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Effect of Liquid Organic Fertilizer from Lamtoro Leaves, Leri Water, and Coconut Fiber on the Growth of Land Kale (*Ipomoea reptans* Poir.)

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Abstract
Lamtoro leaves, leri water, and coconut fiber are organic materials and wastes containing macronutrients and micronutrients, thus they can be used as basic ingredients for liquid organic fertilizer (LOF). This research aims to know the nutrient content of LOF and the effect of its administration, as well as the most optimal concentration on the growth of land kale plants. The research was designed using one-factor Randomized Block Design. LOF were applied at five concentrations; P0 = inorganic; P1 = 10%; P2 = 20%; P3 = 30%; P4 = 40%. Plant growth parameters measured were plant height, number and length of leaves, and plant wet biomass. Statistical data analysis used one-way ANOVA test, followed by Duncan test. Results showed that the nutrients of LOF with lamtoro, leri, and coconut fiber were N 0.92%; P 0.01%; K 0.23%; C/N ratio 6.5; Fe 128.65 mg/kg. LOF was found affecting the growth of land kale plants. Among the four LOF concentrations, the most optimal concentration was 40% on all growth parameters. However, plants treated P0 treatment still had higher growth parameters compared to LOF treatments.

Keywords: concentrations; fertilizer; organic material; organic waste

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INTRODUCTION

Land kale (*Ipomoea reptans* Poir.) is one of the many types of vegetables that are in great demand by the public and contains quite high nutrients, including iron, vitamins A, B, C, and calcium (Hidayati *et al*., 2017). The demand for kale shows an increase proportional to the increasing public awareness of the importance of fulfilling daily nutritional needs. The high market demand for kale must be balanced with the amount of production. Data from the Central Statistics Agency in 2022 shows that the production of kale plants decreased in 2021– 2022, from 341.196 tons to 329.616 tons. This might be caused by the large use of inorganic fertilizers, which possibly reducing soil quality on long period of application, as well as soil and plant productivity (Setiawan *et al*., 2022).

One of the efforts to improve nutrients and soil fertility is by applying organic fertilizer (Roidah, 2013). The application of organic fertilizers aims to maintain and improve soil fertility and preserve the environment. Liquid organic fertilizer (LOF) has many benefits and advantages, including improving the quality of soil nutrients and can be more easily absorbed by plants (Febrianna *et al*., 2018). Futhermore, the limited or absent use of mineral fertilization represents the main feature of organic farming, and several organic farming systems are more energy efficient than the other farming systems (Smith *et al*., 2015). Various types of nutrients in LOF can help fulfill nutrients for plants so as to help increase plant growth (Kurniawan *et al*., 2017). The alternative organic materials with the main nutrients N, P, and K are lamtoro leaves, leri water (rice washing water), and coconut fiber. The three basic ingredients also contain micronutrients including calcium, magnesium, iron, zinc, and so on.

Lamtoro leaves are green plants that can be used for fertilizer-making materials and can fertilize plants, and are easily found in tropical areas and mostly grow wild in rice fields (Ratrinia *et al*., 2014). Lamtoro leaves are high in N so that the nutrients needed by plants can be available, as well as restoring soil conditions to be fertile. In addition, lamtoro leaves contain micronutrients Ca, Mg, Mn, and Fe (Munir and Swasono, 2017). Previous research conducted by Febriani *et al*., (2020) stated that giving lamtoro leaves LOF treatment at various concentrations had an effect on leaf growth and increased root length for land kale plants. Added to the results of research by Pu'u and Mutiara (2018) which states that lamtoro leaves contain the element N of 3.01%.

Leri water is a housebold waste that is easily obtained in daily life and has no economic value, but it will be valuable and can be utilized if processed in the right way (Asngad *et al*., 2013). The use of leri water in LOF material is a way of utilizing organic waste so that waste containing nutrients is not wasted. The virtue of this liquid waste is as a provider of phosphorus nutrients, which function to help plant growth (Wardiah *et al*., 2014). In addition to phosphorus nutrients, leri water also contains iron (Fe), calcium (Ca), and magnesium (Mg). Based on the results of research by Kustiawan *et al*., (2024), the provision of leri water (rice washing water) treatment has a significant effect on the growth and production of green mustard plants.

Coconut fiber comes from the coconut fruit, the contents of which are widely consumed by the community and easily found in tropical areas, such as Indonesia. Coconut fiber waste is generally only used to make crafts, but most coconut fiber is just thrown away and not used (Kuntardina *et al*., 2022). Coconut fiber waste contains elements that can help increase plant growth, namely elements of K and P, as well as Ca, Mg, and Na (Wijaya *et al*., 2017). According to research by Novianto *et al*., (2020), it was stated that the application of coconut fiber LOF given to mustard greens showed an influence on its development and productivity. The utilization of coconut fiber in organic fertilizer material can be used as an example of a method of overcoming coconut fiber waste.

The aims of this research are to determine the levels of nutrients according to quality standards and the result of giving LOF treatments made from lamtoro leaves, leri water, and coconut fiber at various concentrations, as well as to identify the most optimal concentration for the growth and development of land kale plants.

MATERIALS AND METHODS

There were two stages in this research, namely the manufacture and application of liquid organic fertilizer (LOF) treatment based on lamtoro leaves, leri water, and coconut fiber to land kale plants. The research lasted five months, from February 2024 to June 2024, in the greenhouse of the Agricultural Extension Center of Kamal District, Bangkalan Regency. The tools and materials used included a fermentation container in the form of an 80-liter plastic bucket, 30 x 30 cm polybags, "Serimpi Cap Panah Merah" land kale seeds, lamtoro leaves, leri water (rice washing water), and coconut fiber.

The research design in the LOF treatment stage was a one-factor Randomized Block Design (RBD), LOF made from lamtoro leaves, leri water, and coconut fiber at various concentrations. There were five concentrations, namely P0 = inorganic fertilizer (control); P1 = 10% LOF; P2 = 20% LOF; P3 = 30% LOF; and P4 = 40% LOF, with five repetitions so that there were 25 experimental units.

Table 1. Research layout of Liquid Organic Fertilizer (LOF) application stage

Block 1	Block 2	Block 3	Block 4	Block 5
P0 (1)	P4 (3)	P3 (5)	P2 (2)	P1 (4)
P1 (2)	P0 (4)	P4 (1)	P3 (3)	P2 (5)
P2 (3)	P1 (5)	P0 (2)	P4 (4)	P3 (1)
P3 (4)	P2 (1)	P1 (3)	P0 (5)	P4 (2)
P4 (5)	P3 (2)	P2 (4)	P1 (1)	P0 (3)

Information:
P0 : inorganic fertilizer
P1 : 10% LOF
P2 : 20% LOF
P3 : 30% LOF
P4 : 40% LOF
(1), (2), (3), (4), (5) : repetition

The research steps in the LOF-making stage began with the preparation of materials, namely 5 kg of lamtoro leaves, 8 liters of leri water, 2.5 kg of coconut fiber, 30 liters of water, 1 liter of molasses, and 1 liter of EM4 solution. The lamtoro leaves and coconut fiber were cut into smaller pieces, rinsed with water and drained. Next, all the prepared ingredients were placed in a fermentation container and stirred until evenly mixed. The container was then tightly sealed, and the fertilizer was fermented for 21 days under anaerobic conditions. If there was a sour smell, the fertilizer was ready for use. The results of LOF fermentation were then laboratory tested for N, P, K, C/N ratio, and Fe content.

The research steps in the LOF treatment stage began with the preparation of planting media and planting of land spinach seeds. The planting media was prepared by combining latosol soil, compost, and rice husk in a 1:1:1 ratio. Before planting the seeds, selection was carried out by soaking the seeds using warm water for 30 minutes and then selecting the drowned seeds. Each polybag was

planted with three seeds by making three holes, placing one seed in each hole, and then covering them. The distance between polybags was 15 cm. Watering using water regularly every morning and evening. LOF application began when the plants reached 7 days after planting (DAP) and continued weekly until the plants were ready to harvest (35 DAP), with a volume of 60 ml/polybag each time. Meanwhile, the application of inorganic fertilizers involved using urea at a dose of 2 grams/polybag, applied once when the plants reached 7 DAP. The growth parameters measured included plant height, number and length of leaves, and plant wet biomass.

The results of the study, including the nutrient content test results, were analyzed descriptively. The growth observations of land kale plants were analyzed using an ANOVA test, followed by post-hoc Duncan test.

RESULTS

Based on the reasearch that has been carried out on the provision of liquid organic fertilizer (LOF) treatment based on lamtoro leaves, leri water, and coconut fiber, the results of nutrient content levels and growth parameters, namely plant height, number and lenght of leaves, and plant wet biomass are obtained (Table 2 and Table 3).

Table 2. Test results of Liquid Organic Fertilizer (LOF) nutrient content

No.	Parameters	Nutrient Content	Quality Standard *)
1.	N (%)	0.92	2 – 6
2.	P (%)	0.01	2 – 6
3.	K (%)	0.23	2 – 6
4.	C – organic (%)	5.94	Minimum 10
5.	C/N Ratio	6.5	-
6.	Fe (mg/kg)	128.65	90 - 900
7.	pH	5.0	4 – 9

Information: *) Based on the Decree of the Minister of Agriculture of the Republic of Indonesia No. 261/KPTS/SR.310/M/4/2019 on Minimum Technical Requirements for Organic Fertilizers, Biofertilizers, and Soil Improves

Table 3. Observation of the result of Liquid Organic Fertilizer (LOF) application on land kale plants

Treatment	Plant Height (cm)	Number of Leaves (blade)	Leaf Length (cm)	Plant Wet Biomass (gram)
P0 (urea)	55.3 ± 2.3^{c}	22 ± 3.1^{b}	17.6 ± 1.4^{c}	34.0 ± 3.3^{c}
P1	43.9 ± 1.9^{a}	14 ± 2.6^{a}	14.0 ± 1.1^{a}	17.1 ± 1.3^{a}
P2	44.3 ± 1.6^{a}	14 ± 1.1^{a}	14.2 ± 1.4^{ab}	18.0 ± 1.9^{a}
P3	48.1 ± 2.9^{b}	17 ± 2.3^{a}	16.0 ± 1.6^{bc}	20.3 ± 1.8^{ab}
P4	48.5 ± 1.6^{b}	18 ± 4.3^{a}	16.4 ± 0.9^{c}	22.7 ± 4.8^{b}

Information: Different letters (a,b,c) indicated significant difference according to Duncan test at 0.05.

The test results implied that the levels of N, P, K, C-organic, C/N ratio, and Fe in LOF are 0.92%; 0.01%; 0.23%; 5.94%; 6.5; and 128.65 mg/kg, respectively (Table 2). From this data, it can be seen that the levels of N, P, and K elements have not met the quality standards. Meanwhile, the micronutrient Fe and pH of liquid organic fertilizer have met the quality standards.

Based on the data, the results of the analysis of all data imply that the provision of various concentrations of LOF affects all parameters (table 3). The LOF treatment (P1, P2, P3, P4) implies that the higher the concentration of LOF, the higher the number of growth parameters. Although the results of the LOF treatment are still lower than P0 (urea), the use of fertilizer can be said to be effective for the growth of land kale and is expected to replace the use of inorganic fertilizers in the future.

DISCUSSION

Based on the results of LOF testing conducted at the Technical Implementation Unit of Tobacco Institute Goods Quality Certification Testing Surabaya and the Land Resources Laboratory of the Faculty of Agriculture of the State Development University "Veteran" East Java, the nutrients contained in LOF are N, P, K of 0.92%, 0.01%, and 0.23%, respectively (table 2). The test results have not met the quality standards, so it is still necessary to optimize the composition of LOF-making materials to increase the levels of nutrient content. Meanwhile, Fe at 128.65 mg/kg has met the quality standard.

The element N is one of the elements that is needed by plants, because it plays a very important role in vegetative growth, along with the element K which is needed in the photosynthesis process. With the availability of this element, it can increase the growth of the plant crown which also has an impact on triggering the increase in plant height. The element N also plays a role in compiling proteins

that function to form tissues in living things, as well as chlorophyll which functions to make plant leaves green and spur root and leaf growth (Kurniawan *et al*., 2017; Sarif *et al*., 2015). The element Fe also plays a role in the formation of chlorophyll and enzymes, so the presence of these two elements greatly helps the growth of land kale leaves (Fahad *et al*., 2014). The element P is also important because it plays a role in cell division, root and shoot development, and metabolic processes such as respiration and nitrogen fixation (Malhotra *et al*., 2018).

Increased availability of nitrogen can increase the growth of leaf length and wet biomass of plants and help the development of roots that function as nutrient and water absorbers from the soil (Liu *et al*., 2012). High amounts of available N can produce high wet plant biomass due to an increase in chlorophyll which is important in the photosynthesis process. The increase in chlorophyll raises photosynthesis rate and the results are used for the growth of plant organs. The larger plant organs are, the higher the amount of water absorbed (Pramitasari *et al*., 2016).

From the LOF test results, the C/N ratio is also known, as one of the important factors in the balance of nutrients. According to Amnah and Friska (2019), fertilizer quality will be better if the C/N ratio value of the fertilizer is not far from the soil C/N ratio of 10 – 12. The LOF test results show a ratio value of 6.5, which does not follow the soil C/N ratio. The low ratio is because the amount of nitrogen is greater than the amount of carbon (Wasilah *et al*., 2018). The longer the fertilizer fermentation time, the lower the C/N ratio. The amount of C element in the fertilizer-making material has decreased because it is used as an energy source by microorganisms. Meanwhile, the N element increases due to the process of decomposing the material by microorganisms to produce ammonia and nitrogen (Surtinah, 2013). Other chemical properties observed were the degree of acidity (pH), which resulted in a value of 5, which means that it meets the quality standards (4 – 9). The physical properties observed were color and aroma/odor. The fertilizer produced was brown and smelled sour like fermented tape. Following the opinion of Astuti *et al*., (2021), indicators of the success of making LOF include acidic pH, sour smell like tape fermentation, and no foul odor.

Land kale can grow optimally with the fulfillment of growing conditions, including a temperature of 25 – 30°C, soil with sufficient organic matter, and adequate water and light content. The growth of land kale can also be affected by internal and external factors. Internal factors include genes and hormones. Genes determine the genetic traits of each individual, while hormones regulate physiological processes. Meanwhile, external factors include sunlight, temperature, humidity, nutrients, and water. Light and water are the most important factors in determining the plant growth process. Plants receiving sufficient light results in green coloring in its leaves, indicating sufficient chlorophyll and photosynthetic activity. Adequate water affects growth and development and acts as a solvent, facilitating nutrients absorption. Photosynthesis also requires water and CO_2 which will be formed into glucose and oxygen (Mabakotawasi *et al*., 2022; Nurmaeli and Toifur, 2015).

The application of LOF based on lamtoro leaves, leri water, and coconut fiber affects the growth of kale and improves soil conditions with various nutrient content. This is in accordance with Roidah's (2013) statement that LOF application is an effort to fix soil nutrients and maximize soil fertility. Without fullfilling the levels of N, P, and K according to quality standards, can be caused by improper fermentation time and the amount of composition used in making LOF (Jeksen and Mutiara 2017).

Among all the treatments, P0 (urea) produced the best parameter measurements. This is due to the high N element in urea inorganic fertilizer which is the main element in the vegetative growth process. In addition, plant yields from the use of inorganic fertilizers are fairly fast growing, so the use of inorganic fertilizers can be said to be good in the short term because of its impact on the environment such as hard agricultural soil and polluted irrigation water. For the LOF treatment, P4 (40% concentration) produced the best measurements among other LOF treatments on all parameters, so it is expected to replace the use of inorganic fertilizers and is good to use for a long time. Supported by the statement of Sanda and Hasnelly (2023) that the natural/organic ingredients in liquid organic fertilizer will not have an impact on the environment or plants even though it is often used. Therefore, it is recommended that farmers prefer the use of liquid organic fertilizers by considering the adverse effects of using inorganic fertilizers. The best LOF concentration is 40% concentration (400 ml LOF + 600 ml water).

CONCLUSION

The results showed that the elements of N, P, K, C/N ratio, and Fe in Liquid Organic Fertilizer (LOF) were 0.92%, 0.01%; 0,23%, 6.5; and 128.65 mg/kg, respectively. Looking at this data, it can be seen that the content of these nutrients does not meet the hypothesis that the content of nutrients N, P, K,

and C/N ratio in LOF made from lamtoro leaves, leri water, and coconut fiber meets the quality standards. However, the micro-nutrient Fe met the quality standard. The LOF treatments showed a significant effect on the growth and development of land kale plants, and the most optimal LOF concentration was 40% concentration with a composition of 400 ml LOF + 600 ml water in all parameters, namely plant height, number and length of leaves, and plant wet biomass. Although the results of LOF treatments are still lower than P0 (urea), LOF treatments have shown significant results.

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CONFLICT OF INTEREST

There is no conflict of interest.

REFERENCES

Amnah R and Friska M, 2019. Pengaruh Aktivator Terhadap Kadar Unsur C, N, P, dan K Kompos Pelepah Daun Salak Sidimpuan. *Jurnal Pertanian Tropik* 6(3): 342 – 347.

Asngad A, Astuti P and Rahmawati IN, 2013. Pemanfaatan Limbah Air Cucian Beras IR-36 dan IR-64 (Air Leri) Untuk Pembuatan Sirup Melalui Proses Fermentasi Dengan Penambahan Bunga Rosella Sebagai Pewarna Alami. *Seminar Nasional X Pendidikan Biologi FKIP UNS 2013*. Fakultas Keguruan dan Ilmu Pendidikan Universitas Sebelas Maret.

Astuti Y, Setyaningsih M, Lestari S and Anugrah D, 2021. Pelatihan Pembuatan Pupuk Organik Cair (POC) Sebagai Alternatif Pengganti AB Mix Pada Perangkat Hidroponik di SMA Kebangsaan Pondok Aren. *Jurnal ABDI* 7(1): 6 – 11.

Fahad S, Ahmad KM, Anjum MA and Hussain S, 2014. The Effect of Micronutrients (B, Zn, and Fe) Foliar Application On The Growth, Flowering, and Corm Production of Gladiolus (*Gladiolus grandifloras* L.) in Calcareous Soils. *Journal of Agricultural Science and Technology* 16(1): 1671 – 1682.

Febriani WP, Viza RY and Marlina L, 2020. Pengaruh Pemberian Pupuk Organik Cair Dari Daun Lamtoro (Leucaena leucocephala L.) Terhadap Pertumbuhan Tanaman Kangkung Darat (*Ipomea reptans* Poir). BIOCOLONY: *Jurnal Pendidikan Biologi dan Biosains* 3(1): 10 – 18.

Febrianna M, Prijono S and Kusumarini N, 2018. Pemanfaatan Pupuk Organik Cair Untuk Meningkatkan Serapan Nitrogen serta Pertumbuhan dan Produksi Sawi (*Brassica juncea* L.) Pada Tanah Berpasir. *Jurnal Tanah dan Sumberdaya Lahan* 5(2): 1009 – 1018.

Hidayati N, Rosawanti P, Yusuf F and Hanafi N, 2017. Kajian Penggunaan Nutrisi Anorganik Terhadap Pertumbuhan Kangkung (*Ipomoea reptans* Poir) Hidroponik Sistem Wick. *Daun: Jurnal Ilmiah Pertanian dan Kehutanan* 4(2): 75 – 81.

Jeksen J and Mutiara C, 2017. Analisis Kualitas Pupuk Organik Cair Dari Beberapa Jenis Tanaman Leguminosa. *Jurnal Pendidikan MIPA* 7(2): 124 – 130.

Kuntardina A, Septiana W and Putri QW, 2022. Pembuatan Cocopeat Sebagai Media Tanam Dalam Upaya Peningkatan Nilai Sabut Kelapa. *J – ABDIPAMAS (Jurnal Pengabdian Kepada Masyarakat)* 6(1): 145 – 154.

Kurniawan E, Zainuddin G and Nurjannah P, 2017. Pemanfaatan Urine Kambing Pada Pembuatan Pupuk Organik Cair Terhadap Kualitas Unsur Hara Makro (NPK). *Seminar Nasional Sains dan Teknologi 2017*. Fakultas Teknik Universitas Muhammadiyah Jakarta.

Kustiawan N, Maizar, Salman S and Riswandi, 2024. Application of Rice Washing Water and Organic NPK to Increase Caisim Mustard Plant (*Brassica juncea* L) Growth and Production. *Juatika* 6(1): 101 – 115.

Liu B, Cheng L, Li M, Liang D, Zou Y and Ma F, 2012. Interactive Effects of Water and Nitrogen Supply on Growth, Biomass Partitioning, and Water-use Efficiency of Young Apple Trees. *African Journal of Agricultural Research* 7(6): 978 – 985.

Mabakotawasi S, Sutardi and Istiqomah, 2022. Uji Efektivitas Penggunaan MA – 11 Terhadap Pertumbuhan Tanaman Tomat (*Solanum Lycopersicum Miller*). *Biolearning Journal* 9(2): 14 – 16.

Malhotra H, Vandana Sharma S and Pandey R, 2018. *Phosphorus Nutrition: Plant Growth in Response to Deficiency and Excess.* In: Plant Nutrients and Abiotic Stress Tolerance. Springer, Singapore.

Munir M and Swasono MAH, 2017. Potensi Pupuk Hijau Organik (Daun Trembesi, Daun Paitan, Daun Lantoro) Sebagai Unsur Kestabilan Kesuburan Tanah. *Agromix* 3(2): 1 – 17.

Novianto N, Effendy I and Aminurohman A, 2020. Respon Pertumbuhan dan Hasil Tanaman Sawi (*Brassica junceea* L.) Terhadap Pupuk Organik Cair Hasil Fermentasi Sabut Kelapa. *Agroteknika* 3(1): 35 – 41.

Nurmaeli RRE and Toifur M, 2015. Analisis Penentuan Kandungan Gas Oksigen (O2) Fotosintesis Tanaman Gelombang Cinta (*Anthuriumsp*) Pada Variasi Daya Lampu. *Jurnal Taman Vokasi* 3(32): 490 – 499.

Pramitasari HE, Wardiyati T and Nawawi M, 2016. Pengaruh Dosis Pupuk Nitrogen dan Tingkat Kepadatan Tanaman Terhadap Pertumbuhan dan Hasil Tanaman Kailan (*Brassica oleraceae* L.). *Jurnal Produksi Tanaman* 4(1): 49 – 56.

Pu'u YMSW and Mutiara C, 2018. Ragam Tanaman In Situ Sebagai Pupuk Organik di Kecamatan Detusoko dan Kelimutu Kabupaten Ende. *Jurnal Bioindustri* 1(1): 27 – 34.

Ratrinia PW, Maruf WF and Dewi EN, 2014. Pengaruh Penggunaan Bioaktivator EM4 dan Penambahan Daun Lamtoro (*Leucaena leucophala*) Terhadap Spesifikasi Pupuk Organik Cair Rumput Laut *Eucheuma spinosum*. *Jurnal Pengolahan dan Bioteknologi Hasil Perikanan* 3(3): 82 – 87.

Roidah IS, 2013. Manfaat Penggunaan Pupuk Organik Untuk Kesuburan Tanah. *Jurnal Universitas Tulungagung Bonorowo* 1(1): 30 – 42.

Sanda U and Hasnelly, 2023. Respon Tanaman Selada (*Lactuca sativa* L.) Terhadap Pupuk Kandang Sapi dan Konsentrasi Pupuk Organik Cair (POC). *Jurnal Sains Agro* 8(1): 13 – 25.

Setiawan B, Wirda Z, Nasruddin, Hafifah and Safrizal, 2022. Pertumbuhan Kangkung Darat (*Ipomoea reptans* Poir) Dengan Dosis dan Cara Aplikasi Tepung Cangkang Telur Ayam. *Jurnal Ilmiah Mahasiswa Agroteknologi* 1(1): 1 – 5.

Smith L, Williams A and Pearce B, 2015. The Energy Efficiency of Organic Agriculture: A Review. *Renewable Agriculture and Food Systems* 30(3): 280 – 301.

Surtinah, 2013. Pengujian Kandungan Unsur Hara Dalam Kompos yang Berasal Dari Serasah Tanaman Jagung Manis (*Zea mays saccharata*). *Jurnal Ilmiah Pertanian* 11(1): 16 – 26.

Wardiah W, Linda L and Rahmatan H, 2014. Potensi Limbah Air Cucian Beras Sebagai Pupuk Organik Cair Pada Pertumbuhan Pakchoy (*Brassica rapa* L.). *Jurnal Biologi Edukasi Edisi 12* 6(1): 34 – 38.

Wijaya R, Damanik MMB and Fauzi, 2017. Aplikasi Pupuk Organik Cair Dari Sabut Kelapa dan Pupuk Kandang Ayam Terhadap Ketersediaan dan Serapan Kalium serta Pertumbuhan Tanaman Jagung Pada Tanah Inceptisol Kwala Bekala. *Jurnal Agroteknologi FP USU* 5(2): 249 – 255.

Wasilah QA, Winarsih and Bashri A, 2018. Pengaruh Pemberian Pupuk Organik Cair Berbahan Baku Limbah Sisa Makanan Dengan Penambahan Berbagai Bahan Organik Terhadap Pertumbuhan Tanaman Sawi (*Brassica juncea* L.). *LenteraBio* 8(2): 136 – 142.