 108-116. file:///ers/ASUS/Downloads/2636-10117-7-PB.pC:/Usdf.

Hussain, A., Qarshi, I. A., Nazir, H. and Ullah, I. 2012. Plant tissue culture: current status and opportunities, recent advances in plant in vitro culture, Dr. Annarita Leva (Ed.). In Tech. DOI: 10.5772/50568. Available online: https://mts.intechopen.com/books/recent-advancesin-plant-in-vitro-culture/plant-tissue-culture-current-status-and-opportun.

Intan Poespita Windiyani, Tundjung Tripeni Handayani, Zulkifli and Bambang Irawan, 2020. Coconut (*Cocos Nucifera* L) Water and Atonic Plant Growth Regulator Combination to Tomato (*Lycopersicum Esculentum* Mill.) Growth. *Jurnal Ilmiah Biologi Eksperimen dan Keanekaragaman Hayati.* 7(1) : 25-30. file:///C:/Users/ASUS/Downloads/2495-6047-1-PB%20(1).pdf. 2495-6047-1-PB (1).pdf.

Kiral. 2019. Menyiram Tanaman Dengan Air Kelapa. https://lombokorganik.id/menyiram-tanaman-dengan-air-kelapa/.

Manurung, D., Y. B. Swasono Heddydan D. Haryono. 2017. Pengaruhpemberian air kelapapada beberapaba tangatasterha dappertu mbuhan bibitkaret (*Heveabrasiliensis* Mueli Arg.) budding result. *J. Produksi Tanaman.* 5(4) : 6666-694. file:///D:/Tulisan%202021/kopi_air%20kelapa/air%20kelapa/air%ret%20jurnal%20prodtan.pdf20ke%20ka

Marlinda, 2015. Pengaruh Penambahan Bioaktivator EM4 dan Promi dalam Pembuatan Pupuk Cair Organik dari Sampah Organik Rumah Tangga. *Jurnal Konversi.* 4(2) : 30-35.

Martins, L. D., Lindomar de Souza Machado, Marcelo Antonio Tomazdan José Francisco Teixeira do Amaral. 2015. The nutritional efficiency of Coffea spp. A review. *Africant J. of Biotechnology.* 14 (9) : 728-734. www.researchgate.net/publication/273321062_The_nutritional_efficiency_of_Coffea_spp_A_review/link/54fe6f410cf2741b69f04569/download.

Mutryarny, Enny. 2007. Aplikasi air kelapamuda

dalammeningkat kanpertum buhanbibitpisang barangan (*Musa paradisiaca*). *Jurnal IlmiahPertanian.* 4 (1) : 42-53. file:///D:/Tulisan%202021/kopi_air%20kelapa/air%20kelapa/air%20kelapa%20ke%20bibit%20pisang.pdf

Muslimah, Y., Putra, I. and Diana, L. 2016. Pengaruh jenis dan konsentrasi zat pengatur tumbuh organik terhadap pertumbuhan stek lada (*Piper nigrum* L.) *Jurnal Agrotek Lestari*. 2(2): 27-36.http://jurnal.utu.ac.id/jagrotek/article/view/502.

Nurhasanah, S. 2020. Pengaruh Konsenstrasi EM-4 terhadap C/N Rasio Kompos Mata Lele (*Lemna* sp.). *Prosiding Seminar Nasional V 2019 Peran Pendidikan dalam Konservasi dan Pengelolaan Lingkungan Berkelanjutan* ISBN 978-602-5699-83-2; PUBLIKASI ONLINE 5 MARET 2020. 3605-8606-1-PB.pdf.

Nuryatin, M. Anshardan S. Anjar Lasmini, 2018. Pengaruhpermberian em4 dandosispu pukkan dangayamterha dappertumbuhan danhasiltana manselada (*Lactuca sativa* L.). The Effect of EM4 and ifDferent Rates of Chicken Manure on Growth and Yields of Lettuce (*Lactuca sativa* L.). *J. Agrotekbis.* 6 (5): 708–716. *Jurnal Nasionale-J.* Agrotekbis 65708716 Oktober2018.pdffile:///C:/Users/ASUS/Downloads/

Rahmah, A., Sipayung, R. and Simanungkalit, T. 2013. PertumbuhandanProduksi Bawang Merahdengan Pemberian Pupuk KandangAyamdan EM4. *J. Agroekoteknologi.* 1 (4): 952-963. https://media.neliti.com/media/publications/95606-ID-none.pdf.

Sabihan, S. and Anas, 2000. Perkembangan Ilmudalam Bidang Kimia, Biologidan Kesuburan Tanah. *Prosseding Kongres Nasionalke VII HITI Bandung*.

Saefas, S.A., Rosniawaty, S. and Maxiselly, Y. 2017. Pengaruh konsentrasi zat pengatur tumbuh alami dan sintetik terhadap pertumbuhan tanaman teh (*Camellia sinensis* (L.) O. Kuntze) Klon GMB 7 Setelah Centering. *Jurnal Kultivasi*. 6(2): 368-372. https://jurnal.unpad.ac.id/kultivasi/article/view/12591.

Statistik Kopi Indonesia. 2019. https://www.bps.go.id/publication/download. html?nrbvfeve= ZGUyN2VhZDdjM WM3Z TI5ZmQwYWE5NT Bk&xzmn=aHR0cHM6Ly93d3cuYnBzLmdvLmlkL3B1YmxpY2F0aW9u LzIwMjAvMTIvMDIvZGUyN2VhZDdjMWM3ZTI5ZmQwYWE5NTBkL3N0YXRpc3Rpay1rb3BpLWluZG9u ZXNpYS 0yMDE5Lmh0bWw%3 D&tw oadfnoarfeauf=MjAyMS0wNi0zMCAwNDoyNjo0NA%3D%3D.

Yeni Ramadhani Dongorandan Sularno. 2019. Efektifitas interval waktupemberian air kelapaterha dappertum buhanbibittanamankaret (*Haveabrasiliensis*). *J. Agrosainsdan Teknologi.* 4(2) : 79-87. airkelapake karet.pdfair kelapake karet.pdf.