International Journal of Environment, Agriculture and Biotechnology
Vol-9, Issue-2; Mar-Apr, 2024
Peer-Reviewed International Journal
Journal Home Page Available: https://ijeab.com/
Journal DOI: 10.22161/ijeab

The Effect Combination of Liquid Organic Fertilizer and Inorganic Fertilizer on Potato (*Solanum tuberosum* L.) var. Granola G2

Setyono Yudo Tyasmoro*, Gede Nosa Bayu Pratama, Akbar Saitama, Eggy Akhmad Armandoni, Karuniawan Puji Wicaksono, Adi Setiawan, Sudiarso

Department of Agronomy, Faculty of Agriculture, Brawijaya University University, Jl. Veteran, Malang 65145 East Java, Indonesia
*Email : sytyasmoro@ub.ac.id

Received: 28 Jan 2024; Received in revised form: 11 Mar 2024; Accepted: 20 Mar 2024; Available online: 03 Apr 2024

Abstract— *The potato (Solanum tuberosum L.) is a crucial food source highly demanded in Indonesian society. The national potato crop productivity in 2018 was approximately 1,284,773 tons. Enhancing potato availability necessitates increasing productivity by expanding cultivation areas and employing improved cultivation techniques. However, excessive use of inorganic fertilizers may adversely affect soil fertility and quality. Therefore, it is imperative to enhance soil fertility by augmenting organic matter content using organic fertilizers, such as liquid organic fertilizers derived from processed sugar cane residue. Consequently, this study aimed to ascertain the optimal dosage of liquid organic fertilizer for enhancing the growth and yield of potato plants. The research was conducted from June to October 2022 in Nongkojajar Village, Tutur District, Pasuruan Regency. Various tools were utilized, including hand tractors, nameplates, bamboo pegs, gembor, tape measures, a 150 L drum, a stirrer drill, 5 L and 250 mL measuring cups, waring, and a camera. Potato seeds of the granola variety, liquid organic fertilizer, inorganic fertilizers (Urea, SP-36, and KCL), as well as soil and water samples, constituted the materials for the research. The experimental research method was employed, utilizing an environmental randomized block design (RBD) with seven treatments repeated four times. Parameters observed encompassed plant height, number of leaves, leaf area, dry weight, plant growth rate, soil chemical analysis, nutrient absorption, and harvest analysis. The results revealed that the treatment of liquid organic fertilizer at a 100% dose and the combined treatment of liquid organic fertilizer at doses of 50%, 100%, 150%, and 200% + 80% inorganic fertilizer exhibited superior productivity in potato plants compared to the control treatment without fertilizer. Additionally, these treatments demonstrated comparable potato plant productivity to that achieved with the 100% standard dose of inorganic fertilizer.*

Keywords— ***Doses, Combination, Liquid organic fertilizer, Inorganic fertilizer***

I. INTRODUCTION

Potato are a staple food crop highly demanded in Indonesian society. Potatoes are typically cultivated in highland areas or at the foothills of mountains due to the specific growth requirements distinct from other food crops. Over time, potatoes have become a viable alternative commodity after rice, leading to an increasing demand for potato plants each year. This necessitates farmers to innovate to ensure that potato cultivation meets consumer needs [1].

Increasing potato plant production can be achieved, among other methods, by employing organic fertilizers to reduce the use of inorganic fertilizers. Organic fertilizers are divided into two types: solid organic fertilizers and liquid organic fertilizers. Liquid organic fertilizers are typically made from beneficial waste, such as agricultural or

industrial waste. One industrial waste that can be used to produce fertilizer is molasses, a by-product of the sugar cane industry. East Java is the province with the highest sugar cane production in Indonesia, yielding 1,164,691 tons, particularly in Malang with a production of 2,774 tons. This leads to a significant amount of sugar cane drip waste being generated. Molasses is a by-product created during the sugar manufacturing process [2]. Molasses is also utilized as a medium for bread yeast growth because it still contains sugar to support the fermentation process. Waste that has been used as a fermentation medium contains N, P, and K content that can be utilized as liquid organic fertilizer [3]. Liquid organic fertilizers rich in organic matter content can benefit potato plants. The use of liquid organic fertilizers during cultivation can help improve the three natural soil properties: physical, chemical, and biological. Therefore, this study aims to utilize liquid organic fertilizers at various doses during potato cultivation to determine the most effective dosage for potato plant cultivation.

II. MATERIALS AND METHODS

This research was conducted from June 2022 to October 2022 in Wonosari Village, Tutur District, Pasuruan Regency. The tools used in this study included a hoe, measuring cups, Leaf Area Meter (LAM), analytical balance, oven, ruler, and camera. The materials used in this research were potato seeds of the Granola variety, liquid organic fertilizer (molasses), inorganic fertilizers (Urea, SP-36, and KCl). The research utilized a Randomized Block Design (RBD) with a single factor, namely the combination of liquid organic fertilizer and inorganic fertilizer, comprising 7 treatments and 4 replications. The treatments used were as follows: T1: Control, T2: 100% Inorganic fertilizer, T3: 100% Liquid organic fertilizer + 80% Inorganic fertilizer, T4: 50% Liquid organic fertilizer + 80% Inorganic fertilizer, T5: 150% Liquid organic fertilizer + 80% Inorganic fertilizer, T6: 200% Liquid organic fertilizer + 80% Inorganic fertilizer, T7: 100% Liquid organic fertilizer.

The research involved two observed variables: growth and yield. Growth variables included plant height, number of leaves, leaf area, and dry weight of plants. Yield variables included the number of tubers per plant, total tuber weight per plot harvest, and production per hectare. The obtained observation data were analyzed using analysis of variance (ANOVA) at a significance level of 5%. If there was a significant effect, a comparison between treatments was conducted using Duncan's Multiple Range Test (DMRT) at a significance level of 5%. Relative Agronomic Effectiveness (RAE) is also calculated to determine the efficiency of the combination treatment of liquid organic and inorganic fertilizers compared to the farmer's standard treatment (1).

$$\text{RAE} = \frac{\text{Treatment} - \text{Control (T1)}}{\text{Farmer's Practice (T2)} - \text{Control (T1)}} \text{x } 100 \text{ (1)}$$

III. RESULTS AND DISCUSSION

Plant Height

Analysis of variance showed that at 4 and 6 weeks after planting (WAP), the organic fertilizer treatment did not significantly affect the mean height of potato plants. However, the organic fertilizer treatment and combinations with inorganic fertilizer showed significant effects at 8 and 10 WAP. Table 1 presents the analysis of variance for the mean plant height at 8 WAP. The combination treatment of 200% inorganic fertilizer without potassium, combined with 100% liquid organic fertilizer and 80% inorganic fertilizer, exhibited a significantly different mean plant height compared to treatments without fertilizer, 100% liquid organic fertilizer + 80% inorganic fertilizer, 50% liquid organic fertilizer + 80% inorganic fertilizer, 150% liquid organic fertilizer + 80% inorganic fertilizer, and 100% liquid organic fertilizer. Additionally, the treatment of 200% liquid organic fertilizer + 80% inorganic fertilizer showed a greater mean plant height compared to the treatment of 100% liquid organic fertilizer. At 10 WAP, the combination treatment of liquid organic fertilizer with inorganic fertilizer without potassium (100% liquid organic fertilizer + 80% inorganic fertilizer and 200% liquid organic fertilizer + 80% inorganic fertilizer) exhibited a significantly different mean plant height compared to treatments without fertilizer and 100% liquid organic fertilizer but did not significantly differ from the 100% inorganic fertilizer, 50% liquid organic fertilizer + 80% inorganic fertilizer, and 150% liquid organic fertilizer + 80% inorganic fertilizer treatments. The treatments of 100% inorganic fertilizer, 50% liquid organic fertilizer + 80% inorganic fertilizer, and 150% liquid organic fertilizer + 80% inorganic fertilizer showed a significantly different mean plant height compared to treatments without fertilizer but did not significantly differ from the 100% liquid organic fertilizer treatment. This is because the nutrient availability is fulfilled through the application of inorganic fertilizers as well as the role of liquid organic fertilizers that can maximize nutrient absorption and availability in the soil by improving the physical, chemical, and biological properties of the soil [4]. The application of organic fertilizer can increase the soil's organic matter content, making it more porous so that plant roots will be better and more efficient in nutrient absorption [5].

Number of Leaves

Table 1. Potato Plant Height in Combination of Liquid Organic Fertilizer and Inorganic Fertilizer

No	Treatment	Plant Height (cm)			
		4 WAP	6 WAP	8 WAP	10 WAP
1	T1	1.96	10.13	33.60 a	42.92 a
2	T2	4.29	14.96	42.70 bc	60.05 bc
3	T3	2.98	16.68	38.92 ab	60.58 c
4	T4	2.38	14.16	39.31 ab	58.25 bc
5	T5	2.37	13.95	37.81 ab	56.83 bc
6	T6	3.00	14.28	48.07 c	61.09 c
7	T7	4.42	13.80	36.78 ab	55.66 b

Note: T1 (Control), T2 (100% Inorganic), T3 (100% LOC + 80% Inorganic-K), T4 (50% LOC + 80% Inorganic-K), T5 (150% LOC + 80% Inorganic-K), T6 (200% LOC + 80% Inorganic-K), T7 (100% LOC). Mean values followed by the same letter in the same column indicate no significant difference at DMRT 5%.

Analysis of variance in Table 2 showed that at 4 WAP, treatments without fertilizer, 100% liquid organic fertilizer + 80% inorganic fertilizer, 100% liquid organic fertilizer + 80% inorganic fertilizer, 50% liquid organic fertilizer + 80% inorganic fertilizer, 200% liquid organic fertilizer + 80% inorganic fertilizer, and 100% liquid organic fertilizer exhibited mean leaf numbers that did not significantly differ from the 100% inorganic fertilizer treatment. At 6 WAP, the treatments of 100% liquid organic fertilizer + 80% inorganic fertilizer, 50% liquid organic fertilizer + 80% inorganic fertilizer, 50% liquid organic fertilizer + 80% inorganic fertilizer, and 200% liquid organic fertilizer + 80% inorganic fertilizer showed mean leaf numbers that significantly differed from treatments without fertilizer, 100% inorganic fertilizer, and 100% liquid organic fertilizer. However, the treatments of 100% liquid organic fertilizer + 80% inorganic fertilizer and 50% liquid organic fertilizer + 80% inorganic fertilizer exhibited lower mean leaf numbers compared to higher doses of organic fertilizer (150% liquid organic fertilizer + 80% inorganic fertilizer and 200% liquid organic fertilizer + 80% inorganic fertilizer). At 8 WAP, treatments of 100% liquid organic fertilizer + 80% inorganic fertilizer, 50% liquid organic fertilizer + 80% inorganic fertilizer, 150% liquid organic fertilizer + 80% inorganic fertilizer, 200% liquid organic fertilizer + 80% inorganic fertilizer, and 100% liquid organic fertilizer showed mean leaf numbers that did not significantly differ from the 100% inorganic fertilizer treatment. At the final observation time, 10 WAP, the combination treatment of 200% liquid organic fertilizer + 80% inorganic fertilizer showed a significantly different mean leaf number compared to other treatments. The treatment of 100% liquid organic fertilizer + 80% inorganic fertilizer exhibited a significantly different mean leaf number compared to treatments without fertilizer, 100% inorganic fertilizer, and 100% liquid organic fertilizer. The treatments of 50% liquid organic fertilizer + 80% inorganic fertilizer and 150% liquid organic fertilizer + 80% inorganic fertilizer did not significantly differ from the 100% liquid organic fertilizer and 100% inorganic fertilizer treatments. The treatments of 50% liquid organic fertilizer + 80% inorganic fertilizer and 150% liquid organic fertilizer + 80% inorganic fertilizer significantly differed from the treatment without fertilizer but did not significantly differ from the 100% liquid organic fertilizer treatment. At the final observation time, the combination treatment of 200% liquid organic fertilizer + 80% inorganic fertilizer showed a greater mean leaf number compared to other treatments. The application of liquid organic fertilizer can enhance soil organic matter content, which has various benefits for soil fertility. High soil organic matter content benefits plants by providing available nutrients and improving soil physical properties, such as structure, aggregation, infiltration, and water retention [6].

Table 2. Number of Potato Leaves in Combination of Liquid Organic Fertilizer and Inorganic Fertilizer

No	Treatment	Number of Leaves			
		4 WAP	6 WAP	8 WAP	10 WAP
1	T1	3.00 a	7.28 a	15.88 a	22.12 a
2	T2	3.67 ab	9.78 b	31.67 b	50.67 b

3	T3	3.54 ab	12.01 c	28.24 b	53.79 c
4	T4	4.00 b	13.94 d	26.06 b	49.30 b
5	T5	4.12 b	16.46 e	27.56 b	51.62 bc
6	T6	4.12 b	17.08 e	31.63 b	60.00 d
7	T7	3.64 ab	9.94 b	25.91 b	49.04 b

Note: T1 (Control), T2 (100% Inorganic), T3 (100% LOC + 80% Inorganic-K), T4 (50% LOC + 80% Inorganic-K), T5 (150% LOC + 80% Inorganic-K), T6 (200% LOC + 80% Inorganic-K), T7 (100% LOC). Mean values followed by the same letter in the same column indicate no significant difference at DMRT 5%.

Table 3. Potato Leaf Area in Combination of Liquid Organic Fertilizer and Inorganic Fertilizer

No	Treatment	Leaf Area (cm^2 $plant^{-1}$)			
		4 WAP	6 WAP	8 WAP	10 WAP
1	T1	138.68 a	380.65 a	1289.28 a	1853.54 a
2	T2	182.06 bc	734.42 b	2447.37 c	4979.15 c
3	T3	176.24 bc	946.01 c	2371.71 c	4904.44 c
4	T4	184.57 bc	1076.33 c	2106.46 bc	4386.68 bc
5	T5	201.62 c	1340.61 d	2095.49 bc	4822.84 bc
6	T6	199.67 c	1340.58 d	2107.93 bc	5997.62 d
7	T7	151.46 ab	682.82 b	1917.88 b	4081.38 b

Note: T1 (Control), T2 (100% Inorganic), T3 (100% LOC + 80% Inorganic-K), T4 (50% LOC + 80% Inorganic-K), T5 (150% LOC + 80% Inorganic-K), T6 (200% LOC + 80% Inorganic-K), T7 (100% LOC). Mean values followed by the same letter in the same column indicate no significant difference at DMRT 5%.

Dry Weight of Plants

Based on the analysis of variance, there were differences in the dry weight of potato plants at 4-10 WAP, as presented in Table 4. At 4 WAP, the treatment combination of liquid organic fertilizer and inorganic fertilizer at 50% LOC + 80% inorganic-K and 200% LOC + 80% inorganic-K showed significantly different mean dry weights compared to the treatment without fertilizer and 100% LOC. At 6 WAP, the 200% LOC + 80% inorganic-K treatment exhibited significant differences compared to the treatment without fertilizer, 100% LOC + 80% inorganic-K, 50% LOC + 80% inorganic-K, 150% LOC + 80% inorganic-K, and 100% LOC, but did not differ significantly from the 100% inorganic treatment. At 8 WAP, the treatments 100% LOC + 80% inorganic-K and 200% LOC + 80% inorganic-K showed significantly different mean dry weights compared to the treatment without fertilizer and the 100% LOC treatment. At 10 WAP, the 200% LOC + 80% inorganic-K treatment showed significantly different mean dry weights compared to the treatment without fertilizer, 100% inorganic, and 100% LOC treatments.The application of organic fertilizer in soil can also aid in nutrient absorption, especially nitrogen, by reducing mineral leaching [7]. Nitrogen plays the most crucial role in various physiological processes such as imparting green color to plants, increasing leaf and stem numbers, as well as the growth and development of other vegetative parts [8].

Plant Growth Rate

Based on the analysis of variance, the growth rate of potato plants at 4-10 WAP showed significant differences. At 4 WAP, the treatments 100% LOC + 80% inorganic-K and 200% LOC + 80% inorganic-K exhibited significantly different mean growth rates compared to the treatment without fertilizer, 100% inorganic, 50% LOC + 80% inorganic-K, 150% LOC + 80% inorganic-K, and 100% LOC. At 8-10 WAP, the combination treatments of 150% LOC + 80% showed significantly different plant growth rates compared to the other treatments. Treatments without fertilizer, 100% LOC + 80%, 50% LOC + 80%, 200% LOC + 80%, and 100% LOC showed no significant difference in plant growth rate compared to the 100% inorganic treatment. The application of liquid organic fertilizer affects potassium uptake by plants and increases the potassium content in the soil. High potassium uptake indicates that the

application of liquid organic fertilizer can help fulfill potassium nutrient requirements for plants [9].

Yield Components

Based on the analysis of variance, the fertilizer treatments showed significant effects on the number of tubers per plot, tuber weight per plot, and tuber yield per hectare. Table 6 shows that the combination treatment of liquid organic fertilizer and inorganic fertilizer at 200% LOC + 80% inorganic-K significantly differed in mean tuber number compared to the treatment without fertilizer, 100% inorganic, and 100% LOC. For tuber weight and tuber yield variables, the treatments 100% LOC + 80% inorganic-K, 50% LOC + 80% inorganic-K, 150% LOC + 80% inorganic-K, and 200% LOC + 80% inorganic-K showed significantly different production results compared to the treatment without fertilizer but did not significantly differ from the 100% inorganic and 100% LOC treatments. Potassium is a vital nutrient for potato plants in the growth process and supports higher plant yields. [10] explain that potatoes are high-starch-yielding crops, so a high amount of potassium is needed during the relatively short period of tuber growth and development, indicating that the more potassium available, the better the potato tuber yield. For the RAE value, treatments of 100% LOC + 80% inorganic-K, 50% LOC + 80% inorganic-K, 150% LOC + 80% inorganic-K, and 200% LOC + 80% inorganic-K are effective in replacing some doses of inorganic fertilizer, as indicated by Relative agronomic effectiveness (RAE) values of over 95%. The use of liquid organic fertilizer can provide several benefits for plant growth, including reducing dependence on inorganic fertilizers and increasing crop productivity [11]. Liquid organic fertilizers are generally made from natural materials such as compost, manure fertilizers, or fermented crop residues [12]. The use of liquid organic fertilizer can enhance soil fertility, increase nutrient availability to plants, and improve beneficial soil microbe activity [13]. Research by [14] states that the effect of liquid organic fertilizer on potato plant growth and yield. The results indicate that the use of liquid organic fertilizer can significantly reduce the use of inorganic fertilizers without reducing crop yields. Furthermore, [15] state the use of liquid organic fertilizer in potato production and its impact on soil properties. The results show that liquid organic fertilizer can increase potato plant productivity and reduce dependence on inorganic fertilizers.

Table 4. Dry Weight of Potatoes in Combination with Liquid Organic and Inorganic Fertilizers

No	Treatment	Dry Weight (g plant^{-1})			
		2 WAP	4 WAP	8 WAP	6 WAP
1	T1	0.63 a	3.39 a	20.83 a	54.76 a
2	T2	1.66 b	13.21 de	44.94 ab	90.29 cd
3	T3	1.28 ab	8.84 bc	51.36 b	83.09 c
4	T4	1.95 b	8.99 bc	41.94 ab	89.81 cd
5	T5	0.80 a	10.90 cd	26.18 a	99.13 de
6	T6	1.73 b	13.89 e	59.98 b	106.14 e
7	T7	0.75 a	7.18 b	22.55 a	67.84 b

Note: T1 (Control), T2 (100% Inorganic), T3 (100% LOC + 80% Inorganic-K), T4 (50% LOC + 80% Inorganic-K), T5 (150% LOC + 80% Inorganic-K), T6 (200% LOC + 80% Inorganic-K), T7 (100% LOC). Mean values followed by the same letter in the same column indicate no significant difference at DMRT 5%.

Table 5. Growth Rate of Potato Plants in Combination with Liquid Organic and Inorganic Fertilizers

No	Treatment	Crop Growth Rate (g m^{-2} week^{-1})		
		2-4 WAP	4-6 WAP	6-8 WAP
1	T1	0.82 a	5.19 a	10.10 ab
2	T2	2.94 c	9.44 b	13.50 ab
3	T3	2.27 b	12.66 c	9.44 a
4	T4	2.10 b	10.06 b	14.50 b
5	T5	3.00 cd	4.55 a	21.71 c

6	T6	3.62 d	13.72 c	13.74 ab
7	T7	1.91 b	4.33 a	13.47 ab

Note: T1 (Control), T2 (100% Inorganic), T3 (100% LOC + 80% Inorganic-K), T4 (50% LOC + 80% Inorganic-K), T5 (150% LOC + 80% Inorganic-K), T6 (200% LOC + 80% Inorganic-K), T7 (100% LOC). Mean values followed by the same letter in the same column indicate no significant difference at DMRT 5%.

Table 6. Potato Yield in Combination with Liquid Organic and Inorganic Fertilizers

No	Treatment	Number of Tubers per Harvest Plot	Yield (ton ha^{-1})	RAE (%)
1	T1	110.50 a	39.25 a	-
2	T2	150.29 bc	50.41 c	-
3	T3	160.50 cd	51.58 c	110.49
4	T4	157.89 bcd	51.54 c	110.06
5	T5	168.00 cd	52.73 c	120.77
6	T6	175.75 d	53.03 c	123.46
7	T7	135.50 b	46.78 b	67.46

Note: T1 (Control), T2 (100% Inorganic), T3 (100% LOC + 80% Inorganic-K), T4 (50% LOC + 80% Inorganic-K), T5 (150% LOC + 80% Inorganic-K), T6 (200% LOC + 80% Inorganic-K), T7 (100% LOC). Mean values followed by the same letter in the same column indicate no significant difference at DMRT 5%.

IV. CONCLUSION

The addition of liquid organic fertilizer doses of 50%, 100%, 150%, and 200% with 80% inorganic fertilizer was able to provide results similar to the use of 100% inorganic fertilizer and significantly influences various aspects of potato plant growth and yield. The application of 100% liquid organic fertilizer alone without inorganic fertilizer did not able to achieve the same productivity as 100% inorganic fertilizer. The use of liquid organic fertilizer at a 50% dose is the optimum dosage because it demonstrates the same efficiency as higher doses (100%, 150%, and 200%) in replacing the use of inorganic fertilizer by 20%, thus reducing the amount of fertilizer used to 80% of the total required dose.

REFERENCES

[1] Sutrisn N, Surdianto Y. Kajian Formula Pupuk NPK Pada Pertanaman Kentang Lahan Dataran Tinggi di Lembang Jawa Barat. *J. Hort* (2014) 24(2):124-132.

[2] Fitri H, Akyunul J, Anik M. Fermentasi Tetes Tebu Dari Pabrik Gula Pagotan Madiun Menggunakan Saccharomyces Cerevisiae Untuk Menghasilkan Bioetanol Dengan Variasi Ph Dan Lama Fermentasi. *Jurnal ALCHEMY* (2014) 3(1)

[3] Senthilkumar S, Suganya T, Deepa K, Muralidharan J, Sasikala, K. 2016. Supplementa-tion of Molasses in Livestock Feed. *International Journal of Science, Environment and Tech-nology* (2016) 5 (3): 1243 –1250.

[4] Gore N, Sreenivasa M. Influence of liquid organic manures on growth, nutrient content and yield of tomato (*Lycopersicon esculentum*, Mill.) in the sterilized soil. *Karnataka J. Agric. Sci.* (2011) 24(2): 153–157.

[5] Sugiono, Krismawati A. Effectiveness of Organic Fertilizer on Growth and Production of Cabbage Plant (*Brassica oleraceae* L.). *J. Bio. El-Hayah* (2020) 7(4): 152–159.

[6] Lehmann J, Kleber M. The contentious nature of soil organik matter. *Nature* (2015) 528(7580): 60–68.

[7] Martínez-Alcántara B, Martínez-Cuenca MR, Bermejo A, Legaz F, Quiñones A. Liquid Organic Fertilizers for Sustainable Agriculture: Nutrient Uptake of Organic versus Mineral Fertilizers in Citrus Trees. *PLoS One* (2016) 11(10). doi: doi: 10.1371/journal.pone.0161619.

[8] Leghari NAW, Laghari GM, and Leghari AH. Role of Nitrogen for Plant Growth and Development. A Rev. *Adv Env. Biol* (2016) 10(9): 209–218.

[9] Samal D, Kovar JL, Steingrobe B, Sadana US, Bhadoria PS, Claassen N. Potassium uptake efficiency and dynamics in the rhizosphere of maize (*Zea mays* L.), wheat (*Triticum aestivum* L.), and sugar beet (*Beta vulgaris* L.) evaluated with a mechanistic model. *Plant and Soil* (2010) 332(1–2), 105–121.

[10] Grzebisz W, Szczepaniak W, Bocianowski J. Potassium fertilization as a driver of sustainable management of nitrogen in potato (*Solanum tuberosum* L.). *Field Crops Research* (2020) 254, 107824.

[11] Brinton WF, Trankner A, Roffner M. Investigations into liquid compost extracts. *Biocycle* (1996) 37: 68-70.

[12] Marliah A, Hayati M, Muliansyah I. Pemanfaatan pupuk organik cair terhadap pertumbuhan dan hasil beberapa

varietas tomat (*Lycopersicum esculentum* L.) *Jurnal Agrista* (2012) 16.

[13] Marpaung AE, Udiarto BK, Lukman L, Hardiyanto. Potensi pemanfaatan formulasi pupuk organik sumber daya lokal untuk budidaya kubis *J. Hort* (2018). 28.

[14] Marpaung AE, Hanum H, and Sembiring M. The effect of liquid organic fertilizer and phosphate solubilising bacteria Bacillus sp on potato growth (*Solanum tuberosum*) in andisol soil. *IOP Conf. Series: Earth and Environmental Science* (2019) 807(2021): 042079.

[15] Suh C, Meka SS, Ngome AF, Neba DA, Kemngwa IT, Sonkouat AD, Njualem D. Effects of Organic and Inorganic Fertilizers on Growth and Yield of Potato (*Solanum tuberosum* L.) in the Western Highlands of Cameroon. *International Journal of Development Research* (2015) 5(2): 1-6.

.