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Sustainable Fertilization Strategy: The Effect of Mono Potassium Phosphate and Amino Acid Liquid Organic Fertilizer on Melon Plants

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Abstract. Melon plants are a high-value horticultural commodity favored by consumers for their taste and market appeal. This study aimed to determine the best combination of Mono Potassium Phosphate (MKP) fertilizer and Amino Acid Liquid Organic Fertilizer (LOF) doses to enhance the growth and yield of melon plants while promoting nutrient balance and minimizing environmental impact. The experiment was conducted from April to July 2024 in a greenhouse located in Jatirejo Village, Nganjuk Regency, with LOF composition analysis carried out at the BSIP Laboratory. A factorial experiment using a Randomized Block Design (RBD) was applied with two factors: MKP fertilizer dose (5, 10, and 15 g/plant) and LOF dose (0, 50, 100, and 150 ml/plant), resulting in 12 treatment combinations replicated three times. Observed parameters included plant length, number of leaves, fruit weight, fruit diameter, and fruit length. Data were analyzed using ANOVA and followed by a 5% BNJ test for significant differences. The results showed a highly significant interaction between MKP and LOF treatments, with the combination of 15 g MKP and 100 ml LOF per plant producing the best outcomes across most growth and yield parameters, indicating that this treatment is optimal for maximizing melon productivity in a sustainable manner.

Keywords: amino acid liquid; growth response; melon plants; organic fertilizer

INTRODUCTION

Melon plants (*Cucumis melo L.*) originate from the Mediterranean region, located at the intersection of West Asia, Europe, and Africa (Grumet *et al*., 2021). Melon fruit is a popular horticultural commodity, favored by the public for its sweet, refreshing taste and rich nutritional content. In addition, its appealing color enhances its marketability, increasing consumer demand. Melon fruit is typically consumed as a dessert and is also utilized in various industries, including food processing, beverages, cosmetics, health, and pharmaceuticals. These diverse benefits make melons increasingly sought after by consumers, contributing to their high economic value and making investments in melon cultivation highly feasible (Purba *et al*., 2019).

According to (Suhita *et al*., 2024), melon production in Indonesia has been declining from 2020 to 2022. The production figures for 2020, 2021, and 2022 were 138,177 tons, 129,147 tons, and 118,711 tons, respectively. Meanwhile, Putri (2023) report that the annual melon consumption in Indonesia reaches 141,400 tons, indicating that local production does not meet demand. To address this gap, improvements in melon cultivation are necessary to boost production.

One of the key agricultural practices influencing plant yield is fertilization, which involves supplying nutrients to the growing medium for plant absorption. These nutrients are essential to support the plant's metabolic processes during both the growth and reproductive phases.

Phosphorus (P) and potassium (K) are critical nutrients for increasing crop production. These elements are typically applied when plants transition from the vegetative phase to the generative phase and continue until harvest. Phosphorus plays a vital role in stimulating flower, fruit, and seed formation, as well as accelerating fruit ripening. Potassium regulates the translocation of photosynthates, such as carbohydrates and sugars, to fruit organs,

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thereby influencing fruit size and filling. One highly effective fertilizer used by melon farmers is MKP (Mono Potassium Phosphate).

MKP fertilizer contains 52% phosphorus and 34% potassium, is white, crystalline, and highly soluble. (Bhavya M. *et al*., 2024) found that applying 15 grams of MKP fertilizer per plant significantly improved the growth of watermelon (Citrullus vulgaris). Similarly, (Wirajaya *et al*., 2022) reported that a 6-gram per liter concentration of MKP fertilizer significantly increased the number and weight of cayenne pepper fruits.

Efforts to enhance the growth and yield of melon plants should also consider ecological sustainability, such as using organic fertilizers(Makmur & Karim, 2020). Liquid organic fertilizer (LOF) offers a solution to meet plant nutrient needs while minimizing the environmental impact of inorganic fertilizers (Samputri *et al*., 2023). LOF has several advantages, including easier nutrient absorption by plants and the ability to improve the soil's physical, chemical, and biological properties. According to (Yang *et al*., 2019), noted that organic fertilizers do not cause nutrient toxicity, making them more efficient for use.

While previous studies have demonstrated the individual benefits of MKP fertilizer on plant growth (Markus et al., 2025) and the advantages of liquid organic fertilizers in promoting soil health and ecological sustainability (Rohcahyani, 2024), limited research has explored the combined use of MKP and amino acid-based LOF in melon cultivation. This study addresses that gap by investigating the synergistic effects of integrating a high-efficiency inorganic fertilizer (MKP) with a biologically derived organic fertilizer (LOF) to enhance both growth performance and yield quality of melon plants. Unlike previous works that focused on single-source fertilization, the current research aims to optimize fertilization strategies that not only boost productivity but also align with sustainable agriculture practices. This combined approach offers a novel contribution to horticultural management by potentially reducing reliance on synthetic inputs while maintaining high crop performance.

In this study, LOF was made from chicken eggs and "Lofu" liquid waste. (Wahyudi *et al*., 2024) reported that tofu waste contains 40-60% amino acids and protein, while (Putri *et al*., 2021) found that egg whites and yolks contain 863.3 mg/ml and 930.9 mg/ml of protein, respectively. Given the high amino acid and protein content of these raw materials, they can serve as sources of nitrogen (N), a crucial component of amino acids. The objective of this study is to determine the optimal combination of MKP and LOF amino acid fertilizer doses to enhance the growth and yield of melon plants.

METHODS

This research was conducted in a greenhouse located on agricultural land in Jebug Village, Jatirejo Sub-district, Nganjuk Regency, at an altitude of 56 meters above sea level. The composition of the LOF Amino Acid was tested at the Laboratory of the Agricultural Instrument Standardization Center (BSIP). The study was carried out from April to July 2024. The materials used included Golden Alisha F1 watermelon seeds, MKP fertilizer, LOF Amino Acid, ultradap fertilizer, KNO_3 fertilizer, and a planting medium consisting of a 1:1:1 mixture of soil, compost, and rice husks. The tools used included shovels, scissors, spoons, trowels, rulers, hoes, analytical scales, stationery, label paper, plastic clips, cameras, plastic nursery cups, and polybags.

The research activities included: 1) Preparation of LOF Amino Acid, 2) Sowing of watermelon seeds, 3) Transplanting of seedlings, 4) Fertilization, 5) Watering, 6) Weeding, 7) Pollination, 8) Shoot pruning, 9) Fruit selection (leaving one fruit per plant), 10) Pest and disease control, 11) Weed control, 12) Harvesting. MKP fertilizer was applied once a week between 21 and 49 days after sowing (DAS), while the LOF Amino

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Acid was applied weekly from 7 to 35 DAS. Both were applied by pouring them directly into the planting medium.

The experiment used a factorial arrangement in a Randomized Block Design (RBD) with two factors. Factor I: MKP fertilizer dose (A) at three levels: A1: 5 g/plant, A2: 10 g/plant, A3: 15 g/plant. Factor II: LOF Amino Acid dose (B) at four levels: B0: Control (no LOF), B1: 50 ml/plant, B2: 100 ml/plant, B3: 150 ml/plant. There were 12 treatment combinations, each replicated three times, with five plants per replicate, resulting in 180 plants in total. Environmental parameters such as temperature and humidity inside the greenhouse were monitored daily using a digital thermo-hygrometer to maintain uniform conditions and ensure the reproducibility of the results. The observed parameters included plant length, number of leaves, fruit weight, fruit diameter, and fruit length. The collected data were analyzed using Analysis of Variance (ANOVA), and treatments that showed significant differences were further tested using the 5% BNJ (Honestly Significant Difference) test.

RESULTS AND DISCUSSION

Plant Length

The analysis of the effect of the combination of MKP fertilizer doses and LOF Amino Acid doses on plant length showed a very significant interaction at 35, 42, and 49 days after sowing (DAS). Similarly, the individual factors of MKP fertilizer dose and LOF Amino Acid dose also had a very significant effect on plant length at 35, 42, and 49 DAS. However, at 7, 14, 21, and 28 DAS, neither the MKP fertilizer dose nor the LOF Amino Acid dose had a significant effect on plant length. The average plant length at 35, 42, and 49 DAS, based on the combination of MKP fertilizer and LOF Amino Acid doses, is presented in Table 1.

Table 1. Average length of melon plants aged 35 - 49 dap in combination treatment of MKP fertilizer dose and amino acid LoF.

Plant Age (HST)	Treatment	Plant Length (cm)			
		Dosage of LOF Amino Acids (ml/plant)			
	MKP Fertilizer Dosage (g/plant)	0 (B0)	50 (B1)	100 (B2)	150 (B3)
35	5 (A1)	88.33 a	107.67 abc	103.67 ab	115.33 bcd
	10 (A2)	118.00 bcd	118.67 bcde	137.67 de	141.33 e
	15 (A3)	118.00 bcd	127.33 cde	134.33 de	120.00 bcde
	BNJ 5 %	23.19			
42	5 (A1)	109.33 a	114.33 ab	132.67 bc	140.00 cd
	10 (A2)	143.00 cde	138.00 cd	164.00 f	167.33 f
	15 (A3)	139.00 cd	153.33 def	161.00 ef	148.00 cdef
	BNJ 5 %	20.57			
49	5 (A1)	123.33 a	135.00 ab	150.33 bc	158.67 cd
	10 (A2)	161.67 cde	156.33 cd	184.67 f	174.33 def
	15 (A3)	157.00 cd	168.00 cdef	180.33 ef	162.33 cde
	BNJ 5 %	20.81			

Description: The average figures accompanied by the same letters at the same observation age show no significant difference in the 5% BNJ test.

Table 1 shows that the combination of a 10 g/plant dose of MKP fertilizer and a 150 ml/plant dose of LOF Amino Acid (A2B3) produced the highest average melon plant length at 35 and 42 days after sowing (DAS). This result was significantly different from other treatments, except for the combinations

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A2B1, A2B2, A3B1, A3B2, and A3B3 at 35 DAS, and A2B2, A3B1, A3B2, and A3B3 at 42 DAS. At 49 DAS, the longest plants were recorded in the A2B2 treatment combination, which was significantly different from other treatments, except for A3B1, A3B2, and A2B3. The A2B2 treatment combination resulted in a 49.74% increase in plant length at 49 DAS compared to the A1B0 treatment combination.

These results indicate that the effect of treatment combinations on plant length became significant once the plants reached 35 DAS. Researchers suspect that in the early stages of plant growth, genetic factors play a dominant role, resulting in uniform growth across treatments. However, as the plants enter the generative phase, environmental factors begin to influence their development. This is evidenced by the fact that the application of LOF during the early vegetative phase did not show a significant positive impact on plant growth. Only after four to five applications did the treatments result in noticeable differences in plant length. Therefore, applying LOF at the correct dose and frequency, combined with the appropriate MKP fertilizer dose, can enhance plant growth. According to Hapsari (2023), it is more effective to apply LOF at lower doses or concentrations on a regular basis to stimulate plant growth and development.

The plant growth phase is heavily influenced by the availability of essential nutrients, particularly nitrogen (N), phosphorus (P), and potassium (K). The nitrogen content in LOF Amino Acid promotes chlorophyll synthesis, as supported by (Jiaying *et al*., 2022), who stated that nitrogen is essential for chlorophyll production (Simkin *et al*., 2022), further explained that increased chlorophyll content enhances the plant's ability to absorb sunlight, thereby increasing the rate of photosynthesis. Enhanced photosynthetic activity promotes the formation of photosynthates, which are then transported to vegetative organs such as leaves and stems. According to (Brazel & Ó'Maoileídigh, 2019), the largest proportion of photosynthates is allocated to actively photosynthesizing organs, which can be observed through increases in stem height or length, leaf number, leaf area, and stem diameter.

Number of Leaves

The analysis of variance (ANOVA) results for the effect of the combination of MKP fertilizer doses and LOF Amino Acid doses on the number of melon plant leaves showed a significant interaction at 28, 35, and 49 days after sowing (DAS), while at 42 DAS, the interaction was highly significant. For the individual factors, both the MKP fertilizer dose and LOF Amino Acid dose had a very significant effect on the number of leaves between 28 and 49 DAS. However, at 7, 14, and 21 DAS, neither the MKP fertilizer dose nor the LOF Amino Acid treatment had a significant effect on the number of leaves. The average number of melon plant leaves from 28 to 49 DAS, based on the combination of MKP fertilizer doses and LOF Amino Acid treatments, is presented in Table 2.

Table 2 shows that the highest average number of melon plant leaves at 28, 35, 42, and 49 days after sowing (DAS) was produced by the combination of a 15 g/plant MKP fertilizer dose and a 100 ml/plant LOF Amino Acid dose (A3B2). This combination was significantly different from other treatments, except for A2B1, A3B0, A3B1, and A3B3 at 35 DAS, and A2B2 and A3B1 at 49 DAS. The A3B2 treatment combination resulted in a 25.26% increase in the number of leaves at 49 DAS compared to the A1B0 combination.

The formation of leaves is strongly influenced by nitrogen (N). The absorption of N by plants depends on the presence of phosphorus (P) and potassium (K). MKP fertilizer, which contains 52% P and 34% K, enhances the plant's ability to absorb available N from the planting medium, thereby increasing the rate of leaf formation. According to Simkin (2022) the P element in plant tissue serves as a source of cellular

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energy by synthesizing ATP and NADPH. This energy is essential for all cellular metabolic processes, such as the formation of root nodules, which enhance N absorption from both the air and the planting medium. In addition, energy is required for cellular respiration, which supports the process of photosynthesis. The K element also plays a crucial role in energy production. As Novizan (2013), explains, K enhances the rate of photophosphorylation during photosynthesis, accelerating the formation of ATP and NADPH. Therefore, the availability of N, P, and K nutrients at optimal levels stimulates the formation of plant organs, including leaves.

Table 2. Average number of melon leaves aged 28 - 49 dap in the combination of MKP fertilizer dose treatment and amino acid LoF.

Plant Age (HST)	Treatment	Number of Leaves (Shells)			
		Dosage of LOF Amino Acids (ml/plant)			
	MKP Fertilizer Dosage (g/plant)	0 (B0)	50 (B1)	100 (B2)	150 (B3)
28	5 (A1)	20.00 a	21.33 a	22.33 a	21.33 a
	10 (A2)	20.67 a	23.67 a	22.00 a	21.33 a
	15 (A3)	23.00 a	23.33 a	28.00 b	23.33 a
	BNJ 5 %	4.01			
35	5 (A1)	25.00 a	26.33 ab	28.33 bc	26.67 ab
	10 (A2)	26.33 ab	28.33 bc	26.67 ab	26.33 ab
	15 (A3)	28.33 bc	29.00 bc	31.00 c	28.33 bc
	BNJ 5 %	3.06			
42	5 (A1)	29.00 a	30.67 abc	32.00 cd	29.33 ab
	10 (A2)	31.33 abc	31.00 abc	33.00 cd	32.00 cd
	15 (A3)	32.33 cd	34.00 d	37.00 e	31.67 bcd
	BNJ 5 %	2.34			
49	5 (A1)	31.67 a	32.33 a	34.00 abc	32.33 a
	10 (A2)	32.67 a	33.00 a	36.67 bcd	34.33 abc
	15 (A3)	35.00 abc	37.00 cd	39.67 d	33.33 ab
	BNJ 5 %	3.42			

Description: The average figures accompanied by the same letters at the same observation age show no significant difference in the 5% BNJ test.

The performance of plant organs during the vegetative phase, especially stems and leaves, significantly affects the development of generative organs. Since leaves are the primary site for photosynthate production, the more efficient the leaves are, the more photosynthate can be allocated to other organs, particularly the fruit. The performance of plant organs during the vegetative phase, especially stems and leaves, significantly affects the development of generative organs. Since leaves are the primary site for photosynthate production, the more efficient the leaves, the more photosynthate can be allocated to other organs, particularly the fruit. Leaves are source organs that produce and export photosynthate to sink organs such as fruits and seeds. Sink organs serve as importers or recipients of photosynthate. Therefore, increased photosynthate production in the leaves contributes directly to the size and weight of the melon fruit.

Weight, Diameter, and Length of Fruit

The analysis of variance (ANOVA) results for the effect of the combination of MKP fertilizer doses and LOF Amino Acid doses on melon fruit weight showed a highly significant interaction. Similarly, the

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individual effects of MKP fertilizer doses and LOF Amino Acid doses also had a very significant impact on fruit weight. The average weight of melon fruit, based on the combination of MKP fertilizer and LOF Amino Acid doses, is presented in Table 3.

Table 3 shows that the highest average weight of melon fruit was achieved with the A3B2 treatment combination, which was significantly different from other treatment combinations, except for A2B2 and A3B1. The A3B2 treatment combination resulted in a 173.13% increase in fruit weight compared to the A1B0 treatment combination.

The graph in **Figure 1** shows three linear equations for each MKP fertilizer dose treatment on melon fruit weight, based on LOF Amino Acid doses ranging from 0 to 150 ml/plant. The 5 g/plant MKP fertilizer dose (A1) yields the linear equation Y = -0,00002X^2 + 0,00657x + 0,60850 (R^2=0,68), The 10 g/plant MKP fertilizer dose (A2) yields the linear equation Y = -0,00009X^2 + 0,01354x + 1,04700 (R^2=0,51), The 15 g/plant MKP fertilizer dose (A3) yields the linear equation Y = -0,00011X^2 + 0,01531x + 1,2955 (R^2=0,96). The regression analysis for treatment A1 indicates that the peak melon fruit weight of 1.15 kg occurs at a LOF Amino Acid dose of 164.25 ml/plant. For treatment A2, the peak fruit weight of 1.56 kg is reached with a LOF Amino Acid dose of 75.22 ml/plant. Similarly, treatment A3 reaches the peak fruit weight of 1.82 kg at a LOF Amino Acid dose of 69.59 ml/plant.

Table 3. Average length of melon fruit (kg) in combination of MKP fertilizer dose and amino acid LoF dose treatments

Average Fruit Length (cm)				
Treatment	**Dosage of LOF Amino Acids (ml/plant)**			
MKP Fertilizer Dosage (g/plant)	**0 (B0)**	**50 (B1)**	**100 (B2)**	**150 (B3)**
5 (A1)	0.67 a	0.70 ab	1.24 ef	1.06 cd
10 (A2)	1.15 de	1.18 def	1.77 g	0.86 b
15 (A3)	1.32 f	1.72 g	**1.83 g**	1.16 def
BNJ 5 %		0.16		

Description: Numbers followed by the same letter show no significant difference in the 5% BNJ test.

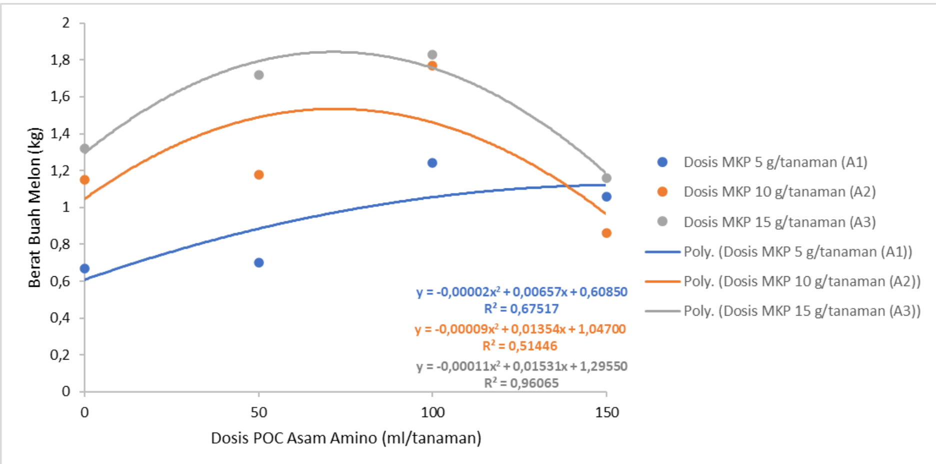

Figure 1. Quadratic regression analysis graph of the relationship between the combination of MKP fertilizer dose treatment and amino acid LoF dose on melon fruit weight

The analysis of variance (ANOVA) results for the effect of the combination of MKP fertilizer dose and LOF Amino Acid dose on the fruit diameter parameter showed

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a highly significant interaction. The individual effects of MKP fertilizer dose and LOF Amino Acid dose also had a very significant impact on fruit diameter. The average fruit diameter, based on the combination of MKP fertilizer and LOF Amino Acid treatments, is presented in Table 4.

Table 4. Average diameter of melon fruit in combination of MKP fertilizer dose and amino acid LoF dose treatments

Average Fruit Length (cm)				
Treatment	**Dosage of LOF Amino Acids (ml/plant)**			
MKP Fertilizer Dosage (g/plant)	**0 (B0)**	**50 (B1)**	**100 (B2)**	**150 (B3)**
5 (A1)	11,30 a	11,50 ab	13,93 c	13,33 c
10 (A2)	13,20 c	13,83 c	15,57 d	12,83 bc
15 (A3)	14,17 c	15,80 d	**16,03 d**	13,40 c
BNJ 5 %	1,38			

Description: Numbers followed by the same letter show no significant difference in the 5% BNJ test.

Table 4 shows that the longest average diameter of melon fruit is found in the A3B2 treatment combination, which is significantly different from other treatment combinations, except for the A2B2 and A3B1 combinations. The increase in melon fruit diameter resulting from the A3B2 treatment combination was 41.86% compared to the A1B0 treatment combination. The results of the analysis of variance for the effect of the combination of MKP fertilizer doses and LOF Amino Acid doses indicate a very significant interaction with the melon fruit length parameter. Each individual factor, namely MKP fertilizer doses and LOF Amino Acid doses, had a very significant effect on the length of the melon fruit. The average fruit length influenced by the combination of MKP fertilizer doses and LOF Amino Acid doses is presented in Table 5.

Table 5. Average length OF melon fruit IN combination OF MKP fertilizer dose AND amino acid LoF dose treatments

Average Fruit Length (cm)				
Treatment	Dosage of LOF Amino Acids (ml/plant)			
MKP Fertilizer Dosage (g/plant)	0 (B0)	50 (B1)	100 (B2)	150 (B3)
5 (A1)	13,17 a	13,30 a	17,40 c	15,30 b
10 (A2)	15,27 b	15,70 b	16,17 b	15,20 b
15 (A3)	15,80 b	17,50 c	17,53 c	15,57 b
BNJ 5 %	1,08			

Description: Numbers followed by the same letter show no significant difference in the 5% BNJ test.

Table 5 shows the average length of the longest melon fruit in the A3B2 treatment combination, which is significantly different from other treatment combinations, except for the A3B1 and A1B2 combinations. The A3B2 treatment combination increased the average length of melon fruit by 33.10% compared to the A1B0 treatment combination.

The results for the weight, diameter, and length of the melon fruit from the combination of MKP fertilizer doses and Amino Acid LOF showed the highest averages in the A3B2 treatment combination (MKP fertilizer dose 15 g/plant and Amino Acid LOF dose 100 ml/plant). These results are positively correlated with the number of melon plant leaves, with the highest average also found in the A3B2 treatment combination. This demonstrates that more

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leaves lead to more photosynthate being allocated from the leaves to the plant's fruit organs, thereby promoting an increase in fruit weight and size. In line with the research by Simkin (2023), the macro- and micronutrient content, particularly N, P, and K in tofu waste LOF, enables plants to grow optimally, thus increasing the dry weight of baby cucumber plants.

The supply of P and K nutrients from the application of MKP fertilizer greatly affects melon fruit yield. The P element stimulates fruit formation, while the K element plays a role in sugar and starch formation and regulates the allocation of photosynthate to the fruit organs. In addition, plants still require N nutrients to maintain leaf performance during photosynthesis throughout the fruit-filling period, ensuring that the photosynthate exported to the fruit organs remains optimal, which in turn increases the weight and size of the fruit. Plant photosynthate is stored in the form of food reserves in generative organs, such as fruit, so the more photosynthate received, the larger the fruit produced. Therefore, the size (length and diameter) of the fruit is positively correlated with its weight. Plants require three essential macronutrients—N, P, and K—in larger quantities compared to other nutrients during the fruit-filling period. In this study, the N nutrient was supplied through Amino Acid LOF fertilization (0.23%) as part of the treatment, Ultradap fertilizer during the vegetative period, and KNO3 fertilizer during the generative period.

The advantage of using LOF is the presence of more complete macro- and micronutrient content, which supports the plant's metabolic processes, thereby improving production outcomes. The P and K nutrients in the Amino Acid LOF and MKP fertilizer work synergistically to meet the plant's nutritional needs. Soares (2024) stated that potassium in plant tissue plays a role in the synthesis of carbohydrates and proteins, strengthening plant structure and organs to prevent them from easily breaking or falling off. The appearance of the melon fruit is shown in Figure 2.

(a) (b)

Figure 2. (a) Melon Fruit Resulting from MKP Fertilizer Dose Treatment; (b) Melon Fruit Resulting from LOF Amino Acid Dose Treatment

The application of Amino Acid LOF at doses below and above 100 ml/plant on melon plants resulted in a decrease in fruit weight and size. It is suspected that the doses of Amino Acid LOF at 50 ml/plant and in the control group did not provide sufficient nutrients for the plants, leading to low photosynthate production, which in turn affected the low weight and size of the melon fruit. According to (Sugianto *et al*., 2020), nutrient deficiencies in plants lead to stunted development of plant tissues, including phloem tissue, which is responsible for transporting photosynthates. Stunted phloem development narrows the phloem, limiting the supply of photosynthates from the leaves to the fruit, which significantly impacts the characteristics of melon fruit yields(Purba *et al*., 2020). Meanwhile, the 150 ml/plant dose of Amino Acid LOF is suspected to be toxic to the plants. This may be due to the presence of micronutrients in Amino Acid LOF,

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which, when applied in amounts exceeding the plant's tolerance limit, can become harmful. As is well known, LOF contains various micronutrients, which plants require in small quantities. It is suspected that the excessive micronutrient content in the LOF Amino Acid, combined with the nutrients already present in the planting medium (a mixture of compost and rice husks), caused the micronutrient levels in the soil to exceed the maximum threshold. This results in toxicity, disrupting the plant's metabolic processes and reducing production. In line with (Dhaliwal *et al*., 2024), the nutrients in LOF that typically cause toxicity in plants are micronutrients.

Research by (Jaiswal *et al*., 2022) shows that applying LOF in doses that exceed the plant's micronutrient requirements reduces production because the plants are poisoned by these micronutrients. Similarly, (Wang & Hao, 2023) found that applying excessive LOF during the generative phase can severely inhibit plant development, potentially leading to plant death. (Priatmojo *et al*., 2024), also noted that the application of tofu liquid waste LOF at doses above 100 ml/polybag decreased plant development, indicated by a reduction in the height of sugarcane shoots, thus confirming that excessive LOF doses can hinder plant growth. On the other hand, (Endriani *et al*., 2023), reported that applying 50 ml/l of tofu waste LOF significantly increased the diameter, length, and weight of bitter melon.

Laboratory tests on the composition of Amino Acid LOF, shown in Table 6, indicate the following macronutrient contents: N, P, K, Ca, and Mg at 0.23%, 0.16%, 0.10%, 0.08%, and 0.05%, respectively, with an organic carbon content of 0.77%. These results suggest that the Amino Acid LOF used in this study does not meet the standards for liquid organic fertilizers set by the Regulation of the Minister of Agriculture 2019. According to the regulation, the composition standards for liquid organic fertilizers (Number 261/KPTS/SR.310/M/4/2019) are a minimum of 10% organic carbon, and N, P, K contents of 2–6% each, with a maximum of 2000 ppm of calcium. Despite not meeting these compositional thresholds, liquid organic fertilizers (LOFs) remain a favorable option in sustainable agriculture due to their generally lower environmental impact compared to synthetic fertilizers. Research has shown that LOFs contribute to improved soil biological activity and fertility while reducing the risk of groundwater contamination (Kolambage et al., 2024). Additionally, LOFs derived from organic waste materials, such as amino acid sources, can promote circular economy practices by recycling agricultural by-products (Lamba et al., 2025). However, their effectiveness highly depends on the quality of raw materials and production processes, which in this case resulted in nutrient concentrations below regulatory standards. Therefore, while the environmental benefits of LOFs support their use in sustainable systems, quality control and standard compliance remain critical to maximizing their agronomic effectiveness and minimizing variability in crop response.

Table 6. Laboratory Test Results of Amino Acid LOF Composition

Test Parameters	Results	Unit
C-Organic	0,77	%
Macro Nutrients		
N – Total	0,23	%
P – Total	0,16	%
K – Total	0,10	%
Ca – Total	0,08	%
Mg – Total	0,05	%

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Although the nutrient composition and organic C content of the Amino Acid LOF are still below the quality standard, the study results showed a significant to highly significant interaction on the growth parameters and yield of melon plants from the combination of MKP fertilizer and Amino Acid LOF doses, leading to a notable increase in yield (Tables 3-5). It is suspected that, in addition to applying the correct dose of Amino Acid LOF, the frequency of application is also crucial to consider. The frequency of LOF application can have varying effects on plant yields, particularly if applied less frequently(Vogeler *et al*., 2019). In this study, Amino Acid LOF was applied five times (once per week) from 7 days after planting (DAP) to 35 DAP, covering the vegetative phase and the transition into the generative phase(Priyadi *et al*., 2022). During this phase, plant cells are actively dividing, and the presence of Amino Acid LOF helps stimulate plant growth and development. Optimal growth and development of vegetative organs such as leaves, stems, and roots during the vegetative phase are essential for supporting fruit filling during the generative phase, thereby increasing plant yield. According to (Hapsari & Suparno, 2023), liquid organic fertilizers should be applied in lower concentrations or doses, but with regular frequency, to be more effective in stimulating plant growth and development.

The combination of MKP fertilizer and Amino Acid Liquid Organic Fertilizer (LOF) significantly affected the growth and yield parameters of watermelon plants, with notable improvements in plant length, number of leaves, and fruit characteristics. The optimal treatment was found in the A2B2 (10 g MKP and 100 ml LOF) and A3B2 (15 g MKP and 100 ml LOF) combinations, which produced the longest plants and highest fruit weight and size. Although the LOF used did not meet national nutrient standards, it still contributed to significant plant performance, suggesting that nutrient availability, even at suboptimal levels, can be beneficial when combined with proper MKP application. Importantly, longer plant length was used as a key indicator of growth success, with statistical rankings (a–g) provided in descending order of performance.

From a sustainability standpoint, the use of LOF holds promise for reducing reliance on synthetic fertilizers while promoting healthier soil and crop systems. Liquid organic fertilizers, particularly those based on amino acids, improve soil microbial activity, reduce environmental contamination, and enhance long-term soil fertility (Rajan et al., 2024). For practical application, growers are advised to use LOF at 100 ml/plant in combination with 15 g MKP, applied regularly to maximize benefits. Further research is needed to optimize dosing intervals, explore synergies with biofertilizers, and assess environmental impacts through life-cycle assessment (LCA). These steps will enhance the sustainable integration of LOF in horticultural practices while improving the scalability and environmental outcomes of organic nutrient solutions (Soares et al., 2024).

CONCLUSION

The best combination of MKP fertilizer and Amino Acid Liquid Organic Fertilizer (LOF) for enhancing the growth and yield of watermelon plants was found in the A3B2 treatment—15 g/plant MKP and 100 ml/plant LOF—which resulted in the highest fruit weight and significant improvements in plant length and fruit diameter. Regression analysis further supports this finding, indicating that the optimal LOF dose for maximizing fruit weight under a 15 g/plant MKP application is 69.59 ml/plant, as shown by the equation $Y = -0.00011X^2 + 0.01531X + 1.2955$ ($R^2 = 0.96$). This combination demonstrated strong synergistic effects, significantly outperforming other treatment groups, and suggests that proper nutrient balance is crucial for maximizing crop productivity. From a sustainability perspective, the use of Amino Acid LOF—despite not meeting

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national standards for organic fertilizer content—contributed to enhanced plant growth and yield. This suggests that LOFs, particularly those derived from organic waste materials, can play a key role in reducing dependency on chemical fertilizers, improving soil health, and supporting environmentally friendly agricultural practices. Growers are encouraged to adopt MKP and LOF combinations, especially using LOF at doses around 70–100 ml/plant in regular intervals, to achieve optimal results. Future research should focus on optimizing application frequencies, integrating biofertilizers, and assessing long-term soil and environmental impacts through life-cycle analysis (LCA) to further validate the ecological and agronomic benefits of LOF-based fertilization strategies.

REFERENCES

Bhavya M., Vidya N. T., & Doni, Y. B. (2024). Influence Of Foliar Application Of 19:19:19 And Mono-Potassium Phosphate On Growth And Yield Of Green Gram (Vigna Radiata L.). *Journal Of Scientific Research And Reports*. Https://Doi.Org/10.9734/Jsrr/2024/V30i21836

Brazel, A. J., & Ó'maoileídigh, D. S. (2019). Photosynthetic Activity Of Reproductive Organs. In *Journal Of Experimental Botany*. Https://Doi.Org/10.1093/Jxb/Erz033

Dhaliwal, S. S., Dubey, S. K., Kumar, D., Toor, A. S., Walia, S. S., Randhawa, M. K., Kaur, G., Brar, S. K., Khambalkar, P. A., & Shivey, Y. S. (2024). Enhanced Organic Carbon Triggers Transformations Of Macronutrients, Micronutrients, And Secondary Plant Nutrients And Their Dynamics In The Soil Under Different Cropping Systems-A Review. *Journal Of Soil Science And Plant Nutrition*, 1–21. Https://Doi.Org/10.1007/S42729-024-01907-6

Endriani, E., Purnama, I., & Alhaviz, A. (2023). Peningkatan Produksi Pare (Momordhica Charantia L) Dengan Pemberian Konsentrasi Dan Interval Pupuk Organik Cair Limbah Tahu. *Jurnal Agrotela*, *3*(1), 72–78. (Vol. 12, No. 1, Pp. 843-853).

Grumet, R., Mccreight, J. D., Mcgregor, C., Weng, Y., Mazourek, M., Reitsma, K., Labate, J., Davis, A., & Fei, Z. (2021). Genetic Resources And Vulnerabilities Of Major Cucurbit Crops. In *Genes*. Https://Doi.Org/10.3390/Genes12081222

Hapsari, N. A. P., & Suparno, S. (2023). Effect Of Concentration Variation Of Liquid Organic Fertilizer Application On The Growth Of Mustard Plants. *Jurnal Penelitian Pendidikan Ipa*. Https://Doi.Org/10.29303/Jppipa.V9i7.2837

Jaiswal, D. K., Krishna, R., Chouhan, G. K., De Araujo Pereira, A. P., Ade, A. B., Prakash, S., Verma, S. K., Prasad, R., Yadav, J., & Verma, J. P. (2022). Bio-Fortification Of Minerals In Crops: Current Scenario And Future Prospects For Sustainable Agriculture And Human Health. *Plant Growth Regulation*, *98*(1), 5–22.

Jiaying, M. A., Tingting, C., Jie, L., Weimeng, F., Baohua, F., Guangyan, L., Hubo, L., Juncai, L., Zhihai, W., & Longxing, T. (2022). Functions Of Nitrogen, Phosphorus And Potassium In Energy Status And Their Influences On Rice Growth And Development. *Rice Science*, *29*(2), 166–178.

Kolambage, S. H., Gajanayake, P., Kumarasingha, U., Manathunga, D., Dassanayake, R. S., Jayasinghe, R., Jayasiri, N., & Wijethunga, A. (2024). Nitrogen-Enriched Liquid Organic Fertilizers (Lofs) Production For Sustainable Agriculture: A Review. *International Journal Of Recycling Of Organic Waste In Agriculture*, *13*(4), 1–14.

Lamba, R., Sangwan, S., Sehrawat, N., Singh, A., Singh, S., & Kumari, A.

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2075

(2025). Development Of Liquid Organic Fertilizers Using Agro-Industrial Wastes For The Hydroponic Cultivation Of Lettuce. *International Journal Of Environmental Research*, *19*(4), 124.

Makmur, M., & Karim, H. A. (2020). Pengaruh Berbagai Dosis Poc Hasil Fermentasi Biogas Terhadap Pertumbuhan Bibit Tanaman Kopi Arabika (Coffea Arabica (L.) Lini S 795). *Agro Bali: Agricultural Journal*. Https://Doi.Org/10.37637/Ab.V3i2.565

Markus, S. V. Y., Mahardika, I. B. K., & Kartini, L. (2025). Pengaruh Pemberian Dosis Pupuk Kandang Kambing Dan Pupuk Mkp Terhadap Pertumbuhan Dan Hasil Kedelai Edamame (Glycine Max (L) Merrill). *Gema Agro*, *30*(1), 53–61.

Priatmojo, T., Sulistiani, R., & Julia, H. (2024). The Growth Response And Yield Of White Eggplant (Solanum Melongena L.) To The Application Of Corn Cob Bokashi And Liquid Organic Fertilizer Of Tempeh Waste. *Jurnal Al Ulum Lppm Universitas Al Washliyah Medan*, *12*(2), 100–108.

Priyadi, R., Juhaeni, A. H., Meylani, V., & Fudholi, A. (2022). The Development Of Inorganic Fertilizer And Bio-Fertilizer Combination And The Effectiveness Of Application On The Growth And Production Of Red Chili. *International Journal Of Design And Nature And Ecodynamics*. Https://Doi.Org/10.18280/Ijdne.170111

Purba, J. H., Suwardike, P., & Suwarjata, I. G. (2019). Pengaruh Konsentrasi Giberelin Dan Jumlah Buah Terhadap Pertumbuhan Dan Hasil Melon (Cucumis Melo Linn.). *Agro Bali: Agricultural Journal*. Https://Doi.Org/10.37637/Ab.V2i1.365

Purba, J. H., Wahyuni, P. S., Zulkarnaen, Z., Sasmita, N., Yuniti, I. G. A. D., & Pandawani, N. P. (2020). Growth And Yield Response Of Shallot (Allium Ascalonicum L. Var. Tuktuk) From Different Source Materials Applied With Liquid Biofertilizers. *Nusantara Bioscience*. Https://Doi.Org/10.13057/Nusbiosci/N120207

Putri, F. S., Suryantini, A., & Mulyo, J. H. (2021). Consumer Preference Towards Layer Chicken Eggs And Native Chicken Eggs In Yogyakarta. *1st International Conference On Sustainable Agricultural Socio-Economics, Agribusiness, And Rural Development (Icsasard 2021)*, 181–189.

Rajan, M., Karunanidhi, D., Jaya, J., Preethi, B., Subramani, T., & Aravinthasamy, P. (2024). A Comprehensive Review Of Human Health Hazards Exposure Due To Groundwater Contamination: A Global Perspective. *Physics And Chemistry Of The Earth, Parts A/B/C*, 103637.

Rohcahyani, F. E. (2024). *Respon Pertumbuhan Dan Hasil Tanaman Melon (Cucumis Melo L.) Pada Dosis Pupuk Majemuk Mkp Dan Poc Asam Amino*. Upn" Veteran" Jawa Timur.

Samputri, H. A., Guniarti, G., & P.S., R. D. (2023). Pengaruh Dosis Poc Kulit Pisang Dan Guano Terhadap Pertumbuhan Terong Ungu (Solanum Melongena L.). *Agro Bali : Agricultural Journal*. Https://Doi.Org/10.37637/Ab.V6i2.1172

Simkin, A. J., Kapoor, L., Doss, C. G. P., Hofmann, T. A., Lawson, T., & Ramamoorthy, S. (2022). The Role Of Photosynthesis Related Pigments In Light Harvesting, Photoprotection And Enhancement Of Photosynthetic Yield In Planta. In *Photosynthesis Research*. Https://Doi.Org/10.1007/S11120-021-00892-6

Soares, A. De A. V. L., Prado, R. De M., Bertani, R. M. De A., Da Silva, A. P.

e-ISSN 2655-853X
https://doi.org/10.37637/ab.v8i2.2075

R., Deus, A. C. F., Kano, C., & Furlaneto, F. De P. B. (2024). Contribution Of Using Filter Cake And Vinasse As A Source Of Nutrients For Sustainable Agriculture—A Review. *Sustainability*, *16*(13), 5411.

Sugianto, S., Fitriani, A., Anggraeni, S., & Setiawan, W. (2020). Pengembangan Mikroskop Digital Berbasis Blended Learning Untuk Meningkatkan Kecerdasan Jasmaniah Kinestetik Mahasiswa Pada Praktikum Anatomi Tumbuhan. *Jurnal Inovasi Pendidikan Dan Sains*. Https://Doi.Org/10.51673/Jips.V1i2.320

Suhita, C. P., Setyaningrum, D., Dewanti, R. P., & Wikanditha, K. (2024). Comparative Efficiency Analysis of Organic and Conventional Melon Farming. *IOP Conference Series: Earth and Environmental Science*, *1364*(1), 12043.

Vogeler, I., Thomas, S., & van der Weerden, T. (2019). Effect of irrigation management on pasture yield and nitrogen losses. *Agricultural Water Management*. https://doi.org/10.1016/j.agwat.2019.01.022

Wahyudi, D. N., Lara Utama, G., & Frediansyah, A. (2024). Tofu wastewater recovery for mannoprotein production from yeast and mold cell walls. *International Journal of Food Properties*, *27*(1), 1247–1264.

Wang, X., & Hao, W. (2023). Reproductive and developmental toxicity of plant growth regulators in humans and animals. *Pesticide Biochemistry and Physiology*, 105640.

Wirajaya, A. A. N. M., Yuliartini, M. S., Kartini, L., Mahardika, I. B. K., & Udayana, I. G. B. (2022). Application of MKP fertilizer (mono kalium phospate) and solid organic fertilizer rabbit on the growth and production of chilli (Capsicum frutescens L.). *International Journal of Life Sciences*. https://doi.org/10.53730/ijls.v6n3.13553

Yang, F. K., He, B. L., Zhang, G. P., Zhang, L. G., & Gao, Y. P. (2019). Impacts of different soil fertility improvement practices with film mulched ridge-furrow tillage on soil nutrient content, maize yield, and water use efficiency in Northwest China. *Chinese Journal of Applied Ecology*. https://doi.org/10.13287/j.1001-9332.201903.029