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Effect of Local Microorganisms (LOM) and Coffee Grounds Waste on Soybean (Glycine Max L. Merrill) Yield

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Abstract

Soybeans are the main source of protein and oil that are widely used in various products, such as soybean oil, tofu, tempeh, soy milk, and soy sauce. With the increasing population, the need for soybeans as a source of protein also continues to increase, so its availability needs to be maintained. One approach that needs to be implemented is organic farming by utilizing various wastes, including coffee grounds. Coffee grounds contain various nutrients, including 44.87% organic C, 1.2% nitrogen, 0.02% phosphorus, and 0.35% potassium. In addition, the use of Local Microorganisms (LOM) containing bacteria such as Lactobacillus sp, Pseudomonas sp, Azospirillium, Azotobacter, Bacillus, Aeromonas, Aspergillus, phosphate-solubilizing microbes, and cellulolytic microbes act as bioactivators for decomposing organic fertilizers. This study aims to determine the effect of interactions between differences in LOM materials and coffee grounds waste on soybean growth and yield, as well as to determine the combination of concentrations that produce the highest soybean yields. The study was conducted in East Tomohon, North Sulawesi Province, Indonesia, from April to September 2024. The study used a Completely Randomized Design (CRD) with a factorial pattern. The treatments consisted of: Factor I (A) = LOM (Local Microorganisms) A1 = LOM bamboo shoots; A2 = LOM banana stumps; A2 = LOM fruits. Factor II (B) = coffee grounds waste. B0 = without coffee grounds waste; B1 = 20 tons/ha of coffee grounds waste compost, A2 = 40 tons/ha of coffee grounds waste compost. Each treatment was repeated three times so that there were a total of 27 experimental units. Data were analyzed using analysis of variance if there was an effect of treatment followed by the Least Significant Difference (LSD) test of 5%. The results showed that the interaction between Local Microorganisms (LOM) made from fruits and LOM from banana stumps with coffee grounds waste produced the highest soybean seed weight. A dose of 20 tons/ha of coffee grounds waste with Local Microorganisms (LOM) fruits and LOM banana stumps proved effective in increasing soybean yields while reducing the number of empty pods.

Keywords: *Soybeans; Coffee Grounds Waste; Local Microorganisms*

Introduction

The use of organic fertilizers in soybean cultivation is important, but farmers still prioritize the use of chemical fertilizers and pesticides. Organic farming is one of the agricultural technologies that utilizes waste as a soil conditioner to improve the physical, chemical, and biological properties of the soil. Soybeans are the main source of protein and oil that are widely used in various products, such as soybean oil, tofu, tempeh, soy milk, and soy sauce. With the increasing population, the need for soybeans as a source of protein also continues to increase, so its availability needs to be maintained. One approach that needs to be implemented is organic farming by utilizing various wastes, including coffee grounds. Coffee grounds contain various nutrients, including 44.87% organic C, 1.2% nitrogen, 0.02% phosphorus, and 0.35% potassium (Kasongo et al., 2011; Sefanya et al., 2022; Jumar et al., 2023). The use of coffee grounds as organic fertilizer can increase the availability of nutrients for soybeans while reducing dependence on chemical fertilizers so that the impact of its use can be minimized.

Coffee grounds waste can be processed into compost, where in the composting process bio decomposers or activators are needed to accelerate the decomposition of organic materials. One of the decomposers that can be used is the Local Microorganism (LOM), which plays a role in accelerating the decomposition of organic materials into nutrients that can be absorbed by plants. The basic materials for LOM, such as bamboo shoots, banana stumps, and fruits have their respective advantages in the decomposition process. The use of banana stumps as raw materials for LOM is based on the content of growth hormones, such as gibberellins and cytokinins, which play a role in stimulating plant growth. In addition, banana stumps also contain various microorganisms that are beneficial to plants, including phosphate-solubilizing microbes, *Aspergillus* sp., *Lactobacillus* sp., *Pseudomonas* sp, and *Azospirillium* sp., which play a role in increasing the availability of nutrients in the soil (Maspary, 2012; Manullang et al., 2018; Pardede et al., 2019). The use of LOM based on banana stumps in making coffee grounds compost can be an effective alternative in improving the quality of organic fertilizers and affecting soybean growth and yield.

Based on the analysis of nutrient content, Local Microorganisms (LOM) derived from bamboo shoots contain nitrogen (N) of 307 mg/L, phosphorus (P) of 142 mg/L, and have a pH of 4.10. The nutrient content allows LOM bamboo shoots to react well at a LOM dose of 50 ml/L of water so that they can provide nitrogen and gibberellin hormones that play a role in influencing plant growth (Maspary, 2012b). Meanwhile, LOM derived from fruits contains macronutrients in the form of nitrogen (N) of 0.1833%, phosphorus (P) of 54.989 mg/L, and potassium (K) of 3.125 mg/L. In addition, LOM fruit also contains calcium (Ca) 3.7 mg/L, magnesium (Mg) 64.5 mg/L, iron (Fe) 1.605 mg/L, manganese (Mn) 0.274 mg/L, zinc (Zn) 1.115 mg/L, and ammonium (NH_4^+) 38.78 mg/L (Soverda & Evita, 2020; Maretza, 2009; Zulfita, 2013; Wiswasta et al., 2016). In addition to acting as a source of nutrients and growth regulators, LOM also contains various microorganisms that function as bio-decomposers. Microorganisms play a role in accelerating the decomposition process of organic matter when interacting with compost made from coffee grounds waste. Therefore, the use of LOM in the processing of coffee grounds waste-based compost can increase the efficiency of nutrient availability for plants optimally (Bawamenewi & Lase, 2025).

The difference in decomposer types in the coffee grounds' decomposition process affects the color of the resulting compost. Three types of decomposers produce blackish-brown compost, while one type of decomposer produces black compost. This color is an indicator of compost maturity, where mature compost is generally blackish brown (Widarti et al., 2015). Mature compost has darker physical properties compared to the original organic material. The use of this type of decomposer in the coffee grounds composting process causes a significant color change from the raw material to darker (Sefanya et al., 2022). This color change indicates that the decomposition process has taken place well, which is indicated by the decomposition of organic material into more stable humus. Based on this, this study aims to analyze the effect of the use of Local Microorganisms (LOM) and coffee grounds waste on soybean

(*Glycine max* Merrill L.) production results. The use of LOM in the coffee grounds waste decomposition process can improve the quality of compost and affect the growth and yield of soybeans.

Method

The research was conducted in East Tomohon, North Sulawesi Province, Indonesia, from April to September 2024. The materials and equipment used were soybean seeds, coffee grounds waste, compound NPK fertilizer, bamboo shoots, banana stumps, various types of fruits (pineapple, papaya, apple, banana), brown sugar, coconut water, and tools such as meters, scales, ovens, soil processing equipment, and stationery. This study used a Completely Randomized Design (CRD) with a factorial pattern. The treatments consisted of two factors, namely: factor I (A) = LOM (Local Microorganisms) A1 = LOM bamboo shoots; A2 = LOM banana stumps; A2 = LOM fruits. Factor II (B) = coffee grounds waste. B0 = without coffee grounds waste; B1 = 20 tons/ha of coffee grounds waste compost, A2 = 40 tons/ha of coffee grounds waste compost. Each combination of treatments was repeated three times, resulting in a total of 27 experimental units. The parameters observed were the number of empty pods per plant and seed weight per plant. Data were analyzed using Analysis of Variance (ANOVA), and if there was a significant effect of treatment, the analysis was continued with the Least Significant Difference (LSD) test of 5%.

Results and Discussion

The results of statistical analysis showed that the interaction between different types of Local Microorganisms (LOM) and coffee grounds waste had a significant effect on the weight of seeds per soybean plant (Table 1). This study showed that the use of Local Microorganisms (LOM) based on fruits at a dose of 40 tons/ha of coffee grounds waste produced the highest soybean seed weight compared to other treatments. This study is not different from previous studies which stated that increasing organic matter in the soil contributes to increasing soil fertility and sustainable plant productivity (Hartatik et al., 2015). Therefore, the use of LOM and coffee grounds waste compost not only supports more optimal soybean production but also increases soil fertility in the long term.

Table 1. The Effect of Interaction between LOM and Coffee Grounds Waste on Soybean Seed Weight

Treatment/Repeat	B0 (without coffee grounds waste)	B1 (20 tons/ha of coffee grounds waste compost	B2 (40 tons/ha of coffee grounds waste compost)
A1 (LOM bamboo shoots)	15.80 A (a)	14.80 A (a)	19.50 A (a)
A2 (LOM banana stumps)	17.37 A (a)	23.57 B (ab)	29.10 B (b)
A3 (LOM fruits)	20.07 A (a)	36.63 C (b)	44.17 C (b)
LSD 5% = 8.20			

Note: Numbers followed by the same notation in the sign ( ) are read horizontally and not in the sign ( ) are read vertically

The results of the analysis showed that the interaction between various types of Local Microorganisms (LOM) and coffee grounds waste did not have a significant effect on the number of empty pods in soybeans. However, differences in the types of LOM and the implications of coffee grounds had a significant effect on the number of empty pods (Table 2). There was no significant interaction between the two factors indicating that the effectiveness of Local Microorganisms (LOM) and

coffee grounds waste in reducing the number of empty pods was more influenced by each treatment. Local microorganisms (LOM) act as biological agents that increase the activity of soil microorganisms, while coffee grounds waste acts as organic matter that improves soil structure and increases the availability of nutrients for plants (Saraswati et al., 2006). The results of previous studies have shown that the combination of local microorganisms and coffee grounds compost plays a role in increasing plant productivity by improving soil nutrient conditions and increasing nutrient absorption by plants (Sebayang, 2020; Siregar, 2023; Siahaan & Suntari, 2019). By increasing the content of organic matter and CEC, the soil becomes more fertile and can provide more optimal nutrients for soybean growth.

The results of the study showed that the application of Local Microorganisms (LOM) based on fruits at a dose of 40 tons/ha of coffee grounds waste produced the highest soybean seed weight. In addition, LOM based on banana stumps with the same dose also produced high soybean seed weight results and showed no significant difference compared to the treatment of LOM banana stumps at a dose of 20 tons/ha of coffee grounds waste. This indicates that LOM based on fruits and banana stumps can increase soybean productivity, especially when combined with the application of coffee grounds compost in optimal amounts.

Table 2. The Effect of Different Types of LOM and Coffee Grounds Waste on the Weight of Empty Soybean Pods

Treatment/Repeat	Average Number of Empty Pods
A1 (LOM bamboo shoots)	1.28 b
A2 (LOM banana stumps)	0.56 a
A3 (LOM fruits)	0.44 a
LSD 5% = 0.53	
B0 (without coffee grounds waste)	1.56 b
B1 (20 tons/ha of coffee grounds waste compost	0.44 a
B2 (40 tons/ha of coffee grounds waste compost)	0.27 a
LSD 5% = 0.53	

The results of the study presented in Table 3 show that Local Microorganisms (LOM) based on fruits and banana stumps have high organic carbon (C-organic) content, and contain nitrogen (N), phosphorus (P), and potassium (K) in significant amounts. LOM plays a role in the decomposition process of coffee grounds waste, accelerating the transformation of organic matter into compost that is rich in nutrients. With the increasing availability of nutrients in the soil, soybean plants obtain better-growing conditions, which ultimately increases seed weight per plant and reduces the number of empty pods.

Table 3. Content of N, P, K, pH, and C-Organic Coffee Grounds with Local Microorganisms (LOM)

Coffee Grounds Waste + LOM	pH H_2O	C-Organik (%)	N (%)	P (ppm)	K (%)
Banana stumps	7.04	34.42	0.33	1.69	1.25
Fruits	7.49	33.42	4.43	1.56	1.14

Source: Palm Plant Instrument Standard Testing Center Testing Laboratory, 2024 (International Organization of Standardization 17025 Accreditation)

Discussion

Coffee grounds waste, as a source of organic soil material, not only plays a role in increasing soil fertility but also affects the physical properties of the soil, such as color changes, reduced plasticity, and

decreased soil cohesion. Thus, the soil becomes looser and easier to process, which indirectly supports soybean growth. Local Microorganisms (LOM) used as liquid organic fertilizers have the advantage of increasing the population of soil microbes that play a role in the decomposition of organic matter into bananas. Bananas are known to contain various beneficial microorganisms, such as *Lactobacillus* sp., *Pseudomonas* sp., *Azospirillum* sp., *Azotobacter* sp., *Bacillus* sp., *Aeromonas* sp., and fungi such as *Aspergillus* sp. In addition, this LOM contains phosphate-solubilizing microbes and cellulolytic microbes that contribute to the process of decomposing organic waste into high-quality compost (Maspary, 2012b; Pardede et al., 2019; Manullang et al., 2018; Saraswati et al., 2006). Decomposing bacteria in Local Microorganisms (LOM) of banana stumps plays an important role in accelerating the composting process of coffee grounds waste, resulting in more stable and nutrient-rich compost for plants. Increasing the dose of coffee grounds compost application significantly increases the levels of organic carbon (C-organic) in the soil, which functions as an indicator of soil quality (Cervera-Mata et al., 2018). The higher the C-organic content, the more the soil's ability to retain moisture, provide nutrients, and support the activity of microorganisms that are beneficial to plants. The results of this study are not different from previous studies which stated that increasing organic matter in the soil contributes to increasing soil fertility and sustainable plant productivity (Roidah, 2013; Hartatik et al., 2015).

The presence of nutrients in sufficient quantities is important for plant growth and development. The available nutrients allow plants to carry out metabolic processes optimally. This process plays a role in cell division, enlargement, and elongation, which ultimately helps overall plant growth (Cervera-Mata et al., 2018; Roidah, 2013; Hartatik et al., 2015). Thus, the use of LOM and coffee grounds waste compost in organic farming systems helps to increase plant productivity sustainably by ensuring optimal nutrient availability for soybean plants. The application of coffee grounds compost has been shown to increase pH, organic carbon content (C-organic), total nitrogen (N-total), available phosphorus (P-available), exchangeable potassium (K-dd), and exchangeable sodium (Na-dd), and Cation Exchange Capacity (CEC). Improvement in soil chemical properties shows that coffee grounds compost is useful as an effective ameliorant in increasing soil fertility compared to control treatments without the provision of coffee grounds compost (Siahaan & Suntari, 2019; Jumar et al., 2022; Pramesti et al., 2024).

LOM application contributes to increased soybean yields and reduced number of empty pods. LOM acts as a source of nutrients containing macro and micronutrients, as well as a biological agent that accelerates the decomposition of organic matter in the soil. In addition, LOM contains bacteria that function as plant growth promoters. LOM made from banana stumps is known to have a fairly high nutritional content, such as carbohydrates of 76.57%, water 18.97%, fat 2.11%, protein 0.32%, calcium 717 mg/100 g, phosphorus 114 mg/100 g, and iron 0.13 mg/100 g (Maspary, 2012b; Maspary, 2012a).

LOM made from banana stumps contains various important microorganisms such as *Lactobacillus* sp., *Pseudomonas* sp., *Azospirillium* sp., *Azotobacter* sp., *Bacillus* sp., *Aeromonas* sp., *Aspergillus* sp., as well as phosphate and cellulolytic solubilizing microbes (Manullang et al., 2018; Indawan et al., 2024). These microorganisms are useful for accelerating the decomposition process of organic matter and increasing the availability of nutrients needed by plants. Previous studies have shown that the use of LOM as a bioactivator increases the efficiency of organic matter utilization and increases the availability of nutrients in the soil (Siahaan & Suntari, 2019; Pramesti et al., 2024). Therefore, the combination of LOM and coffee grounds compost can be an effective strategy for increasing soybean productivity sustainably.

Banana stumps are known to contain macronutrients such as phosphorus (P) and potassium (K), which play an important role in supporting the growth and development of fruit and plant stumps. In addition, banana peels are also rich in micronutrients, including calcium (Ca), magnesium (Mg), sodium (Na), and zinc (Zn). These micronutrients function to increase plant resistance to pests and diseases and play a role in the process of flower and fruit formation. With this balanced nutritional content, banana peels can provide benefits for plants in achieving optimal growth and supporting maximum production

results (Ho et al., 2015; Zou et al., 2022).

Several previous studies have also confirmed that the application of LOM in agricultural systems can increase the activity of beneficial soil microbes, improve soil structure, and increase the efficiency of nutrient absorption by plants. In addition, the combination of LOM with compost from coffee grounds waste has been shown to increase the organic matter content of the soil and contribute to increasing more optimal harvest results compared to treatments without LOM or compost (Saraswati et al., 2006; Siahaan & Suntari, 2019; Pramesti et al., 2024). Other research by Yosephine et al., (2021); Zou et al., (2022), and Indawan et al., (2024) showed that LOM derived from certain organic materials, such as banana stumps and fruits, can provide long-term nutrients while improving soil quality to support sustainable plant growth. Therefore, the application of LOM and compost from organic waste can be an effective strategy for increasing soybean productivity and maintaining soil fertility.

Conclusion

The interaction of Local Microorganisms (LOM) based on fruits and banana stumps with a dose of 20 tons/ha of coffee grounds waste has been proven to provide the highest soybean seed weight. This shows that the use of easily obtained organic materials can increase soybean production without prioritizing inorganic fertilizers. The optimal dose of 20 tons/ha of coffee grounds waste combined with Local Microorganisms (LOM) from fruits and banana stumps plays a role in increasing soybean yields and reducing the number of empty pods. The use of LOM and organic waste as natural fertilizers contributes to increasing soil fertility and reducing production costs and farmers' dependence on inorganic fertilizers.

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References

Bawamenewi, T. ., & Lase, N. . (2025). Peran Mikrobiologi dalam Pengolahan Limbah Pertanian Menjadi Pupuk Organik. *Hidroponik: Jurnal Ilmu Pertanian Dan Teknologi Dalam Ilmu Tanaman*, *2*(70), 53–63.

Cervera-Mata, A., Pastoriza, S., Rufián-Henares, J. Á., Párraga, J., Martín-García, J. M., & Delgado, G. (2018). Impact of Spent Coffee Grounds as Organic Amendment on Soil Fertility and Lettuce Growth in Two Mediterranean Agricultural Soils. *Archives of Agronomy and Soil Science*, *64*(6), 790–804. https://doi.org/10.1080/03650340.2017.1387651.

Hartatik, W., Husnain, & Widowati, L. . (2015). Peranan Pupuk Organik dalam Peningkatan Produktivitas Tanah dan Tanaman. *Jurnal Sumberdaya Lahan*, *9*(2), 107–120.

Ho, L. H., Tan, T. C., Abdul Aziz, N. A., & Bhat, R. (2015). In Vitro starch Digestibility of Bread with Banana (Musa Acuminata X Balbisiana ABB cv. Awak) Pseudo-stem Flour and Hydrocolloids. *Food Bioscience*, *12*, 10–17. https://doi.org/10.1016/j.fbio.2015.07.003.

Indawan, E., Agastya, I. M. ., Julianto, R. P. ., Ahmadi, K., & Hastuti, P. . (2024). Training on Making Local Microorganism of Banana Buds for Sustainable Agriculture in Gadingkasri Village Klojen District Malang City. *Jurnal Abdi Masyarakat*, *2*(2), 442–449.

https://jurnal.forindpress.com/index.php/jamas.

Jumar, J., Saputra, R. A., Wahdah, R., Elmi, M., & Sholeha, Y. N. (2023). The potential of coffee ground compost to enhance soil pH, growth, and production of mustard greens in acid-dry land. *IOP Conference Series: Earth and Environmental Science*, *1266*(1). https://doi.org/10.1088/1755-1315/1266/1/012037.

Jumar, Saputra, R. ., & Sefanya, M. . (2022). Penentuan Kualitas Kompos Ampas Kopi Berdasarkan Karakteristik Fisik dan Uji Perkecambahan Benih. *Prosiding Seminar Nasional Lingkungan Lahan Basah*, *7*(1), 285–289.

Kasongo, R. K., Verdoodt, A., Kanyankagote, P., Baert, G., & Ranst, E. Van. (2011). Coffee waste as an alternative fertilizer with soil improving properties for sandy soils in humid tropical environments. *Soil Use and Management*, *27*(1), 94–102. https://doi.org/10.1111/j.1475-2743.2010.00315.x.

Manullang, R. R., Rusmini, R., & Daryono, D. (2018). Kombinasi Mikroorganisme Lokal Sebagai Bioaktivator Kompos. *Jurnal Hutan Tropis*, *5*(3), 259. https://doi.org/10.20527/jht.v5i3.4793.

Maretza, D. . (2009). *Pengaruh Dosis Ekstrak Rebung Bambu Betung terhadap Pertumbuhan Semai Sengon (Paraserianthes falcataria (L.)* (Laporan Penelitian Institut Pertanian Bogor).

Maspary. (2012a). *Apa Kehebatan MOL Bonggol Pisang*. Kementerian Pertanian. http://www.gerbangpertanian.com/20%0A12/05/apa-kehebatan-mol-bonggolpisang.html.

Maspary. (2012b). *Membuat MOL Rebung Bambu*. Kementerian Pertanian. http://gerbangpertanian.com.

Pardede, N., Rizali, A., & Sari, N. (2019). Optimasi Lahan Pada Sistem Tumpang Sari Jagung Manis. *Jurnal Agroqua*, *17*(2), 115–125. https://doi.org/10.32663/ja.v.

Pramesti, F. ., Firnia, D., Putri, W. ., & Sodiq, A. . (2024). Applying coffee processing waste as an organic material against growth and yield of caisim plant (Brassica chinensis var . parachinensis). *Gema Wiralodra*, *15*(2024), 156–166.

Roidah, I. S. (2013). Manfaat Penggunaan Pupuk Organik Untuk Kesuburan Tanah. *Jurnal Universitas Tulungagung Bonorowo*, *1*(1).

Saraswati, R., Setyorini, D., & Anwar, K. (2006). Organisme Perombak Bahan Organik. In *Balai Besar Litbang Sumberdaya Lahan Pertanian* (Vol. 1, Issue 2).

Sebayang, M. . (2020). *Pengaruh Pemberian Ampas Kopi Terhadap Pertumbuhan Dan Hasil Tanaman Kangkung Darat (Ipomea reptans Poir)*. Universitas Islam Negeri Sumatera Utara.

Sefanya, M. A., Jumar, J., Rizali, A., & Saputra, R. A. (2022). Evaluation of the Chemical Quality of Coffee Grounds Composted by Various Types of Decomposers Using a Scoring System. *Trop. Wetland J*, *8*(2), 21–27. https://doi.org/10.20527/twj.v8i2.113.

Siahaan, W., & Suntari, R. (2019). The Effect of Application of Coffee Waste Compost on Chemical Properties of Andisol Ngabab, Malang Regengy. *Jurnal Tanah Dan Sumberdaya Lahan*, *6*(1), 1123–1132. https://doi.org/10.21776/ub.jtsl.2019.006.1.11.

Siregar, F. A. (2023). Penggunaan Pupuk Organik Dalam Meningkatkan Kualitas Tanah Dan Produktivitas Tanaman. In *Resume Jurnal*.

Soverda, N., & Evita. (2020). Peran Mikroorganisme Lokal Rebung Bambu Terhadap Pertumbuhan Dan Kandungan Protein Tanaman Kedelai. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, *4*(2), 223–233.

https://doi.org/10.22437/jiituj.v4i2.11610.

Widarti, B. ., Wardhini, W. ., & Sarwono, E. (2015). Pengaruh Rasio C/N Bahan Baku Pada Pembuatan Kompos Dari Kubis dan Kulit Pisang. *Jurnal Integrasi Proses*, *5*(2), 75–80.

Wiswasta, I. G. N. ., I Ketut, W. ., & Dewa, N. . (2016). *Mikro Organisme Lokal (MOL) Sebagai Pupuk Cair dari Limbah Pertanian dan Kaitannya Dengan Ketersediaan Hara Makro dan Mikro*. Universitas Mahasaraswati Denpasar.

Yosephine, I. O., Efendi, E., & Widya, T. L. (2021). Pengaruh Pupuk Organik Cair dari Bonggol Pisang Terhadap Kadar hara Nitrogen Total dan C-Organik Pada Bibit Kelapa Sawit. *Jurnal Agro Estate*, *5*(2), 89–109. https://doi.org/10.47199/jae.v5i2.89.

Zou, F., Tan, C., Zhang, B., Wu, W., & Shang, N. (2022). The Valorization of Banana By-Products: Nutritional Composition, Bioactivities, Applications, and Future Development. *Foods*, *11*(20). https://doi.org/10.3390/foods11203170.

Zulfita, F. . (2013). Pengaruh Konsentrasi Mikroorganisme Lokal (MOL) Rebung Bambu Terhadap Pertumbuhan dan Hasil Tanaman Kailan pada Tanah Gambut. *Jurnal Lembaga Penelitian Universitas Tanjung Pura Pontianak*.