

## **Application of Liquid Organic Fertilizer Concentrations and Types of Growing Media on the Growth and Yield of Lettuce (*Lactuca sativa* L.)**

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### **ABSTRACT**

This research aims to determine the optimum concentration of amino acid liquid organic fertilizer and types of planting media for the growth and production of lettuce plants (*Lactuca sativa* L.). It has been carried out in Karanganyar District, Pekalongan Regency. The design used in this study is a Complete Group Random Design (CGRD). A factorial experiment consisting of 2 factors. The first factor is the Concentration of Liquid Organic Fertilizer which consists of 4 levels, namely: K<sub>0</sub> = 0 ppm (Control), K<sub>1</sub> = 500 ppm, K<sub>2</sub> = 1000 ppm, and K<sub>3</sub> = 1500 ppm. The second factor is the Type of Planting Media which consists of 3 levels, namely: M<sub>1</sub> = Soil: Husk Charcoal (1:1), M<sub>2</sub> = Soil: Manure (1:1), M<sub>3</sub> = Soil: Cocopeat (1:1). The data was analyzed with the F test, if it was significantly different, it was followed by the 5% Least Significant Different (LSD) test. The variables that were observed were Plant height, Number of leaves, Leaf area, Root volume, Longest root length, Stem diameter, Crop weight, Plant Consumption Weight. The results showed that the concentration of liquid organic fertilizer was significantly different in the variables of leaf area, stem diameter, and straw weight. The types of planting media differ very significantly in the variables of leaf area, root volume, stem diameter, crop weight, and plant consumption weight.

**Keywords** : amino acid liquid organic fertilizer concentration, types of planting media, lettuce.

### **ABSTRAK**

Penelitian ini bertujuan untuk mengetahui konsentrasi optimum pupuk organik cair amino acid dan macam media tanam terhadap pertumbuhan dan produksi tanaman selada (*Lactuca sativa* L.). Telah dilaksanakan di Kecamatan Karanganyar, Kabupaten Pekalongan. Rancangan yang digunakan dalam penelitian ini adalah Rancangan Acak Kelompok Lengkap (RAK). Percobaan faktorial yang terdiri dari 2 faktor. Faktor pertama adalah Konsentrasi Pupuk Organik Cair yang terdiri dari 4 taraf yaitu : K<sub>0</sub> = 0 ppm (Kontrol), K<sub>1</sub> = 500 ppm, K<sub>2</sub> = 1000 ppm, dan K<sub>3</sub> = 1500 ppm. Faktor kedua Macam Media Tanam yang terdiri dari 3 taraf yaitu : M<sub>1</sub> = Tanah : Arang Sekam (1:1), M<sub>2</sub> = Tanah : Pupuk Kandang (1:1), M<sub>3</sub> = Tanah : Cocopeat (1:1). Data dianalisis dengan uji F, jika berbeda nyata dilanjutkan dengan uji BNT 5%. Variabel yang diamati adalah Tinggi tanaman, Jumlah daun, Luas daun, Volume akar, Panjang akar terpanjang, Diameter Batang, Berat Brangkas, Berat Konsumsi Tanaman. Hasil penelitian menunjukkan konsentrasi pupuk organik cair berbeda nyata pada variabel luas daun, diameter batang, dan berat brangkas. Macam media tanam berbeda sangat nyata pada variabel luas daun, volume akar, diameter batang, berat brangkas, dan berat konsumsi tanaman.

**Kata Kunci** : Konsentrasi pupuk organik cair, macam media tanam, selada

## INTRODUCTION

Lettuce (*Lactuca sativa* L.) is one of the horticultural commodities with promising prospects and considerable commercial value. The increasing population in Indonesia, along with growing public awareness of nutritional needs, has led to a rising demand for vegetables. Lettuce contains various nutrients, such as fiber (1.3 g), carbohydrates (2.9 g), vitamin C (9.2 g), iron (0.9 mg), protein (1.4 g), and minerals. Lettuce leaves have many benefits; they can be consumed raw as a salad ingredient, used as food garnish, and are believed to help relieve internal heat and improve digestion. The nutritional content of vegetables—especially vitamins and minerals—cannot be substituted by staple foods. Thus, vegetables play an important role in meeting the body's needs for these essential nutrients (Sari et al., 2022). Currently, lettuce production does not meet domestic demand. Due to its many benefits and growing popularity, Indonesia has to import this commodity. Lettuce has significant potential to be developed as a promising export commodity.

It is highly suitable for cultivation in Indonesia, not only because of favorable climatic conditions but also due to the potential profits it offers to farmers (Rahmayanti & Fuadholi, 2021). This increasing demand requires a corresponding increase in production. However, environmental conditions and limited land area often pose challenges to vegetable cultivation.

Improving plant production can be achieved through efficient and effective cultivation techniques. One approach to increasing yield is the proper use of growing media and fertilization. The high price of organic vegetables is primarily due to the limited number of producers and the relatively low productivity, making them exclusive products (Muljaningsih, 2011). To optimize lettuce growth, fertilization is essential. Fertilizers are a key agricultural input that directly affect plant growth, contributing up to 20% to the success of agricultural ventures. Nutrients are vital for plant physiological processes, and deficiencies can negatively impact plant

growth and productivity (Amin et al., 2024).

Liquid organic fertilizers can be applied by watering the cultivation area. Amino Age liquid fertilizer is used in specific concentrations and must be diluted with water for application. This type of fertilizer is long-lasting and can be used over a wide area. It can be stored in any place as long as it is protected from direct sunlight and heavy rain. Meanwhile, chicken manure fertilizer adds nutrients and increases decomposer microorganisms, thereby improving the chemical and biological properties of the soil (Hidayatush et al., 2020).

The nutrient requirements of plants depend on the availability of all essential nutrients in the soil. Maximum yield can only be achieved when all growth conditions, including nutrient supply, are optimal. Optimal conditions mean nutrients are available in the correct amounts, as any deficiency or excess of one nutrient can reduce the efficiency of others (Embarsari et al., 2015). Lettuce also requires a suitable growing medium to support its development. Therefore, a proper planting medium is essential. The chosen medium must be rich in nutrients to meet the plant's needs. It should also retain moisture around the roots, provide sufficient air circulation, and maintain nutrient availability (Krestiani & Supriyo, 2020).

## RESEARCH METHOD

The research was conducted in Pododadi Village, Karanganyar Subdistrict, Pekalongan Regency, Central Java, located at an altitude of approximately 90 meters above sea level, from March 2024 to April 2024. The experimental design used was a Randomized Complete Block Design (RCBD) arranged in a factorial pattern consisting of two factors. The first factor was the concentration of liquid organic fertilizer, which included four levels: K<sub>0</sub> (0 ppm/control), K<sub>1</sub> (500 ppm), K<sub>2</sub> (1000 ppm), and K<sub>3</sub> (1500 ppm). The fertilizer was applied by watering it evenly onto the planting media at weekly intervals until the plants were 28 days after transplanting (DAT). The second factor was the type of

growing media, consisting of three levels: M1 (soil and rice husk charcoal in a 1:1 ratio), M2 (soil and manure in a 1:1 ratio), and M3 (soil and cocopeat in a 1:1 ratio). These media were thoroughly mixed and placed into polybags before planting. The combination of these two factors resulted in 12 treatment combinations.

Each treatment was repeated three times, resulting in a total of 36 experimental units. Each unit consisted of five plant samples, giving a total of 180 experimental units. The treatment combinations involved the application of different types of growing media and varying concentrations of Amino Age fertilizer to lettuce plants. The observed variables included plant height, number of leaves, leaf area, root volume, longest root length, stem diameter, fresh biomass weight, and consumable plant weight. The collected data were analyzed using analysis of variance (ANOVA) at a 5% significance level. If significant differences were found between treatments, the analysis was followed by the Least Significant Difference (LSD) test. Regression analysis was used to evaluate the effect of Amino Age concentration, while orthogonal contrast

testing was applied to assess the differences among types of growing media.

## RESULTS AND DISCUSSION

The results of the study indicated that the concentration of liquid organic fertilizer had a significant effect on leaf area, stem diameter, and fresh biomass weight. The highest number of leaves was observed at the 500 ppm concentration, with an average of 10.94 leaves. The greatest leaf area was also achieved at the 500 ppm concentration, reaching 132.70 cm<sup>2</sup>. Similarly, the highest fresh biomass weight was recorded at 500 ppm, with a value of 10.17 g. These findings suggest that liquid organic fertilizer concentration had a statistically significant influence at 500 ppm, particularly on the number of leaves, leaf area, and stem diameter. The nutrient content in the liquid organic fertilizer appears to support plant growth and productivity, as evidenced by the increase in leaf area and stem diameter. In contrast, the 1500 ppm concentration exhibited a highly significant effect on the development of fresh biomass weight and consumable plant weight (Table 1).

Table 1. Mean Values and Statistical Analysis Data of Liquid Organic Fertilizer Concentration Application

| TREATMENT                               | Number of Leaves (leaves) | Leaf Area (cm <sup>2</sup> ) | Stem Diameter (mm) | Biomass Weight (g) | Edible Plant Weight (g) |
|-----------------------------------------|---------------------------|------------------------------|--------------------|--------------------|-------------------------|
| Liquid Organic Fertilizer Concentration |                           |                              |                    |                    |                         |
| Ko = Control                            | 8,83 ab                   | 126,66 b                     | 0,24 b             | 6,65 b             | 6,20 b                  |
| K1 = 500 ppm                            | 10,94 a                   | 132,70 a                     | 0,26 b             | 10,16 a            | 8,21 a                  |
| K2 = 1000 ppm                           | 7,43 b                    | 133,66 a                     | 0,21 b             | 6,15 b             | 5,80 b                  |
| K3 = 1500 ppm                           | 9,69 ab                   | 134,20 a                     | 0,42 a             | 6,84 b             | 6,06 b                  |

Note: Data analyzed using Least Significant Difference (LSD) test at 5% significance level

The macronutrient content of Amino Age liquid organic fertilizer—including nitrogen (N), phosphorus (P), potassium (K), organic carbon (C-organic), and pure amino acids—at a concentration of 500 ppm has been shown to positively influence the growth and yield of lettuce (*Ratrinia et al., 2014*). The nitrogen content in the liquid organic fertilizer promotes rapid leaf development, while amino acids support

the photosynthesis process, enabling plants to photosynthesize efficiently.

In addition, amino acids serve as nutrients for soil microbes (*Julian et al., 2018*). The application of amino acids to the soil enhances the activity and population of beneficial microorganisms. According to *Khumaira et al. (2013)*, liquid organic fertilizer application increases soil microbial populations, including beneficial

bacteria and fungi such as saprophytic bacteria, actinomycetes, and decomposer fungi that play an essential role in mineral decomposition. Similarly, research conducted by *Suliasih et al. (2013)* demonstrated that liquid organic fertilizer application enhances phosphatase enzyme activity, which in turn mobilizes phosphate-solubilizing microbes, making phosphorus more available to plants. A well-balanced and active microbial community in the soil contributes to improved organic matter mineralization, thereby increasing soil fertility. When nutrient cycling is efficient and nutrient availability to plants is improved, the presence of soil microorganisms becomes a key factor in enhancing soil quality. Furthermore, the organic carbon content in liquid organic fertilizer serves as a food source for soil microorganisms, which play an important role in maintaining soil fertility for plant growth (*Julian et al., 2018*).

The results of the study also showed that the type of growing media had a highly significant effect on several growth and yield variables, including leaf area, root volume, stem diameter, fresh biomass weight, and consumable plant weight. The largest leaf area was observed in the growing medium composed of soil and cocopeat (M3), reaching 144.48 cm<sup>2</sup>. The highest root volume was recorded in the soil and manure medium (M2), at 0.52 ml. The greatest stem diameter was obtained in the soil and cocopeat medium (M3), at 0.44 cm. For fresh biomass weight, the highest value was again found in the soil and cocopeat medium (M3), amounting to 9.98 g. Similarly, the highest consumable plant weight was recorded in the same medium (M3), reaching 8.67 g. These results highlight the importance of selecting appropriate growing media, as the combination of soil and cocopeat provides favorable physical and biological conditions for optimal lettuce growth and production.

Table 2. Mean Values and Statistical Analysis Data of Types of Growing Media

| TREATMENT                      | Plant Height (cm) | Leaf Area (cm <sup>2</sup> ) | Root Volume (ml) | Longest Root Length (cm) | Stem Diameter (mm) | Biomass Weight (g) | Edible Plant Weight (g) |
|--------------------------------|-------------------|------------------------------|------------------|--------------------------|--------------------|--------------------|-------------------------|
| Types of Growing Media         |                   |                              |                  |                          |                    |                    |                         |
| M1 = Soil + Rice Husk Charcoal | 20,59 a           | 130,55 b                     | 0,48 b           | 6,68 ab                  | 0,22 b             | 5,15 b             | 5,18 b                  |
| M2 = Soil + Manure             | 20,54 a           | 120,38 c                     | 1,10 a           | 5,26 b                   | 0,19 b             | 7,23 b             | 5,85 b                  |
| M3 = Soil + Cocopeat           | 16,06 b           | 144,48 a                     | 0,38 b           | 7,34 a                   | 0,44 a             | 9,98 a             | 8,66 a                  |

Note: Data analyzed using Least Significant Difference (LSD) test at 5% significance level

Cocopeat contains essential nutrients such as phosphorus (P), potassium (K), magnesium (Mg), sodium (Na), and calcium (Ca) (*Fahmi et al., 2022*). According to *Krestiani and Supriyo (2015)*, cocopeat has a high water retention capacity and can improve soil structure by loosening compacted soil. However, the use of cocopeat as a growing medium must be supplemented with balanced fertilization to supply nutrients that are naturally limited or unavailable in cocopeat. Without appropriate fertilization, cocopeat alone may not meet the nutritional requirements of plants. In addition, rice husk charcoal (biochar) is

characterized by a high carbon (C) content and has the ability to enhance soil porosity, thus contributing to improved aeration and better soil structure. Manure, on the other hand, is rich in both essential nutrients and organic matter while containing low moisture content.

Research from several studies has demonstrated that the application of manure has a positive effect on plant growth due to its rapid decomposition, which allows for a quicker release of nutrients into the soil, thereby improving soil fertility and promoting healthy plant development.

Table 3. Mean Values of the Interaction Between Liquid Organic Fertilizer Concentration and Types of Growing Media

| TREATMENT | Plant Height (cm) | Number of Leaves (leaves) | Leaf Area (cm <sup>2</sup> ) | Stem Diameter (mm) | Biomass Weight (g) | Edible Plant Weight (g) |
|-----------|-------------------|---------------------------|------------------------------|--------------------|--------------------|-------------------------|
| KoM1      | 26,41a            | 10,66bc                   | 130d                         | 0,23c              | 7,50cd             | 7,33cd                  |
| KoM2      | 24,25ab           | 8,00de                    | 127d                         | 0,10d              | 7,10cde            | 6,46de                  |
| KoM3      | 12,33f            | 7,83e                     | 123e                         | 0,40b              | 5,36def            | 4,80g                   |
| K1M1      | 11,76f            | 7,83e                     | 127,55d                      | 0,23c              | 5,33def            | 6,00ef                  |
| K1M2      | 17,16de           | 8,33cde                   | 128,38d                      | 0,13cd             | 9,03bc             | 5,13fg                  |
| K1M3      | 18,06cde          | 16,67a                    | 142,16c                      | 0,43b              | 16,13a             | 13,50a                  |
| K2M1      | 21,83bc           | 8,17de                    | 122,33e                      | 0,23c              | 2,93f              | 2,90i                   |
| K2M2      | 20,33bcd          | 7,17e                     | 113,33f                      | 0,17cd             | 7,56cd             | 8,00c                   |
| K2M3      | 14,23ef           | 6,97e                     | 165,33a                      | 0,23c              | 7,97c              | 6,50de                  |
| K3M1      | 22,35abc          | 7,91e                     | 142,33c                      | 0,2cd              | 4,83ef             | 4,50hg                  |
| K3M2      | 20,43bcd          | 10,33bcd                  | 112,83f                      | 0,37b              | 5,23def            | 3,833h                  |
| K3M3      | 19,63cd           | 10,83b                    | 147,43b                      | 0,7a               | 10,46b             | 9,86b                   |

Note: Data analyzed using Least Significant Difference (LSD) test at 5% significance level

The results of the study revealed a highly significant interaction between the concentration of liquid organic fertilizer and the type of growing media on several growth and yield variables, including the number of leaves, leaf area, fresh biomass weight, and consumable plant weight. An interaction effect occurs when both the fertilizer concentration and the growing media type jointly influence plant growth and productivity. For the number of leaves, the highest value was observed at the interaction of 500 ppm liquid organic fertilizer combined with soil and cocopeat media, yielding 17 leaves. As the plant matures, the number of leaves increases due to ongoing physiological growth. The largest leaf area was recorded at the interaction of 1000 ppm liquid organic fertilizer and soil with cocopeat, reaching 165.33 cm<sup>2</sup>. Regarding fresh biomass weight, the highest value was obtained from the interaction of 500 ppm liquid organic fertilizer and soil with cocopeat media, amounting to 16.13 grams.

Similarly, the greatest consumable plant weight was observed at the same interaction, with a value of 13.50 grams. Among the tested media, the combination of soil and cocopeat proved to be the most effective. Cocopeat has a notable advantage

in its capacity to retain and store water, reportedly up to 69% of soil moisture. Its micro-sized pores slow down water movement, thereby increasing water availability (Febriani *et al.*, 2021). In line with this, Irawan and Kafiar (2015) found that cocopeat holds more moisture than either rice husk charcoal or soil alone.

Additionally, the interaction between liquid organic fertilizer concentration and growing media type was also significant for plant height and stem diameter variables. The best interaction for plant height was observed at 0 ppm liquid organic fertilizer combined with soil and rice husk charcoal, resulting in a height of 26.41 cm. For stem diameter, the highest value occurred at the interaction of 1500 ppm liquid organic fertilizer with soil and cocopeat, reaching 0.7 mm. These findings underscore the importance of both nutrient management and appropriate media selection in optimizing lettuce growth and productivity.

## CONCLUSION

Based on the results and discussion of this study, several conclusions can be drawn as follows:

1. The application of different concentrations of liquid organic fertilizer had a highly significant

effect on leaf area, stem diameter, and consumable plant weight, with the best results observed at the 500 ppm concentration.

2. The most effective growing media was the combination of soil and cocopeat.
3. A significant interaction was observed between the concentration of liquid organic fertilizer and the type of growing media on the variables of leaf number, leaf area, fresh biomass weight, and consumable plant weight.

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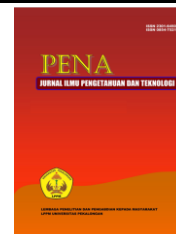




# PENA

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