International Journal of Agriculture and Environmental Research

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

GROWTH TRAITS OF BASIL (*Ocimum sanctum* L.) UNDER APPLICATION OF LIQUID ORGANIC FERTILIZER AND NITROGEN FERTILIZER

[1*]Haris Kriswantoro, [1]Denny Yulianto, [1]Yani Purwanti, [1]Laili Nisfuriah, [1]Gamal Abd. Nasser, [1]Rastuti Kalasari, [1]Fitri Yetty Zairani, [1]Asmawati Asmawati and [1]Widiarti Widiarti

[1]Study Program of Agrotechnology, Faculty of Agriculture, University of Palembang, Palembang, Sumatera Selatan Province, Indonesia.

*Corresponding author

DOI: https://doi.org/10.51193/IJAER.2025.11110

Received: 27 Jan. 2025 / Accepted: 05 Feb. 2025 / Published: 14 Feb. 2025

ABSTRACT

Basil is a vegetable crop that has high economic value, so in improving the quality of growth requires fertile planting media and is able to provide nutrients in sufficient quantities according to their needs. Liquid organic fertilizer (LOF) is one solution in improving soil fertility and plant growth, while nitrogen fertilizer can overcome the lack of N elements in the soil which is often a limiting factor, especially for plant vegetative growth. This study aimed to determine the growth traits of basil plants due to the application of liquid organic fertilizer and various levels of N fertilizer. The research was conducted in the experimental garden of Agriculture Faculty, Palembang University, from April to June 2021. The experimental was arranged using a Factorial Randomized Block Design, which consisted of two factors with three replications. The treatments tested were: 1) LOF, consisting of without LOF (F0) and with LOF (F1), 2) N fertilizer level, consisting of 0 kg ha^{-1} (N0), 75 kg ha^{-1} (N1), 150 kg ha^{-1} (N2), and 225 kg ha^{-1} (N3). The least significance difference (LSD) test at level 5% showed that the basil plants treated with LOF exhibit better growth traits than the plants without LOF. Furthermore, in the treatment of N fertilizer, overall basil plants were given N fertilizer with 150 kg ha^{-1} (N2) showed the best growth traits than the other levels. Meanwhile, there was no significantly interaction between LOF and N fertilizer treatment for all variables.

Keywords: Basil plant, growth, nitrogen, organic fertilizer, soil fertility

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

1. INTRODUCTION

Basil (*Ocimum sp.* L.) is one of the annual herbs that grown and has been used widely for culinary, a medicinal herb, food flavor, medical industries, and in the fragrance industry (Saha *et al*., 2016; Aldarkazali et al., 2019). Meanwhile, many people in Indonesia have cultivated basil plants, because people already know its uses for culinary, medicine, cosmetics, and bio pesticides (Kalsum and Kesmayanti, 2021). Basil is included in the group of plants that are easily adaptable to the surrounding environment and easy to grow (Aranta et al., 2019).

As one of the plants are used in culinary, basil leaves are an important harvesting organ that is used to become leafy vegetables. Basil leaves are commonly mixed in dishes to add aroma (Rahayu et al., 2019). Leafy vegetables are one of the vegetables consumed when they are in the vegetative phase (Delyani and Kartika, 2016).

The need for basil plants to have the right amount of nitrogen in the soil is one of the important factors in supporting the increase in basil production, because the nutrient that plays an important role in the vegetative phase, especially for leaf growth, is nitrogen (Delyani and Kartika, 2016; Rahayu et al., 2019). The addition of nutrients to the soil both through the application of inorganic fertilizers, especially N fertilizers (Delyani and Kartika, 2016) and organic fertilizers (Kalsum and Kesmayanti, 2021), can give a positive effect on improving the growth of basil plants, so as to obtain maximum crop yields. The organic C content contained in organic fertilizers can improve the physical, chemical and biological properties of the soil, so as to create optimal growing environmental conditions for basil plants.

Meanwhile, there was a significant difference in growth in basil plants that were treated with N fertilizer doses. High doses of N fertilizer decreased plant vegetative growth, so that plant yields were lower than basil plants that received N treatment with lower and medium doses (Nurzynska-Wierdak et al., 2012).

Based on the description above, this study was encouraged to be carried out with the aim of determining the growth traits of basil plants (*Ocimum sanctum* L.) due to the application of liquid organic fertilizers and various doses of nitrogen fertilizers.

2. MATERIALS AND METHODS

This research has been carried out in the experimental garden of the Faculty of Agriculture, University of Palembang which is located on Jalan Dharmapala No. IA Bukit Besar, Palembang. The research period took place from April to July 2021. During the study, the averaged of air temperature recorded was 27.9 ^{o}C and air relative humidity was 81%.

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

The materials used were Tirode variety basil seeds, ultisol soil, Dewa liquid organic fertilizer, and Urea fertilizer. Meanwhile, the tools used were: 2 kg polybags, buckets, raffia ropes, hoes, rulers, cameras, other stationery and laboratory tools.

This study used a Factorial Randomized Block Design with 2 treatment factors and 3 replications. The first treatment factor was Liquid Organic Fertilizer (LOF), i.e. without LOF application (F0) and with LOF application (F1). The second treatment factor was the dose of N fertilizer in the form of Urea fertilizer, i.e. 0 kg ha^{-1} (N0), 75 kg ha^{-1} (N1), 150 kg ha^{-1} (N2) and 225 kg ha^{-1} (N3). Based on the treatment factors tried, as many as 8 treatment combinations were obtained. Each combination will be repeated 3 times, so that a total of 24 experimental units will be obtained. Each experimental unit consists of 3 plants, so there was a total of 72 plants.

2.1 Procedures

2.1.1 Land Preparation

The land for placing the polybags was cleaned of roots and weeds and then leveled.

2.1.2 Preparation of planting media

The planting medium was prepared with a composition of topsoil soil and husk charcoal fertilizer in a ratio of 1:1, then all materials were mixed. The planting medium was put into a polybag with a media weight of 2 kg. Next, a planting hole was made in each polybag 5 cm deep, to insert basil seedlings that were ready to be transplanted from the seedbed.

2.1.3 Seed nursery

Before planting, basil seeds were sown in the seedling medium. The seedling medium used was in the form of a composition of topsoil soil and husk charcoal in a ratio of 1:1, the two ingredients are mixed until evenly distributed. The seedling media was put into a seedbed container. Basil seeds were sown on the seedling medium, covered thinly using fine soil,then watered. The seedling medium was stored in a shade that was not exposed to direct sunlight for 3 weeks.

2.1.4 Planting seedlings

After 3 weeks, the basil seedlings that have grown were transplanted into polybags that have been filled with planting media. Each polybag was planted with 1 seedling. Planting seedlings was carried out in the afternoon.

2.1.5 Fertilization

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

Fertilization used LOF application at a dose of 3 ml L^{-1}. POC application was carried out on some plants that receive LOF fertilizer treatment, while the rest were not given LOF. LOF was applied by spraying on plants and into the soil using a hand prayer that was carried out when the plant at 2 weeks and 4 weeks after planting. Furthermore, basil plants were also given Urea fertilizer according to the predetermined treatment dose, i.e. 0, 75, 150 and 225 kg ha^{-1}. The application of Urea fertilizer consists of two stages. The first stage of 1/2 dose was carried out when the plant at 3 weeks after planting, and the second fertilization of 1/2 dose was given when the plant at 5 weeks after planting.

2.1.6 Plant maintenance

Maintenance of basil plants, including: watering, mulching, and pest control.

2.1.7 Harvesting

Harvesting was carried out when the plant was 50 days after planting, by pulling out all plant organs.

2.1.8 Parameters observation

Plant height (cm), plant height was measured from the root neck to the apical of stem, carried out at the time of harvest. Shoot fresh weight (g), measurement was taken immediately after harvest by weighing the entire top of the plant. Root fresh weight (g), measurement was taken immediately after harvest by weighing the entire root. Shoot Dry Weight (g), measurement was made by drying the shoot in the oven at a temperature of 70^{o}C for 24 hours until it reach a constant weight. Root dry weight (g), measurement was carried out by drying the roots in the oven at a temperature of 70^{o}C for 24 hours until they reach a constant weight.

2.2 Statistical Analysis

Based on the explanation above, the data were analyzed statistically by using analysis of variance (Anova) of Factorial Randomized Block Design. If significantly effect of the treatments were found, then the data were tested using Least Significance Different (LSD) test at the level of 5%.

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Analysis of variance of liquid organic fertilizer application and N fertilizer dose and their interaction on basil growth

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

Analysis of variance showed that the treatment of liquid organic fertilizer application had a very significantly effect on root fresh weight and shoot dry weight, had a significantly effect on plant height and root dry weight, but no significantly effect on shoot fresh weight. N fertilizer treatment has a very significantly effect on root fresh weight and shoot dry weight, had a significantly effect on plant height and shoot fresh weight, but no significantly effect on root dry weight. Meanwhile, the interaction had an insignificantly effect on all observation variables (Table 1). The result of this study was in line with the results of previous studies, which reported that basil plants showed better growth with the application of liquid organic fertilizers (Kalsum and Kesmayanti, 2021) and accompanied by the application of nitrogen fertilizers (Nurzynska-Wierdak et al., 2012).

Table 1: Variance analysis of liquid organic fertilizer application and N fertilizer dose to the variables.

Variables	F value			CV (%)
	F	N	I	
Plant height (cm)	5.00*	5.31*	0.23^{ns}	24.86
Shoot fresh weight (g)	3.35^{ns}	3.73*	1.14^{ns}	15.54
Root fresh weight (g)	8.09**	5.96**	2.27^{ns}	24.68
Shoot dry weight (g)	11.05**	20.16**	1.49^{ns}	8.97
Root dry weight (g)	6.80*	1.24^{ns}	0.79^{ns}	21.30
F table 0.05	4.60	3.34	3.34	
F table 0.01	8.86	5.56	5.56	

Remarks: * = significantly effect, ** = very significantly effect, ns = no significantly effect, F = liquid organic fertilizer, N = nitrogen fertilizer, I = interaction between treatments, CV = coefficient of variance

3.1.2. The effect of liquid organic fertilizer application on basil growth

Based on the LSD test of liquid organic fertilizer treatment indicated that basil plants with LOF (F1) showed significantly different growth and were better than plants without LOF (F0). As seen in Table 2, the application of liquid organic fertilizer has promoted an increase in plant height, root fresh weight, shoot dry weight and root dry weight of basil plant.

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

Table 2: The LSD test of liquid organic fertilizer treatment on the average of plant height, shoot fresh weight, root fresh weight, shoot dry weight, and root dry weight.

Treatment	Plant height (cm)	Shoot fresh weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)
Liquid Organic Fertilizer					
- Without LOF (F0)	15.03 a	3.47	1.23 a	0.43 a	0.19 a
- With LOF (F1)	18.88 b	3.90	2.11 b	0.49 b	0.33 b
LSD 5%	3.69	-	0.67	0.04	0.11

Remarks: Numbers followed by the same letter in the same column show an insignificantly different at the 5% LSD test level

The application of LOF to basil plants provides better growth and very significantly different compared to the growth of plants without LOF. This study was in line with the results reported by Kalsum and Kesmayanti (2019) and Aranta et al. (2019). Organic fertilizers both in liquid and solid form are able to encourage the growth and development of basil plants to be better. This indicates that the application of organic fertilizers can be an effective material in managing soil fertility for vegetable crop production. The content of organic matter in organic fertilizers can improve the capacity of soil to bind and supply nutrients, as well as be beneficial for the life of soil microorganisms (Ndzingane et al., 2022), and in general, organic matter is able to improve the physical and chemical properties of soil (Mahmud et al., 2023). Furthermore, such conditions can create a good and favorable planting medium for the growth and development of basil plants.

Increased nutrient availability and better soil water holding capacity can optimize the root activity of basil plants in nutrient absorption, which is then followed by increased translocation and assimilation of nutrients providing a beneficial influence on the overall vegetative growth appearance of basil plants (Al-mansour et al., 2017; Aranta et al., 2019). The application of organic fertilizers in sufficient quantities and in accordance with the needs of basil plants can create favorable growing environmental conditions for the process of photosynthesis and accumulation of nutrients in plants, so that plant production in quantity and quality will also increase (Bufalo et al., 2015).

Meanwhile, basil plants that were not given organic fertilizer showed the lowest yield in plant vegetative growth. This is because without organic matter, poor growth media will be produced, which results in disruption of the plant metabolic process, so that the growth of basil plants is also inhibited (Aranta et al., 2019).

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

3.1.3. The effect of N fertilizer dose on basil growth

The results of the LSD test of N fertilizer dose treatment disclosed that basil plants with Urea fertilizer of 150 kg ha^{-1} (N2) and 225 kg ha^{-1} (N3) showed significantly different growth and were better than other fertilizer dose treatments. This could be seen from variables of plant height, shoot fresh weight, and shoot dry weight whose appearance that no significantly different between N2 and N3 treatment, but in root fresh weight showed that the highest was achieved by the N2 treatment and significanly different to the other treatments (Table 3). Meanwhile, basil plants without N fertilizer (N0) had lower growth than plants with N fertilizer. Overall, the growth of basil plants shows a tendency to increase along with the increase in the dose of N fertilizer applied up to 150 kg ha^{-1} (N2).

Table 3: The LSD test of N fertilizer dose treatment on the average of plant height, shoot fresh weight, root fresh weight, shoot dry weight and root dry weight.

Treatment	Plant height (cm)	Shoot fresh weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)
N fertilizer dose					
- 0 kg ha^{-1} (N0)	11.34 a	3.21 a	0.97 a	0.36 a	0.18
- 75 kg ha^{-1} (N1)	17.51 b	3.43 a	1.53 a	0.44 b	0.25
- 150 kg ha^{-1} (N2)	18.36 b	4.22 b	2.76 b	0.51 c	0.32
- 225 kg ha^{-1} (N3)	20.60 b	3.87 ab	1.42 a	0.52 c	0.28
LSD 5%	5.22	0.71	0.95	0.05	-

Remarks: Numbers followed by the same letter in the same column show an insignificantly different at the 5% LSD test level

The application of N fertilizer has a significant effect on the growth of basil plants. This is because N is one of the important macronutrients needed by cultivated plants for the synthesis of various compounds, such as amino acids, enzymes and nucleic acids (Nurzyńska-Wierdak, 2012), and is needed in the synthesis of chlorophyll (Rahayu et al., 2020), so that it can affect the growth and yield of basil plants.

The higher the N applied up to 150 kg ha^{-1} of urea fertilizer (N2), it turns out that the vegetative growth of basil plants tends to increase. However, between N2 and N3 treatments tend to provided relatively similar growth, compared to other N fertilizer dose treatments.

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

The positive response of basil plants to increased doses of N fertilizer, especially in intensive irrigation systems, has also been reported by Sifola and Barbieri (2006) and Biesiada and Kus (2010). This indicated that the treatment of N fertilizer with this dose in this study was the optimal dose to support the growth of basil plants. Chemical fertilizers at optimal doses can release a larger amount of nutrients at a faster rate, so that more is also absorbed by plants, which in turn provides higher plant growth and yield (Al-mansour et al., 2017).

Nitrogen is one of the main nutrients needed by all plants, including basil for optimal growth and production. Nitrogen functions is to increase vegetative growth, so that plant leaves become wider and greener (Rahayu et al., 2020). To get good growth and production, using the appropriate dose of fertilizer is one of the important factors to encourage optimal plant growth and production. Wide leaves have the potential to produce higher photosynthesis compared to narrow leaves (Kogoya et al., 2018). The N content of plants is closely related to the rate of leaf photosynthesis and plant production. When N is given in sufficient quantities and according to the needs of the plant, the color of the leaves becomes greener, which can further encourage the rapid growth rate of the plant (Niazi et.al. 2022).

Meanwhile, the low dose of fertilizer causes the nutrients needed by plants unfulfilled, so that plants cannot grow optimally. Lack of N in plants causes inhibition of the formation of proteins and amino acids, affecting the growth of buds and other plant organs. The deficiency of element N will be seen in the color of the leaves, namely the leaves become yellowish-green until they turn yellow completely. Plants that lack element N will experience a lower rate of photosynthesis, so the photosynthetic product are also limited, and result in inhibited vegetative growth of plants (Rahayu et al., 2019).

The result of the variance analysis showed that the interaction treatment had an insignificant effect on all observation parameters. This meant that each treatment did not affect each other in expressing the agronomic properties of plants. Plant growth and development were not only influenced by soil fertility, but climatic factors were also thought to contribute to influencing the growth of basil plants.

4. CONCLUSION

The application of LOF could encourage the vegetative growth of basil plants to be better. Similarly, N fertilizer of 150 kg ha^{-1} was able to increase the vegetative growth better than other N fertilizer treatments. There was no significantly interaction between the application of LOF and N fertilizer dose on the vegetative growth of basil plants.

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

ACKNOWLEDGEMENT

Our deepest gratitude to all participants who have contributed to the completion of this article.

REFERENCES

[1]. Aldarkazali, M., Rihan, H.Z., Carne, D., and Fuller, M.P. (2019). The growth and development of sweet basil (*Ocimum basilicum*) and bush basil (*Ocimum minimum*) grown under three light regimes in a controlled environment. Agronomy, 9,743.

[2]. Al-mansour, B., Suryanarayana, M.A., Kalaivanan, D., Umesha, K., and Vasundhara, M. (2017). Effect of graded levels of N through FYM, inorganic fertilizers and bio fertilizers on growth, herbage yield, oil yield and economics of sweet basil (*Ocimum basilicum* L.). Medicinal Plants, 9(4), 250-258.

[3]. Aranta, D.P., Rahayu, A., and Mulyaningsih, Y. (2019). Growth and production of lemon basil (*Ocimum basilicum* L.) grown in different compositions of urea fertilizer and cattle urine. Jurnal Agronida, 5(1), 21-28.

[4]. Biesiada, A., and Kuś, A. (2010). the effect of nitrogen fertilization and irrigation on yielding and nutritional status of sweet basil (*Ocimum basilicum* L.). Hortorum Cultus, 9(2), 3-12.

[5]. Bufalo, J., Cantrell, C. L., Astakie, T., Zheljazkov, V. D., Gawde, A., and Boaro, C. S. F. (2015). Organic versus conventional fertilization effects on sweet basil (*Ocimum basilicum* L.) growth in a greenhouse system. Industrial Crops and Products, 74, 249-254.

[6]. Delyani, R., and Kartika, J.G. (2016). Effect of nitrogen and biological liquid fertilizer to growth and production of perennial indigenous leafy vegetables. Bul. Agrohorti, 4(3), 336-342.

[7]. Kalsum, U., and Kesmayanti, N. (2021). Evaluasi peran pupuk organik pada peningkatan pertumbuhan dan kualitas hasil pada budidaya kemangi (*Ocimum basilicum* L.) organik. Prosiding Seminar Nasional Penelitian dan Pengabdian 2021, "Penelitian dan Pengabdian Inovatif pada Masa Pandemi Covid-19", pp. 217-226.

[8]. Kogoya, T., Dharma, I.P., and Sutedja, I.N. (2018). The effect of urea fertilizer dosage on the growth of spinach plants removes white (*Amaranthus tricolor* L.). E-Jurnal Agroekoteknologi Tropika, 7(4), 575-584.

[9]. Mahmud, S.P., Puspitorini, P., and Serdani A.D. (2023). Respon pertumbuhan dan hasil tanaman kemangi (*Ocimum sanctum* L.) terhadap pemberian pupuk organik dan arang sekam sebagai media tanam. Journal Grafting, 13(1), 1-7.

[10]. Ndzingane, T.S., Masarirambi, M.T., Nxumalo, K.A., Kunene, E.N., Earnshaw, D.M., Mpofu, M., Dlamini, D.V., and Sihlongonyana, S. (2022). Effects of organic fertilisers on growth, yield and nutritional content of sweet basil (*Ocimum basilicum* L.). Advancement in Medicinal Plant Research, 10(1), 1-16.

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

[11]. Niazi, S., Sulaiman, M.F., Sadat, M.I., Saleh, G., and Nakasha, J.J. (2022). The Effects of different rates of nitrogen fertilizer and shade on physiological characteristics and yield of basil (*Ocimum tenuiflorum*). Annals of Agri-Bio Research, 27(1), 50-55.

[12]. Nurzynska-Wierdak, R., Rozek, E., Dzida, K., and Borowski, B. (2012). Growth response to nitrogen fertilization and of potassium common basil (*Ocimum basilicum* L.) plants. Hortorum Cultus, 11(2), 275-288.

[13]. Rahayu, A., Nahraeni, W., Rochman, N., and Faturrochman, A. (2019). Growth response of basil accessions on various nitrogen natural fertilizer composition. Jurnal Agronida, 5(2), 70-77.

[14]. Rahayu, A., Rochman, N., Nahraeni, W., and Fitriasari, N. (2020). Production and quality of seven basil (*Ocimum basilicum* L.) accessions in various composition of urea fertilizer and mexican sunflower compost. Advances in Biological Sciences Research, 13, 267-273.

[15]. Saha, S., Monroe, A., and Day, M.R. (2016). Growth, yield, plant quality and nutrition of basil (*Ocimum basilicum* L.) under soilless agricultural systems. Annals of Agricultural Science, 61, 181-186.

[16]. Sifola, M.I., and Barbieri G. (2006). Growth, yield and essential oil content of three cultivars of basil grown under different levels of nitrogen in the field. Sci. Hort., 108, 408–413.

