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Morphological trait variation of the immature liberica coffee (*Coffea liberica*) from West Java, Indonesia applied difference of coffee husk compost and biofertilizer

YUDITHIA MAXISELLY♥, FERRANI RIEFALINA NAFY, INTAN RATNA DEWI ANJARSARI
Department of Agronomy, Faculty of Agriculture, Universitas Padjadjaran. Jl. Raya Bandung-Sumedang Km. 21, Jatinangor, Sumedang 45363, West Java, Indonesia. Tel.: +62-228-4288890, ♥email: yudithia.maxiselly@unpad.ac.id

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Abstract. *Maxiselly Y, Nafy FR, Anjarsari IRD. 2023. Morphological trait variation of the immature liberica coffee (*Coffea liberica*) from West Java, Indonesia applied difference of coffee husk compost and biofertilizer. Biodiversitas 24: 5988-5994.* Improving the growth of immature Liberica coffee is achievable through fertilizer application. This is because nutrients can be provided to plants by microorganisms from organic and biological fertilizers. Therefore, this research aimed to determine the response and the best treatment for applying coffee husk compost and consortium biofertilizer, which contained nitrogen-fixing and phosphate-solubilizing bacteria on the growth of immature Liberica plant. The experiment was held at Ciparanje Research Center, Padjadjaran University, West Java, with an altitude of ±750 meters above sea level (masl) from January to May 2023. Furthermore, a randomized complete block design (RCBD) was conducted with six treatment combinations. Each treatment was repeated four times including control (Urea 20 $g.plant^{-1}$ + SP36 25 $g.plant^{-1}$ + KCl 15 $g.plant^{-1}$), solid coffee husk compost 3 $kg.plant^{-1}$, liquid coffee husk compost 80 $mL.L^{-1}$, biofertilizer 10 $mL.L^{-1}$, solid coffee husk compost 3 $kg.plant^{-1}$ + biofertilizer 10 $mL.L^{-1}$, and liquid coffee husk compost 80 $mL.L^{-1}$ + biofertilizer 10 $mL.L^{-1}$. The results showed that biofertilizer significantly affected for increasing the morphology trait of immature Liberica coffee, namely the plant height, stem diameter, number of primary branches, length of primary branches, leaf area, and leaf chlorophyll index. The best treatment for immature Liberica plants was the liquid coffee husk compost 80 $mL.L^{-1}$ + biofertilizer 10 $mL.L^{-1}$. Based on this research, the combination of coffee husk compost, especially the liquid form, and biofertilizer is the potential application to boost the immature Liberica coffee growth.

Keywords: Compost, immature plant, microorganism, nutrient

INTRODUCTION

Coffee is a prominent example among the plantation commodities, assuming an important role within the economic landscape of Indonesia. Specifically, according to the Indonesian Bureau of Statistics, it is one of the crucial contributors to foreign exchange for that country (BPS 2020). Coffee development depends on several factors, including the species, environment, and agricultural techniques (Maxiselly et al. 2023).

Among several species of coffee that dominate world trade are arabica (*Coffea arabica* L.), robusta (*Coffea canephora*), and Liberica (*Coffea liberica*). Liberica is a type of liberoid coffee originating from Liberia, the west coast of Africa (Davis et al. 2022), that contains huge phytochemical compositions (Maxiselly et al. 2022). The coffee possesses a distinct flavor profile, characterized by its subtle bitterness in contrast to Robusta. It has an intriguing fragrance reminiscent of jackfruit and elements found in arabica and chocolate varieties. This unique composition has garnered consumer preference, driving an upward trajectory in demand for Liberica (Halim-Lim et al. 2022). Regarding production, Liberica coffee has longer fruits than other types, which is 2-3 cm, while the lengths of robusta and arabica are 1.2 cm and 1.5 cm (Rosyady et al. 2022). Like robusta coffee, this species can thrive in high temperatures and low altitudes. According to Nillan et al. (2020), Liberica can grow optimum between 18 and 28°C and is maximum adapted to 34°C. According to the Liberica characteristic, some tropical nations like Malaysia and Indonesia are suited for developing this species (Ismail et al. 2014). The data from the Indonesian Bureau of Statistics BPS (2020) showed fluctuations in coffee production between 2018 and 2020. The coffee production that commenced at 756.05 thousand tons in 2018 was subjected to a decline, reaching 752.51 thousand tons in 2019, reflecting a decrease of 0.47%. The achievement of optimal coffee plant cultivation is reinforced by attentive maintenance practices, of which appropriate fertilization is an important component.

Fertilization within coffee plant cultivation incorporates organic and inorganic constituents into the soil, fulfilling essential nutrients. This objective is achieved by combining inorganic and organic fertilizers (Hazra 2016). The category of organic fertilizer includes materials sourced from agricultural byproducts, such as residual waste generated from coffee plant production processes. Another fertilizer that is formulated from natural sources is biofertilizer. Biofertilizers are substances that contain one or more species of microorganisms that can convert nutrients from an inedible form to a usable form through biological processes like nitrogen fixation, phosphate solubilization, excretion of substances that promote plant growth or cellulose, and biodegradation in soil, compost, and other environments (Kumar et al. 2022). Using environmentally friendly agricultural methods that preserve a long-term soil ecology constitutes sustainable agriculture (Khalisha et al. 2022).

Coffee plant production waste is liquid waste generated from the washing and stripping process through the wet processing of coffee. However, solid waste is generated through the dry processing of coffee (Tolessa et al. 2022). According to Dzung et al. (2013), the parchment of coffee fruit contains nitrogen (N) of 1.27%, phosphate (P) of 0.06%, and potassium (K) of 2.46%. In addition, according to Orrego et al. (2018), the outer skin of coffee contained N 1.94%, P 0.28%, and K 3.61%. Element N plays a role in stimulating plant vegetative growth, and P enhances root growth and enlargement of plant cell tissue. Meanwhile, K plays a role in photosynthesis and metabolizing enzymes and minerals (Wang et al. 2013).

Organic and biological fertilizers can be combined to increase growth, specifically during the immature phase of the 1st year (TBM-1). The liquid of consortium biofertilizer contains different N-fixing and phosphate solvent bacteria as well as phosphate solvent fungi, spurring plant growth to increase crop production (Hernández-Álvarez et al. 2023). Biological fertilizers can minimize environmental pollution and improve land quality (Khalisha et al. 2022). According to the explanation above, this research aimed to determine the response and the best treatment for applying coffee husk compost and consortium biofertilizer, which contained nitrogen-fixing and phosphate-solubilizing bacteria on the growth of immature Liberica plant.

MATERIALS AND METHODS

Research area

This research was conducted at Ciparanje Research Field, Agricultural Faculty, Universitas Padjadjaran, West Java, with an altitude of ±750 masl for the morphological trait observation. Meanwhile, solid and liquid organic fertilizer analysis was conducted at the Soil Chemical and Plant Nutrition Laboratory, Agricultural Faculty, Universitas Padjadjaran.

Materials

The planting material was a 1-year-old Liberoid Meranti 1 (LIM 1) variety Liberica TBM. The growing medium used was Inceptisol, and the fertilization employed solid organic fertilizer from coffee husk waste. For liquid organic fertilizer, Arabica husk waste, agricultural EM-4, brown sugar, water, Bion UP consortium biofertilizer that contained nitrogen-fixing microbes (*Azotobacter chroococcum, Azotobacter vinelandii, Azospirillum,* and *Acinetobacter*) as well as phosphate solubilizing bacteria *Pseudomonas cepacia* and phosphate solubilizing fungi *Penicillium sp*., and control fertilizer in Urea, SP36, and KCl were used. Meanwhile, the tools included scales, meters, calipers, measuring cups, filters, meters, barrels, drills, fertilizer sprayers, plant markers, documentation tools, buckets, filters, gloves, shovels, scissors, and chlorophyll meters (MC-100 Apogee Instruments Inc, US).

Research methods

The method used was a randomized complete block design (RCBD) with 6 treatment combinations. Each treatment was repeated 4 times, including A: control (Urea 20 g.plant^{-1} + SP36 25 g.plant^{-1} + KCl 15 g.plant^{-1}), B: solid coffee husk waste 3 kg.plant^{-1} (SOF), C: liquid coffee husk waste 80 mL.L^{-1} (LOF), D: biofertilizer 10 mL.L^{-1} (BF), E: solid coffee husk waste 3 kg.plant^{-1} + biofertilizer 10 mL.L^{-1} (SOF+BF), and F: liquid coffee husk waste 80 mL.L^{-1} + biofertilizer 10 mL.L^{-1} (LOF+BF).

Procedures

Preparation of liquid organic fertilizer

Moreover, creating liquid organic fertilizer commences with precisely measuring coffee skins according to the prescribed quantity. Subsequently, a solution comprising brown sugar of around 600 g mixed with 1 L water and a decomposition agent of EM-4 (600 mL) is blended. The blended coffee skin is carefully placed in a sealed container like a jerry can. Therefore, water around 5 L is thoroughly incorporated into the 20 kg coffee-skin mixture container. This concoction undergoes a fermentation process lasting 7-14 days, according to Widyabudiningsih et al. (2021). The resultant fermented solution is filtered and transferred into another container. The defining characteristics of fully prepared liquid organic fertilizer are characterized by the brownish-yellow color, an aroma reminiscent of alcohol, and complete disintegration due to decomposition (Nasution and Rizka 2022). Before being applied to the plant, the liquid fertilizer was analyzed with the most probable number method for Nitrogen-fixing bacteria (Cappucino et al. 1983) and used quantitative total plate count for Phosphate solvent bacteria contents (Arfarita et al. 2017).

Application of treatment

The application of liquid organic fertilizer for coffee husk waste is made by watering at the base of the stem and spraying on coffee plant leaves every 2 weeks. However, the solid organic fertilizer from compost is applied once at the beginning of planting, 1 week before planting. The solid coffee husk compost was analyzed for its composition before being applied to the soil by following SNI 7763, 2018 procedures. The biofertilizer is applied by watering at the base of the stem and spraying on coffee plant leaves once a week.

Planting and maintenance

Planting preparation begins with clearing the land to be used from weeds; Liberica is planted with a 1.5 × 2.5 m planting distance. Coffee plant maintenance carried out includes watering and weeding. Watering is conducted once every two days to maintain soil moisture, while weeding is carried out by pulling out weeds around the plant weekly.

Observation variables

The parameters observed included an increase in plant height (cm) measured from the base of the stem to the growing point, stem diameter (mm) measurements were carried out using a caliper at the height of 3 cm above the ground surface, number of branches which counted is the primary branch, branch length (cm), leaf area (cm^2) with formula: $0.6626(WL)^{1.0116}$ W: leaf wide L: leaf length (Antunes et al. 2008), and leaf chlorophyll index (CCI). Measurement of chlorophyll content using a Digital Chlorophyll Meter clamped on the leaf of the sample plant until a number appears on the monitor expressed in CCI (Chlorophyll Content Index) units. Observations were made every 2 weeks from 2 to 12 weeks after treatment (WAT).

Data analysis

Data were statistically analyzed using the F test at the 5% level through SASM-Agri software. A Duncan Multiple Range Test (DMRT) was performed at a 95% confidence level when there were significant differences between treatments.

RESULTS AND DISCUSSION

Liquid organic fertilizer of coffee husk waste

Table 1 shows the analysis of the content of liquid organic fertilizer of coffee husk waste. The liquid organic fertilizer comprises composting coffee husk waste containing N-fixing and phosphate solvent bacteria at 1.37 × 10^{11} CFU.mL^{-1} and 1.87 × 101^{11} CFU.mL^{-1}. N-fixing bacteria can bind N both symbiotically and nonsymbiotically (Camut et al. 2021). Bacteria secrete phytohormones in the form of gibberellin, Indole Acetic Acid (IAA), kinetin, and vitamin B (Widawati and Suliasih 2019), while phosphate solvents are biocontrol agents that can protect plants against disease.

Solid organic fertilizer of coffee husk waste

Table 2 shows the analysis of the content of solid organic fertilizer of coffee husk waste. The solid organic fertilizer from composting coffee skin waste has a 37.19% C-Organic, a C/N ratio of 14.27, N 2.61%, and a 5.5 pH value. This has met the quality standards of Permentan number 261 of 2019, namely at least C-Organic 15%, C/N ratio 25, pH 4-9, and N 2% (Permentan 2019).

Composite organic fertilizer contains a variety of macronutrients that plant needs, namely N, P, and K. N is one of the main components of proteins, enzymes, hormones, and vitamins influencing plant growth (Dikr and Belete 2017). According to Jiang et al. (2023), coffee husks contain N, P, and K as macronutrients for plant development. P element plays a role in transporting energy from plant metabolism, the formation of seeds, and root growth, in addition to the position in plant cell division and tissue enlargement (Sardans and Peñuelas 2021). Even though K functions in photosynthesis, it efficiently uses water, strengthens branches, forms a strong foundation, and increases disease resistance (Zahoor et al. 2017).

Table 1. Analysis of liquid organic fertilizer content of coffee husk waste

Parameter	Unit	Results
Nitrogen-fixing bacteria	CFU/mL	1.37 x 10^{11}
Phosphate solvent bacteria	CFU/mL	1.87 x 10^{11}

Table 2. Analysis of solid organic fertilizer content of coffee husk waste

Parameter	Unit	Results
C-Organik	%	37.19
C/N	-	14.27
N	%	2.61
pH	-	5.50

Vegetative growth

The results of observing the morphology of immature Liberica coffee (Figure 1), which were given several applications of coffee waste fertilizer and biofertilizer, showed their vegetative characteristics. These characteristics are plant height, stem diameter, number of branches, branch length, leaf area, and leaf chlorophyll index. The observation data (Table 3-8) shows high accuracy from the coefficient variation value (CV) below 20%. However, two observations have a CV value of more than 20%: branch length at 4 weeks after treatment (WAT) (24.29%) and 6 WAT (21.68%). According to Maxiselly et al. (2021), CV values above 20% when observing immature perennial plants indicate the accuracy of data collection. This was also stated by Utami et al. (2023), that research with a CV value of more than 20% shows the significant influence of the environment on the data collected.

Plant height

The results of DMRT (Table 3) show that SOF, LOF, BF, SOF+BF, and LOF+BF treatments can increase the growth of the same plant height resulting from control. The biofertilizer, LOF, and SOF used in the treatment contain various PGPRs, phytohormones, and nutrients needed by plants.

Biofertilizers containing N-fixing bacteria such as *Azotobacter* sp. *Azospirillum* sp. *Acinetobacter* sp. and P-solvent bacteria like *Pseudomonas* sp. and *Penicillium* sp. assist in the provision of fertilizer elements due to the N fixation of air and the dissolving of P from inorganic P (Kumar et al. 2022). Biofertilizers also contain various phytohormones, including Indole Acetic Acid (IAA), cytokinin, and gibberellin.

IAA influences plant growth rate, enhancing cell prolongation processes and differentiation. According to Sosnowski et al. (2023), the role of cytokinin in plant cells is to stimulate cell division by increasing the rate of protein synthesis. The organic content of POP compositing processes can also cause abundant plant nutrients. Coffee skin waste has a C-organic composition of 37.19%, C/N 14.27, N 2.61%, and pH 5.5. This met the quality standards of Permentan No. 261 of 2019: minimum C-Organic 15%, C/N 25, pH 4-9, and N 2% (Permentan 2019).

Stem diameter

DMRT results in (Table 4) showed that in 4 WAT, the treatment of SOF, BF, SOF+BF, and LOF+BF significantly differed from the control. However, the POC treatment was not significantly different from the control. Table 4 showed that the BF, SOF+BF, and LOF+BF treatments exhibited superior stem diameter growth compared to the remaining options between 6 WAT to 12 WAT. This is suspected because the three treatments contain biological fertilizer used to contain various PGPRs such as N-fixing bacteria (*Azotobacter* sp., *Azospirillum* sp., *Acinetobacter* sp.) and P-solvent bacteria *(Pseudomonas sp*. and *Penicillium* sp.), phytohormones, and nutrients needed by the plant.

Azotobacter sp. is a bacterium that can fix nitrogen and synthesize phytohormones by auxin (IAA), cytokinins, and gibberellins (Vikhe 2014). IAA and gibberellins are important in stimulating cell elongation at the growing spot (Gusmiaty et el. 2019; Castro-Camba et al. 2022). Hormones also stimulate plant growth and suppress phytopathogens (Reddy et al. 2018). Furthermore, *Azospirillum* sp. is a bacterium that can convert atmospheric N into N available for plant absorption (Reddy et al. 2018). Adequate N availability is essential for protein formation; while the levels are abundant, growth is promoted through enhanced cell division. These cells are subjected to differentiation, leading to continued and sustained plant growth (Camut et al. 2021). The bacteria contained in the liquid organic fertilizer coffee-skin waste content are N-fixing and P-solvent bacteria. N-fixing bacteria can help plants interact with nitrogen requirements in stimulating growth, mainly stems and branches (Tarigan et al. 2018). The composition of the liquid and solid coffee husk combined by bacteria effectively increases the immature Liberica coffee growth.

Figure 1. Immature Liberica coffee that observed

Table 3. Plant height (cm) of Liberica at 2 WAT-12 WAT affected by liquid and solid organic fertilizer of coffee husk waste and biofertilizer

Treatment	2 WAT	4 WAT	6 WAT	8 WAT	10 WAT	12 WAT
A: Control	1.40	1.92 ab	2.24	7.00	9.25 b	11.00 b
B: SOF	1.32	1.60 b	2.12	7.00	9.75 b	14.00 ab
C: LOF	1.76	2.16 a	2.60	8.12	12.00 ab	15.63 a
D: BF	1.50	2.00 a	2.78	8.88	13.00 a	17.50 a
E: SOF+BF	1.43	2.03 a	2.50	8.50	11.38 ab	15.25 a
F: LOF+BF	1.65	2.15 a	2.69	9.50	13.25 a	17.13 a
CV. (%)	14.47	10.87	14.10	19.39	16.34	15.13

Notes: Numbers in a column followed by the same letter are not significantly different based on the DMRT at the level of α=5%. WAT: week after treatment

Table 4. Stem diameter (mm) of Liberica at 2 WAT-12 WAT affected by liquid and solid organic fertilizer of coffee husk waste and biofertilizer

Treatment	2 WAT	4 WAT	6 WAT	8 WAT	10 WAT	12 WAT
A: control	0.42	0.38 b	0.65 d	1.03 d	1.46 d	1.93 d
B: SOF	0.50	0.54 a	0.89 bc	1.33 c	1.86 c	2.49 bc
C: LOF	0.41	0.44 ab	0.78 cd	1.18 cd	1.64 cd	2.44 c
D: BF	0.48	0.56 a	1.04 a	1.74 ab	2.5 ab	3.40 a
E: SOF+BF	0.46	0.51 a	1.03 ab	1.61 b	2.31 b	2.68 bc
F: LOF+BF	0.41	0.53 a	1.13 a	1.93 a	2.69 a	2.98 ab
C.V. (%)	17.06	15.42	10.30	9.34	9.40	12.40

Notes: Numbers in a column followed by the same letter are not significantly different based on the DMRT at the level of α=5%, WAT: week after treatment

Number of primary branches

Table 5 shows the DMRT results that SOF+BF treatment resulted in a better number of branches than others but not significantly different from SOF and LOF+BF at 8 WAT. In the SOF+BF treatment, the solid organic fertilizer used comes from composting coffee husk waste with a C-Organic of 37.19%, C/N 14.27, N 2.61%, and pH 5.5; this combination has met the quality standards of Permentan Number 261 of 2019, namely at least C-Organic 15%, C/N 25, pH 4-9, and N 2% (Permentan 2019).

Adejobi et al. (2017) stated that applying organic fertilizer to cocoa seedlings increased the number of branches by 85% compared to controls. Composting fertilizer with macronutrients such as N, P, and K has various functions for plant growth. Element N is important in plant vegetative growth, P plays a role in energy storage and fruit ripening, and K is crucial in photosynthesis and branch formation (Sagitarini and Dewi 2023).

Branch length

The DMRT results in (Table 6) showed that the SOF, BF, SOF+BF, and LOF+BF treatments had no significantly different effect on the number of branches at 10 WAT. However, the 4 treatments had a significantly different effect from the LOF treatment and control at 10 WAT. In 12 WAT, the LOF treatment was significantly different from the SOF and LOF+BF, and SOF was significantly different from LOF and BF. SOF, SOF+BF, and LOF+BF resulted in a better increase in the number of branches than others. This was suspected because the 3 treatments used organic and liquid fertilizers from coffee skin waste and biofertilizers that contained various nutrients, bacteria, and phytohormones needed by the plant.

Composting organic fertilizer contains various macronutrients needed by plants, namely N, P, and K. N acts as the main constituent of proteins, enzymes, hormones, and vitamins in plants, affecting plant growth (Dikr and Belete 2017).

Biofertilizer used in the SOF+BF treatment contains one of the N-fixing bacteria, namely *Azotobacter* sp. The bacteria also produce phytohormones, including gibberellin (GA3) (Dikr and Belete 2017). Phytohormones have various important roles in plant growth, including during cell division and enlargement (Baniasadi and Saffari 2016). Another research supports this result: gibberellin promotes branch growth in perennial plants and is proven to increase lateral branch length on *Jatropha curcas* (Ni et al. 2015).

Leaf area

DMRT results in (Table 8) showed that treatment BF produced the best leaf area compared to others at 12 WAT. This is suspected because treatment BF uses biofertilizer containing *Plant Growth Promoting Rhizobacteria* (PGPRs). One of these PGPRs is N-fixing bacteria in the form of *Azotobacter* sp., causing increased vegetative growth. According to Mu and Chen (2021), element N is very influential on vegetative growth, such as leaf, P affects the preparation of protein, and Mg influences the process of photosynthesis, namely as a constituent of chlorophyll formation molecules.

Leaf size is related to the ability of plants to receive the sunlight needed in the photosynthesis process to generate a source of carbohydrate energy for plant growth (Zhang et al. 2021; Tang et al. 2022). The leaf length can be used as a benchmark to determine the ability to produce photosynthesis. The larger the leaf area of the plant, the greater the reception of sunlight (Huang et al. 2021).

Leaf chlorophyll index

Table 7 shows that DMRT results on BF treatment produced the best leaf chlorophyll index compared to others. Biofertilizer treatment uses biological fertilizer containing N-fixing rhizobacteria and P-solvent. The combination of N and P elements available for plants assisted by P-solvent and N-fixing bacteria spurred an increase in chlorophyll and chloroplast content in the leaf. Therefore, photosynthesis increased and produced better plant growth (Evans 2013). This was evidenced in the research conducted by Hyder et al. (2023), where the administration of N-fixing combined with P-solvent rhizobacteria resulted in a relatively high chlorophyll content compared to control on oil palm seedlings.

Table 5. Number of primary branches Liberica at 2 WAT-12 WAT affected by liquid and solid organic fertilizer of coffee husk waste and biofertilizer

Treatment	2 WAT	4 WAT	6 WAT	8 WAT	10 WAT	12 WAT
A: control	0.78	1.11	1.37	1.61 bc	1.87	2.06
B: SOF	0.71	1.10	1.49	1.80 abc	2.15	2.39
C: LOF	0.71	1.06	1.32	1.54 c	1.92	2.13
D: BF	0.91	1.16	1.76	1.54 c	1.80	2.04
E: SOF+BF	0.85	1.27	1.61	1.95 a	2.15	2.43
F: LOF+BF	0.71	1.11	1.57	1.90 ab	2.09	2.34
CV (%)	18.17	15.42	10.30	9.34	9.40	12.40

Notes: Numbers in a column followed by the same letter are not significantly different based on the DMRT at the level of α=5%; WAT: week after treatment

Table 6. Length of primary branches (cm) of liberica at 2 WAT-12 WAT affected by liquid and solid organic fertilizer of coffee husk waste and biofertilizer

Treatment	2 WAT	4 WAT	6 WAT	8 WAT	10 WAT	12 WAT
A: control	0.06	0.35	0.40	0.49	0.59 b	0.83 bc
B: SOF	0.05	0.40	0.48	0.58	0.78 a	1.11 a
C: LOF	0.05	0.33	0.42	0.46	0.58 b	0.68 c
D: BF	0.05	0.32	0.40	0.54	0.73 a	0.79 bc
E: SOF+BF	0.05	0.32	0.40	0.53	0.76 a	0.89 abc
F: LOF+BF	0.05	0.36	0.47	0.62	0.79 a	0.92 ab
C.V. (%)	19.60	24.29	21.68	17.13	11.63	16.71

Notes: Numbers in a column followed by the same letter are not significantly different based on the DMRT at the level of α=5%; WAT: week after treatment

Table 7. Leaf chlorophyll index (CCI) of Liberica at 2 WAT-12WAT affected by liquid and solid organic fertilizer of coffee husk waste and biofertilizer

Treatment	2 WAT	4 WAT	6 WAT	8 WAT	10 WAT	12 WAT
A: control	6.08 e	12.98 e	22.70 e	35.85 d	46.63 de	58.65 e
B: SOF	7.48 de	13.55 de	23.45 e	36.80 d	45.45 e	58.73 e
C: LOF	7.90 d	14.83 d	27.35 d	40.13 c	48.75 cd	61.83 d
D: BF	17.85 a	24.20 a	37.83 a	49.63 a	57.80 a	77.65 a
E: SOF+BF	10.58 c	16.38 c	30.73 c	41.40 c	50.40 c	67.05 c
F: LOF+BF	13.35 b	20.13 b	33.95 b	45.10 b	53.45 b	70.88 b
CV (%)	10.79	5.80	3.63	2.68	3.60	2.77

Notes: Numbers in a column followed by the same letter are not significantly different based on the DMRT at the level of α=5%; WAT: week after treatment

Table 8. Leaf area (m^2) of Liberica at 2 WAT-12WAT affected by liquid and solid organic fertilizer of coffee husk waste and biofertilizer

Treatment	12 WAT
A: control	36.35 e
B: SOF	46.63 d
C: LOF	49.68 d
D: BF	100.63 a
E: SOF+BF	68.30 c
F: LOF+BF	87.13 b
CV (%)	5.35

Notes: Numbers in a column followed by the same letter are not significantly different based on the DMRT at the level of α=5%; WAT: week after treatment

In conclusion, the treatments of organic fertilizer from coffee skin waste and biofertilizer were the techniques for enhancing growth across all parameters, including plant height, stem diameter, number of primary branches, primary branch length, leaf area, and leaf chlorophyll index in immature year 1 Liberica plant. Treatment using LOF+BF responded best to the high plant parameters, stem diameter, leaf width, and leaf chlorophyll index of immature year 1 Liberica plants.

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