



APPLICATION OF VARIOUS CONCENTRATIONS OF LIQUID ORGANIC FERTILIZER FROM COFFEE FRUIT SKIN WASTE ON THE GROWTH OF ARABICA COFFEE SEEDLINGS (*Coffea arabica* L.)

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Abstract

The excessive and continuous use of inorganic fertilizers can indirectly reduce soil quality and fertility. This can result in high production costs, yet unsatisfactory yields and product quality. One effort to address this issue is by using organic liquid fertilizer derived from coffee pulp waste. This study aims to determine the effects and the appropriate dosage of liquid organic fertilizer made from coffee pulp waste on the growth of Arabica coffee seedlings. The research was conducted at the Wulang Pari Coffee Processing Unit in Laci Carep Village, Langke Rembong Subdistrict, Manggarai Regency, East Nusa Tenggara, from July 2024 to August 2024. The study utilized a Randomized Block Design with one factor, which was the concentration of liquid organic fertilizer from coffee pulp waste consisting of 5 treatment levels and repeated 4 times. Each treatment consisted of 5 plants, resulting in a total of 100 plants. From each experimental unit, 3 sample plants were taken, resulting in 75 sample plants. The treatment levels used were K0 = Control (0 ml/application), K1 = 20 ml/application, K2 = 40 ml/application, K3 = 60 ml/application, and K4 = 80 ml/application. The results of the study concluded that the application of various concentrations of liquid organic fertilizer from coffee pulp waste did not significantly differ in their effects, and the concentration P4 (80 ml/application) provided the optimal dosage for research parameters such as plant height, number of leaves, and number of shoots.

Keywords: Coffee Fruit Skin, Fertilizer, Liquid Organic Fertilizer, Soil Fertility

1. Introduction

The coffee commodities often cultivated in Indonesia and widely favored by the community are Arabica coffee (*Coffea arabica*) and Robusta coffee (*Coffea canephora*). Arabica coffee is more well-known than Robusta coffee due to its high-quality beans, distinctive aroma after roasting, delicious taste, and strong, complex aroma. It is highly renowned and has significant economic value among the 80 coffee species worldwide (Priantari et al., 2022). Public interest in coffee has steadily increased over the past decade. Coffee is no longer just a drink typically consumed by older generations but is also enjoyed by young people today. Furthermore, coffee is now enjoyed across generations and by various genders. While it was traditionally associated with men, many women have also grown fond of drinking coffee (Hafni, 2020; Tamilmani and Pandey, 2015 in Ika Priantari and Andi Dharmawan, 2022).

The growth and production of coffee are determined from the early stages of seedling development, which is a crucial phase in cultivation to produce high-quality seedlings (Rosniawaty, et al., 2017). There are three types of coffee that can grow well in Indonesia: Arabica, Robusta, and Liberica. However, the most widely cultivated types are Arabica and Robusta, as these are the varieties of coffee that are highly favored by the public, thus having high economic value. Nevertheless, the quality and productivity of coffee cultivation in Indonesia have not yet reached their full potential (Ditjenbun, 2021).

The proper use of fertilizers will be highly beneficial both economically, technically, environmentally, and socially. Suboptimal land productivity in producing coffee in line with its potential yield is partly due to the insufficient availability of nutrients for the plants. One of the regions where most of the community's livelihood is coffee farming, specifically Robusta coffee, is in the Manggarai and East Manggarai Regencies. Robusta coffee has been cultivated for decades, yielding hundreds of tons in a single harvest. The abundant coffee production naturally corresponds with the by-product of milling, which is coffee husk waste. However, this coffee husk waste has not yet been optimally utilized, and is often discarded or left unused.

The accumulation and improper disposal of coffee husk waste can lead to environmental pollution. Simanihuruk et al. (2010) stated that the accumulation of coffee waste, if left untreated, can become a medium for the growth of decomposing microbes, as coffee husk contains a relatively high moisture content, around 75-80%, which can cause foul odors. Coffee husk waste constitutes about 40-45% of the total amount of coffee. The husk produced from coffee bean milling is nearly equivalent in amount to the coffee beans obtained. This is in line with the opinion expressed by Arwana et al. (2010) that the potential husk waste generated from the milling process weighs about 48% of the total weight of the whole coffee cherry. One of the efforts that can be made to address the increasing amount of coffee husk waste is to process it into liquid organic fertilizer, which can benefit both soil and plants.

Liquid organic fertilizer made from coffee husk waste is rich in macro and micronutrients that can improve soil structure and increase plant productivity. Liquid organic fertilizer from coffee waste can be applied to coffee plants themselves as well as other types of plants. Coffee husk waste contains essential nutrients such as Nitrogen, Phosphorus, and Potassium, which are needed by plants. Additionally, the nitrogen and phosphorus content in organic fertilizer made from coffee husk waste is higher than that of organic cow manure fertilizer, making it a potential alternative for natural soil amendments (Maulida et al., 2018).

The innovation of utilizing coffee pulp as liquid organic fertilizer is still not widely known by the majority of the community, particularly coffee farmers in Manggarai and East Manggarai Regency. Most farmers consider the coffee pulp from the milling process as mere waste with no economic value. Therefore, research was conducted on the use of coffee pulp waste to produce liquid organic fertilizer, which is then applied to coffee seedling nurseries. The implication of this research is that if coffee grinding waste is utilized properly, it will be an added value for farmers. This research aims to determine the

effect and the appropriate dosage of liquid organic fertilizer made from coffee pulp waste on the growth of Arabica coffee seedlings.

2. Research Methods

This research was conducted at the Wulang Pari Coffee Processing Unit, in Laci Carep Village, Langke Rembong Subdistrict, Manggarai Regency, East Nusa Tenggara. It took place from July 2024 to August 2024. The tools used in this research included buckets, knives, rulers, clear hoses, wooden stirrers, a mobile phone camera, and writing instruments. The materials used in this research were coffee husk waste, water, EM4, banana peels, lamtoro leaves, and Arabica coffee seedling polybags. The experimental design used in this research was a Randomized Block Design. Factor P was the concentration of coffee husk extract, which consisted of 5 treatments: K0: control (0 ml/application), K1: dose 20 ml/application, K2: dose 40 ml/application, K3: dose 60 ml/application, and K4: dose 80 ml/application. The treatments were repeated 4 times. Each treatment consisted of 5 plants, with 3 sample plants. The total number of coffee plants used was $5 \times 4 \times 5 = 100$ coffee plants. The observation data were analyzed using Analysis of Variance at a 5% significance level, and if significant differences were found, they were followed by the Duncan Multiple Range Test at a 5% test level.

3. Result and Discussion

Plant Height (cm)

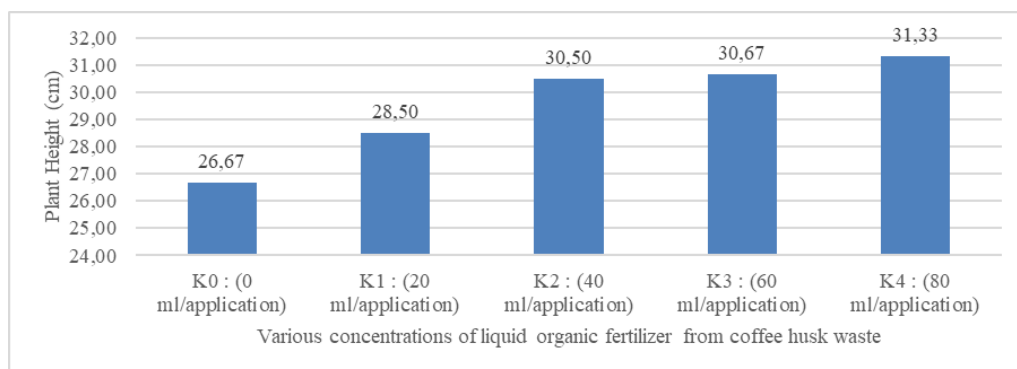


Figure 1. Average plant height diagram

Based on the data presented in Figure 1, the tallest plants were found in the K4 treatment, reaching 31.11 cm, while the shortest plants were in the K0 treatment, measuring 26.67 cm. This is likely due to the adequate nitrogen (N) content in the liquid organic fertilizer made from coffee skin waste, which is sufficient for the growth of Arabica coffee seedlings. According to Novita *et al.*, (2018), during the vegetative phase, plants focus on developing roots, stems, and leaves, requiring sufficient nitrogen. Nitrogen functions to improve the vegetative growth of plants and assists in chlorophyll formation (Rosniawaty *et al.*, 2017). According to Lakitan (2013), significant results in the height growth of coffee seedlings can be supported by the availability of essential nutrients, ensuring that plant growth is not hindered and can reach its full potential. Additionally,

plants that receive nitrogen in accordance with their needs will grow taller with broader leaves.

The chlorophyll content in coffee plant leaves affects the rate of photosynthesis and respiration in the coffee plant. Chlorophyll functions as a light absorber, which is essential for photosynthesis. High chlorophyll content in coffee plants indicates a high rate of photosynthesis (Setyawan, 2023). This is consistent with the statement by Lingga dan Marsono (2013) that the presence of essential nutrients such as nitrogen, phosphorus, and potassium is closely related to plant height growth. In Fadli (2021) research, the best treatment that resulted in the tallest soybean plants was the application of coffee fruit peel waste at a dose of 150 g per plant. Adnan (2014) research showed that the application of 150 g of coffee fruit peel waste per plant had a significant effect on the observed variable of the height of Arabica coffee seedlings.

Number of leaves (blades)

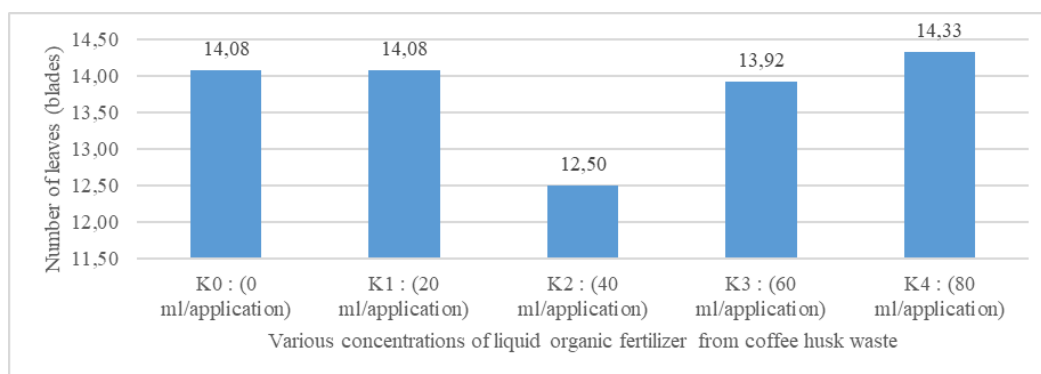


Figure 2. Diagram of average number of leaves

Based on the data presentation in Figure 2 regarding the average number of leaves, the highest number of leaves in Arabica coffee seedlings was found in treatment K4 with 14.33 leaves, while the lowest number of leaves was found in treatment K2 with 12.50 leaves. This is likely due to the nutrient content, especially the nitrogen (N) found in the liquid organic fertilizer made from coffee husk waste in treatment K4, which was able to increase the number of leaves in Arabica coffee seedlings. According to Yuliana dan Mochamad (2019), a plant's growth can be indicated by the number of leaves, and the number of leaves also provides information about the plant's photosynthetic capacity.

Leaves are an important organ used in the process of photosynthesis, where the products of photosynthesis are used for plant growth. According to Sumiyannah dan Sunkawa (2018), nitrogen found in liquid organic fertilizer has functions, including being a main component in the formation of proteins, chlorophyll, nucleic acids, and organic compounds. The formation of chlorophyll can be used in the photosynthesis process, where its optimal results are used for leaf growth. The research findings by Sahputra *et al.*, (2013) explain that the application of liquid organic fertilizer from coffee husk waste can also increase the number of leaves in Arabica coffee seedlings.

Bar diameter (mm)

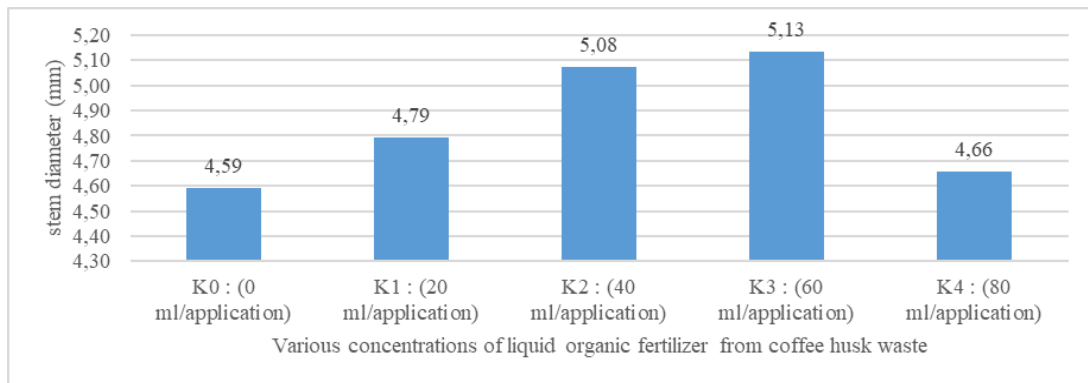


Figure 3. Average stem diameter diagram

Based on the data presentation in Figure 3, the largest stem diameter of Arabica coffee seedlings was observed in treatment K3, which measured 5.13 mm, while the smallest stem diameter was found in treatment K0, measuring 4.59 mm. This is believed to be due to the presence of nitrogen (N) in the liquid organic fertilizer derived from coffee husk waste, which can enhance the growth of Arabica coffee stem diameter. The increase in stem diameter occurs because the plant's nutrient needs are met, particularly nitrogen (N). The high nitrogen content in the liquid organic fertilizer from coffee husk waste helps promote growth during the vegetative phase, including the increase in stem diameter.

This is consistent with the research by Dewantara *et al.*, (2017), which states that high nitrogen nutrient content can support the vegetative process of plants, as nitrogen plays a role in the overall growth of plants, especially in stems, branches, and leaves. The research by Santoso *et al.*, (2013) showed that the increase in the diameter of Arabica coffee seedlings due to the application of liquid organic fertilizer made from coffee skin waste can enhance the humus content in the soil, which in turn increases soil fertility chemically, resulting in better growth of the coffee seedlings over time. The nitrogen content is very important as the main component in the synthesis of proteins carried out by plant cells, thus accelerating the development of plant organs (Arisandy, 2022).

Number of shoots

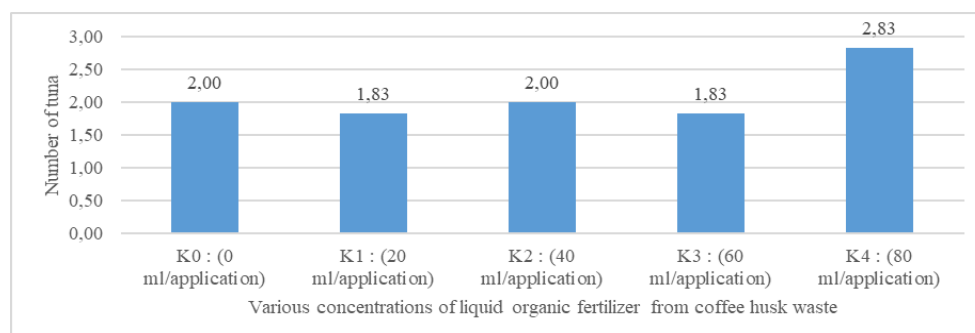


Figure 4. Diagram of average number of shoots

Based on the data presentation in Figure 4, the highest number of shoots was observed in treatment K4 with 2.83 shoots, while the lowest number of shoots was observed in treatments K1 and K3 with 1.83 shoots. This is likely due to the presence of nutrients in the liquid organic fertilizer made from coffee husk waste, which is capable of enhancing the growth of Arabica coffee shoots. The study by Gawad *et al.*, (2012) found 2.52 coffee shoots with the application of liquid organic fertilizer. The high number of shoots in treatment P4 may be due to the presence of macro nutrients, specifically nitrogen (N) at 16%, which can increase the number of shoots (Ferdy, 2023).

Root Length (cm)

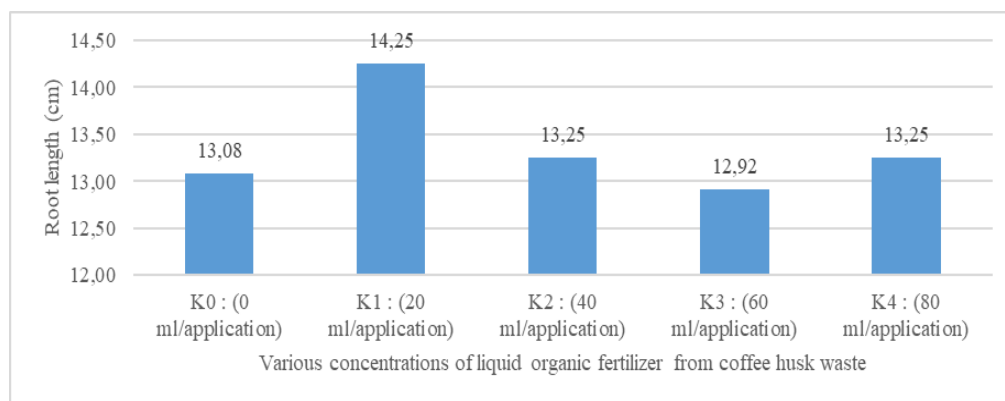


Figure 5. Diagram of average root length

Based on the data presentation in Figure 5 regarding the root length parameter, the longest root length was observed in treatment K1: 14.25 cm, while the shortest root length was observed in treatment K3: 12.89 cm. This is likely due to the presence of nutrients in the coffee husk waste fertilizer, which is found in the liquid organic fertilizer made from coffee husk waste, enhancing the root length growth of Arabica coffee seedlings. In addition to providing nutrients, the application of liquid organic fertilizer made from coffee husk waste can improve the physical properties of the soil, making it more friable, thereby allowing roots to grow and develop well. As the plant grows, the rate of nutrient absorption will increase (Ngaisah, 2014).

During their growth and development, plants require essential nutrients, particularly macronutrients such as phosphorus (P), potassium (K), and nitrogen (N), which aim to accelerate root growth and enhance plant development. The research by Rinekso *et al.*, (2011) found that phosphorus is primarily beneficial for stimulating root growth, especially in young plants, allowing the roots to grow and develop well. The availability of phosphorus in the soil will react with iron and aluminum ions, forming insoluble phosphorus compounds in the soil, making it accessible for plant use (Nugroho, 2022).

4. Conclusion

Based on the research that has been conducted, it can be concluded that the application of various concentrations of liquid organic fertilizer from coffee fruit peel waste does not show a significant difference, and the P4 concentration (80 ml/application) provides the

optimal dose for the research parameters, including plant height, number of leaves, and number of shoots. The limitations in this study are the obstacles in the utilization of post-harvest plantation waste, the materials used are only coffee fruit skin waste. The suggestions in this study should be conducted in a greenhouse or greenhouse, there needs to be an increase in the combination of liquid organic fertilizer materials with other fruit skin waste.

5. Referensi

- Arwana, Ketut. I., Ni.G.A.d. Martiningsih.E., Budiasa, I.M., Sukarna.I.G. 2010. Pemanfaatan Limbah Kulit Buah Kopi Arabika Dalam Upaya Peningkatan Keuntungan Ukm (Usaha Kecil Dan Menengah) Dan Pelestarian Lingkungan. *Majalah Aplikasi Ipteks Ngayah*. Vol 1, No 1. Hal 89-96
- Adnan. 2014. Pengaruh Kompos Kulit Kopi dan Interval Aplikasi Pupuk Bio Cair (*Herbafarm*) Terhadap Hasil Jagung Manis (*zea Mays saccharata* Sturt). *Jurnal Agriculture*. 10 (2): 26.
- Arisandy, A, F. 2022. *Pengaruh Konsentrasi Ekstrak Bawang Merah Terhadap Pertumbuhan Sambung Pucuk Kopi Robusta dan Arabika (Doctoral dissertation, Universitas Jambi)*.
- Dewantara, F. R., J. Ginting dan Irsal. 2017. Respon Pertumbuhan Bibit Kopi Robusta *Coffea arabica* L.) terhadap Berbagai Media Tanaman dan Pupuk Organik Cair. *Jurnal Agroteknologi FP USU* 5 (3) : 676-684.
- Ditjenbun. Provsu, 2021. Statistik Perkebunan Indonesia. Direktorat Jendral Perkebunan, Departemen Pertanian, Jakarta. 19 Halaman.
- Fadli Z., Parwito, dan Togatorop E. R. 2021. Respon Pertumbuhan dan Produksi Tanaman Kedelai (*Glycine Max* (L.) Merill) dengan Pemberian Berbagai Jenis Pupuk Organik Cair dan Limbah Kulit Kopi. *Jurnal Pucuk*. 1 (1):1-14.
- Ferdya, N. C. 2023. *Pengaruh Campuran Limbah Ampas Teh, Ampas Kopi Dan Kulit Nanas Terhadap Pertumbuhan Tanaman Kopi Arabika (Doctoral dissertation, Universita Muhammadiyah Metro)*.
- Gawad A. E., M. A. Nehad, H. A. Mahady, and ES. Boshra. 2012. In vitro micropropagation protocol and acclimatization of coffea trees (*Coffea arabica* L.). *J. Plant Production, Mansoura Univ*. Vol. 3 (1) : 109 – 116.
- Lakitan B. 2013. *Dasar-Dasar Fisiologi Tumbuhan*. Jakarta: Rajawali Pers.
- Lingga P., dan Marsono. 2013. *Petunjuk Penggunaan Pupuk*. Jakarta: Penebar Swadaya.
- Maulida, Desi., Lisa Erfa, Ferziana, dan Yusanto. 2018. Teknologi Pemanfaatan Limbah Kulit Kopi Melalui Pelatihan Pembuatan Kompos. *Prosiding Seminar Nasional Penerapan IPTEKS*: 50-56.
- Ngaisah, S. 2014. Pengaruh Kombinasi Limbah Cair Tahu dan Kompos Sampah Organik Rumah Tangga pada Pertumbuhan dan Hasil Panen Kailan (*Brassica oleracea* Var. Acephala). *Skripsi*. Jurusan Biologi Fakultas SAINTEK. UIN Maulana Malik Ibrahim Malang.
- Novita, E., Anis F. Dan Hendra A.P. 2018 Pemanfaatan Kompos Blok Limbah Kulit Kopi sebagai Media Tanam. *Jurnal Agrotek* 2 (2) : 61-72.
- Nugroho, S. A., Bagiatus, S., Setyoko, U., Fatimah, T., Novenda, I. L., & Pujiastati, P. 2022. Pengaruh Zpt Nabati Dan Media Tumbuh Terhadap Perkembangan Kopi Robusta. *Jurnal Biosense* 5 (2), 62-76.
- Priantari Ika., Hendy Firmanto., Mutiara Rahmatul Laili, (2022). Karakteristik Fisik Kualitas Biji Kopi *Coffea arabica* dan *Coffea canephora*. *Jurnal Ilmiah Biologi Eksperimen dan Keanekaragaman Hayati (J-BEKH)*, Vol.9(2):43-50. ISSN 2338-4344 eISSN 2686-200X. ikapriantari@unmuhjember.ac.id.file:///C:/Users/win10/Downloads/267(43-50)+Ika+ Priantari.pdf. Diakses Tanggal 18 Desember 2023.
- Rinekso, B. K., Sutrisno, K., Sumiyati, S. 2011. Studi Pembuatan Pupuk Organik Cair dari Fermentasi Urine Sapi dengan Variasi Lokasi Peternakan yang Berbeda. <https://www.enveng.undip.ac.id>. Diakses 16 Juli 2020.
- Rosniawaty, S., R., Sudirja, H., Hidayat. 2017. The Use of Organic Waste as Media Planting and Application of castie urine for *Coffea (Coffea arabica* L.) Seedings. *Jurnal Kultivasi* 16 (1) : 287-292.
- Simanihuruk, Kiston, Sirait J. 2010. Silase Kulit Buah Kopi Sebagai Pakan Dasar pada Kambing Boerka Sedang Tumbuh. *Seminar Nasional Teknologi Peternakan dan Veteriner. Sumatera Utara (ID) 2010*
- Sahputra A., A. Barus, dan R. Sipayung. 2013. Pertumbuhan dan Produksi Bawang Merah (*Allium Ascalonicum* L.) Terhadap Pemberian Kompos Kulit Kopi dan Pupuk Organik cair. *Jurnal Online*

- Agroekoteknologi*. 2 (1) : 26-35.
- Santoso, D. H., Sufardi., and Syakur., 2013. Limbah Kopi, EM4 dan Mikoriza Untuk Meningkatkan kualitas Tanah dan Pertumbuhan Bibit Kopi Arabika Gayo-1(*Coffea Arabica L.*). *Jurnal Manajemen Sumber Daya Lahan*, 3 (1), pp. 421-429.
- Sumiyannah, & Sunkawa I. 2018. Pengaruh Pemangkasan Pucuk dan Pupuk Nitrogen Terhadap Pertumbuhan dan Hasil Tanaman. Varietas Anjasmoro. *Agroswagati*. 6 (1) : 693-709.
- Setyawan, E . B., & Subroto, G. 2023. Analisis Sifat Fisiologi Dalam Daun Sebagai Bahan Seleksi pada Beberapa Klon Kopi Arabika (*Coffea Arabica L.*) Berkala Ilmiah Pertanian,6 (4), 190- 198.
- Yuliana A.E., dan Mohamad N. 2019. *Kajian Hubungan Antara kadar Nitrogen Media Tanam dan keragaan Tanaman dan Daun Pada Sistem Vertikultur*. Seminar Nasional multi Disiplin. UNHAWA Jombang.