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Growth and Production Response of Lettuce (*Lactuca Sativa*, L) Due to GDM Liquid Organic Fertilizer and NPK Mutiara Concentration

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Abstract: The research was conducted in July-August 2024, located in Gurgur Pematangsintar, Siantar Simarimbun District with an altitude of 390 meters above sea level. The purpose of the research was to determine the response of growth and production of lettuce (*Lactuca sativa* L.) due to the concentration of GDM liquid organic fertilizer (LOF) and NPK Mutiara. The study used a factorial Randomized Block Design (RBD) with two factors. The first factor was the administration of the GDM LOF dose (G) consisting of 4 levels, namely G_0 = Control, G_1 = 10cc/plot, G_2 = 20cc/plot and G_3 = 30cc/plot. The second factor was Mutiara NPK (N) consisting of 4 levels N_0 = Control, N_1 = 100g/plot, N_2 = 200g/plot and N_3 = 300g/plot. The parameters observed were plant height (cm), number of leaves (strands), net weight per plant (g) and net weight per plot (kg). The results showed that the GDM LOF and NPK Mutiara fertilizer treatments significantly affected plant height, leaf number, net weight per sample, and net weight per plot. GDM LOF treatment at a dose of 30cc/plot was the best dose, and NPK Mutiara treatment at 300g/plot was the best. However, the interaction between GDM LOF and NPK fertilizer showed no significant effect on plant height, leaf number, net weight per sample, or net weight per plot.

Keywords: GDM Liquid Organic Fertilizer, NPK Mutiara, Lettuce.

I. Introduction

Lettuce (*Lactuca sativa* L.), is native to the valleys of the Eastern Mediterranean, specifically West Asia. Evidence from paintings in ancient Egyptian tombs indicates that lettuce has been cultivated since 4500 BC. This plant later spread to various countries. Its distribution includes the Caribbean, Malaysia, East, Central, and West Africa, and the Philippines, before spreading to Indonesia. Lettuce is commonly eaten fresh as an appetizer, mixed with other vegetables. Lettuce is excellent for consumption because it contains a variety of nutrients essential for good health. Health benefits of lettuce include improving and facilitating digestion and acting as a remedy for feverish symptoms (Jahro, 2018).

According to the Central Statistics Agency (2016), lettuce production in 2010 was 41.11 tons/year and decreased in 2015 to 39,289 tons/year. The rate of lettuce production in 2010-2015 was 5.19-6% per year. However, national lettuce production was still lower than consumption, which was 35.30 kg/capital/year. Meanwhile, the volume of lettuce imports in 2015 was 21.1 tons, so there is an opportunity to increase production to meet the national lettuce consumption level.

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Increasing lettuce production requires efficient and effective planting methods, such as applying organic fertilizers to improve soil structure. One such method is the application of liquid organic fertilizers, such as GDM Liquid Organic Fertilizer.

GDM Liquid Organic Fertilizer (LOF) is a liquid organic fertilizer specifically formulated for agriculture, plantations, golf courses, and ornamental plants. GDM LOF provides plant nutrition and improves soil structure, supports seedling propagation, increases plant resistance to disease, and increases lettuce production (GDM Liquid Organic Fertilizer, 2018).

Fertilizer use in agriculture often involves inorganic fertilizers. Inorganic fertilizer use is a farming system that uses intensive synthetic fertilizers and pesticides. Differences in soil and crop management in agricultural ecosystems will affect the soil's chemical properties and nutrients.

NPK fertilizer is a compound fertilizer that provides plants with the elements N, P, and K. Numerous types of NPK fertilizers are available on the market, each with varying concentrations of these elements, which are excellent for plant growth and production, increasing yields, and maintaining a balance of nitrogen, phosphorus, and potassium. The use of NPK Mutiara fertilizer offers several advantages, including: more complete nutrient content, more labor-efficient application, less hygroscopic properties, and a longer shelf life. This fertilizer is more practical, requiring only a single application (Fatikhah, 2019). Based on the information described above, this study aimed to determine the growth and production responses of lettuce (Lactuca sativa L.) to the concentrations of GDM LOF and NPK Mutiara.

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II. Research Methodology

This research was conducted in Gurgur, Sawah 2 Simalungun. This research was conducted for 45 days, starting from July to August 2024. The materials used in this research were lettuce seeds, GDM LOF fertilizer, NPK Mutiara 16: 16: 16, Bayrusil, while the tools used were hoes, machetes, rakes, meters, watering cans, signs, handsprayer and stationery.

This study used a factorial Randomized Block Design (RAK), with two treatment factors, where the first factor was the dose of POC GDM (G) consisting of 4 levels, namely G_1 = Control, G_1 = 10 cc/plot, G_2 = 20 cc/plot dan G_3 = 30 cc/plot. The second factor was the dose of NPK Mutiara fertilizer (N) consisting of 4 levels N_0 = Control, N_1 = 100 g/plot, N_2 = 200g/plot dan N_3 = 300g/plot. The parameters observed were plant height (cm), number of leaves (strands), net weight per plant (g) and net weight per plot (kg).

III. Result and Discussion

Plant Height (cm)

The results of the analysis of variance of plant height showed that plant height responded significantly to the GDM LOF and NPK fertilizer treatments, but did not respond significantly to the interaction between the two treatments. Differences between treatments were tested using the LSD average difference test at the 5% level, as shown in Table 1.

Table 1. Difference Test of Average Plant Height and Number of Leaves of Lettuce Plants Due to GDM POC and Mutiara NPK Fertilizer Treatments

Treatment	Average Plant Height (cm)			Average Number of Leaves (Blades)		
	2 WAP	3 WAP	4 WAP	2 WAP	3 WAP	4 WAP
GO	4.64 d	17.69 d	27.15 d	2.58 d	4.54 d	6.48 d
G1	6,10 c	19.48 c	28.13 c	3,25 c	4,96 c	7,63 c
G2	6.97 b	20.38 b	29.53 b	3.63 b	5.60 b	8.10 b
G3	7.39 a	20.69 a	30.24 a	4.23 a	6.44 a	8.79 a
LSD 5%	**0.19**	**0.22**	**0.42**	**0.17**	**0.19**	**0.24**
N0	5.75 d	18.74 d	28.23 c	3.02 d	4,90 d	7,23 d
N1	6.14 c	19.43 c	28.56 bc	3.33 c	5,27 c	7,65 c
N2	6.38 b	19.86 b	28.97 ab	3.54 b	5.58 b	7.92 b
N3	6.83 a	20.20 a	29.28 a	3.79 a	5.79 a	8.21 a
LSD 5%	**0.19**	**0.22**	**0.42**	**0,17**	**0.19**	**0.24**
G0N0	4.34	15.73	27.11	2,17	4,08	6,08
G0N1	4.59	17.52	26.99	2,50	4,42	6,33
G0N2	4.69	18.54	27.27	2,67	4,75	6,50
G0N3	4.94	18.96	27.24	3,00	4,92	7,00
G1N0	5.52	19.05	27.32	2,83	4,58	7,08
G1N1	5.97	19.42	27.74	3,25	4,83	7,50
G1N2	6.23	19.59	28.41	3,33	5,08	7,83
G1N3	6.69	19.85	29.04	3,58	5,33	8,08
G2N0	6.52	20.21	29.27	3,25	5,25	7,42
G2N1	6.94	20.26	29.39	3,58	5,50	8,17
G2N2	7.20	20.53	29.65	3,83	5,75	8,42
G2N3	7.19	20.50	29.78	3,83	5,92	8,42
G3N0	6.62	19.96	29.22	3,83	5,67	8,33
G3N1	7.05	20.52	30.14	4,00	6,33	8,58

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G3N2	7.41	20.79	30.56	4,33	6,75	8,92
G3N3	6.49	21.50	31.05	4,75	7,00	9,33

Notes: Numbers followed by different notations in the same column are not significantly different at the 5% LSD level.

Table 1 shows that the GDM LOF treatment (G_3) showed the tallest plants at 2, 3, and 4 weeks post-planting (WAP) respectively (7.39 cm), (20.69 cm), and (30.24 cm), which were significantly different from the other treatments. The results of the GDM LOF study can be used as an organic fertilizer and helps improve the physical, chemical, and biological conditions of the soil, making it very beneficial for plant growth, especially lettuce. The physical conditions of the soil improved by GDM LOF include aggregate stability, structure, and soil porosity because the soil mass density is reduced. This is because GDM LOF functions to improve the physical properties of the soil and add nutrients so that the fertilizer given can be absorbed by plants quickly (Rambe et al., 2020). Table 1 shows that the NPK (N_3) fertilizer treatment showed the tallest plants at 2, 3, and 4 weeks after planting (WAP) respectively (6.83 cm), (20.20 cm), and (29.28 cm), which were significantly different from the other treatments. This is because the higher the fertilizer dose given up to the optimum limit as plant growth increases (Ernawati et al., 2017).

Table 1 shows that the interaction of GDM LOF fertilizer and NPK fertilizer (G_3N_3) showed the tallest plants at 2, 3, and 4 weeks after planting (6.49 cm), (21.50 cm), and (31.05 cm), respectively, which were not significantly different from other treatments. This is because good soil physical properties will provide better nutrients, so that the application of NPK fertilizer can support plant growth and production (Hariani et al., 2016).

Number of Leaves

The results of the analysis of variance for leaf number showed that leaf number significantly responded to the GDM LOF and NPK fertilizer treatments, but not significantly to the interaction between the two treatments. The differences in the effects of the treatments were tested using the LSD average test at the 5% level, as shown in Table 1.

Table 1 shows that the GDM LOF (G_3) treatment showed the highest number of leaves at 2, 3, and 4 weeks after planting (WAP), respectively (4.23), (6.44), and (8.79), significantly different from the other treatments. This is because GDM LOF contains nitrogen nutrients that can be absorbed by plants.

Table 1 shows that the NPK (N_3) fertilizer treatment produced the highest number of leaves at 2, 3, and 4 weeks after planting (WAP), respectively (3.79), (5.79), and (8.21), significantly different from the other treatments. This is because the higher the dose, the greater the availability of nutrients to the plants. Nitrogen is crucial for leaf formation, particularly during the formation of new cells and cell elongation in the apical meristem of lettuce (Oktavianti et al., 2017). NPK fertilizer is well absorbed by plants because it dissolves in water, making it easier for them to absorb. This is consistent with the findings of Mansyur et al. (2021) who stated that inorganic fertilizers have several advantages: high nutrient content, high water absorption capacity, and high solubility, which makes them readily absorbed by plant roots.

Table 1 shows that the interaction of GDM POC and NPK fertilizer (G3N3) treatments showed the highest number of leaves at 2, 3, and 4 weeks post-planting (WAP) respectively (4.75), (7.00), and (9.33), which were not significantly different from the other treatments. This is because GDM LOF and NPK fertilizers were less supportive in stimulating plant growth.

Net Weight Per Plant (Kg)

The results of the analysis of variance showed that the net weight per plant responded significantly to the treatment of GDM LOF fertilizer and NPK fertilizer, but did not respond significantly to the interaction between the two treatments. The difference in the effect of treatment was tested using the LSD average test at the 5% level, which can be seen in Table 2.

Table 2. Test of differences in average net weight per sample due to the application of GDM LOF and NPK fertilizer

Treatment	Average Net Per Plant (g)	
G0	69.50	c
G1	84.58	c
G2	107.50	b
G3	179.25	a
LSD 5%	**16.51**	
N0	86.33	c
N1	107.92	b
N2	117.92	ab

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N3	128.67	a
LSD 5%	**16.51**	
G0N0	65.33	
G0N1	68.00	
G0N2	70.67	
G0N3	74.00	
G1N0	73.33	
G1N1	84.33	
G1N2	88.33	
G1N3	92.33	
G2N0	86.33	
G2N1	105.33	
G2N2	113.33	
G2N3	125.00	
G3N0	120.33	
G3N1	174.00	
G3N2	199.33	
G3N3	223.33	
LSD 5%	**33.01**	

Notes: Numbers followed by different notations in the same column are not significantly different at the 5% LSD level.

Table 2 shows that the GDM LOF (G_3) treatment produced the heaviest net weight per sample (179.25 g), while the G_0 treatment produced the lowest (69.50 g). This was significantly different from the other treatments. Research by Setyaputri (2021) indicates that GDM LOF significantly influences the growth of vegetative plant parts.

Table 2 shows that the NPK N_3 fertilizer treatment produced the heaviest net weight per plant (128.67 g), while the N_0 treatment produced the lowest (86.33 g). The NPK Mutiara fertilizer treatment contains a large and balanced amount of N, P, and K, along with additional Ca and Mg. Therefore, a single application of this fertilizer provides a balanced macronutrient balance for lettuce plants. The higher the dose, the heavier the resulting plants (Ramadhan et al., 2022).

Table 2 shows that the interaction between the GDM LOF fertilizer and G_3N_3 NPK fertilizer treatments resulted in the heaviest net weight per sample (128.67 g) and the lowest in G_0N_0 (86.33 g), significantly different from the other treatments. This indicates that lettuce plants will not produce maximum yields when the required nutrients are not sufficiently available. Fertilizer is key to soil fertility because it contains one or more elements to replace elements that are depleted by plants. However, excessive and uncontrolled use can negatively impact soil fertility, plant growth, the environment, and the balance of soil microorganisms (Rambe et al., 2020).

Net Weight of Plants per Plot (Kg)

The analysis of variance results showed that the net weight per plot significantly responded to the GDM LOF and NPK fertilizer treatments, but not significantly to the interaction between the two treatments. Differences between treatments were tested using the test at the 5% level, as shown in Table 3.

Table 3 shows that the GDM LOF G_3 treatment produced the highest net weight per plot (2,542 g) and the lowest (1,055 kg), significantly different from the other treatments. This is because the application of GDM LOF increases nutrient content.

Table 3 shows that the NPK N_3 fertilizer treatment produced the highest net weight per plot (1,767 kg) and the lowest (1,311 kg), significantly different from the other treatments. This may be because the N_3 treatment plants had a higher water content from soil absorption, resulting in a higher net weight.

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Table 3. Test of differences in average net weight per plot due to the application of GDM LOF and NPK fertilizer

Treatment	Average Net Weight per Plot (kg)	
G0	1.055	d
G1	1.264	c
G2	1.499	b
G3	2.542	a
LSD 5%	**0.14**	
N0	1.311	d
N1	1.567	c
N2	1.716	b
N3	1.767	a
LSD 5%	**0.14**	
G0N0	1.023	
G0N1	1.027	
G0N2	1.06	
G0N3	1.11	
G1N0	1.146	
G1N1	1.235	
G1N2	1.353	
G1N3	1.323	
G2N0	1.323	
G2N1	1.506	
G2N2	1.658	
G2N3	1.507	
G3N0	1.752	
G3N1	2.498	
G3N2	2.791	
G3N3	3.127	
LSD 5%	**0.29**	

Notes : Numbers followed by different notations in the same column are not significantly different at the 5% LSD level.

According to Sitompul (1995) in Rachmadhani et al. (2014), regarding the effect of inorganic fertilizer on lettuce growth, the fertilizer application rate did not result in differences in water absorption or yield accumulation. Table 3 shows that the interaction between the GDM LOF and G_3N_3 NPK fertilizer treatments resulted in the highest net weight per plot (3,127 kg) and the lowest (1,023 g), significantly different from the other treatments. This is suspected to be due to physical conditions or soil type, which do not affect plant growth. If soil fertility is low, nutrient addition through fertilization is necessary. Determining the recommended fertilizer dosage for plants.

IV. Conclusion

The GDM LOF treatment significantly affected plant height, leaf number, net weight per sample, and net weight per plot. The best dose of GDM POC fertilizer was 30 cc/plot.

The NPK fertilizer treatment significantly affected plant height, leaf number, net weight per sample, and net weight per plot. The best NPK fertilizer treatment was at a dose of 300 g/plot.

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The interaction between the GDM POC and NPK fertilizer treatments did not significantly affect plant height, leaf number, net weight per sample, and net weight per plot. The best combination dose of GDM POC and NPK fertilizer was 30 cc/plot and 300 g/plot.

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