International Journal of Natural Science Studies and Development (IJOSS)
Volume 2 Issue 2 20245 pp 186-199
E-ISSN: 2615-1383
DOI: https://doi.org/10.55299/ijoss.v2i2.26

The Effect of Liquid Organic Fertilizer from Fish Waste and Trichokompos on The Growth of Soybean Plants (*Glycine max*) of The Edamame Variety

Nanda Aprilia[1], Rahmi Dwi Handayani Rambe[2*], Indra Gunawan[3]

[1,2,3] *Department of Agriculture, Universitas Islam Sumatera Utara, Medan, North Sumatra, Indonesia*
**Corresponding author: rahmi.dwihandayani@fp.uisu.ac.id*

Abstract

Soybeans (*Glycine max*) are the third most important food commodity after rice and corn and are one of the legumes used as a major source of protein and vegetable oil in the world. This study was conducted at the Experimental Farm of the Faculty of Agriculture, University of Islam Sumatra Utara, at an elevation of approximately 25 meters above sea level. This study aims to determine the effect of liquid organic fertilizer from fish waste and Trichokompos on the growth of Edamame soybean plants. This study employs a factorial randomized block design (RBD), with the first factor being Fish Waste Liquid Organic Fertilizer, consisting of four levels: L0 = No Fish Waste Liquid Organic Fertilizer (control), L1 = Fish Waste Liquid Organic Fertilizer 100 ml/polybag, L2 = 200 ml of liquid organic fertilizer from fish waste per polybag, L3 = 300 ml of liquid organic fertilizer from fish waste per polybag. The second factor was Trichokompos fertilizer, consisting of 4 levels: T0 = No Trichokompos fertilizer (control), T1 = Trichokompos fertilizer 12.5 tons/ha (62.5 g/polybag), T2 = Trichokompos fertilizer 25 tons/ha (125 g/polybag), T3 = Trichokompos fertilizer 37.5 tons/ha (187.5 g/polybag). The results of the study indicate that the application of Fish Waste Liquid Organic Fertilizer affects plant height, number of leaves, and stem diameter. Trichokompos affects plant height but does not affect the number of branches or stem diameter. The interaction between Fish Waste Liquid Organic Fertilizer and Trichokompos did not affect any of the observed parameters.

Keywords: *Soybean Plant, Liquid Organic Fertilizer from FishWaste, Trichokompos Fertilizer*

1. INTRODUCTION

Soybeans (*Glycine max*) are the third most important food commodity after rice and corn and are one of the legumes used as a major source of protein and vegetable oil in the world. One type of soybean that is in high demand both domestically and internationally is edamame soybeans. Edamame is a promising crop that needs to be developed because it has an average yield of 3.5 tons per hectare, which is higher than the average yield of regular soybeans, which ranges from 1.7 to 3.2 tons per hectare. In addition, edamame also has broad export market opportunities (Sudiarti, 2018). In 2020, Indonesia was only able to export 13.58% of its edamame soybeans. The high demand for edamame soybean exports, particularly from Japan, indicates that edamame soybeans have significant potential for increased production to meet Indonesia's market demand (Pertanian,

History:
Received : May 02, 2025
Revised : June 12, 2025
Accepted : July 02, 2025
Published : July 30, 2025

Publisher: Inovasi Pratama Int. Press

2020).

According to Diah (2018), organic materials or fertilizers can increase agricultural commodity yields and have a function in improving the physical, chemical, and biological properties of soil, so that the soil can provide nutrients in balanced amounts. Organic fertilizers are classified into two types based on their form: solid organic fertilizers and liquid organic fertilizers. One type of liquid organic fertilizer (POC) that can be utilized is liquid organic fertilizer made from fish waste (Waryanti, 2013).

Fish waste has high levels of nitrate and ammonia because it contains high levels of protein and fat. Fish waste can be used as a material for making organic fertilizer (Anggarseti, 2023). According to Murdaningsih (2021), fish offal contains 36-57% protein; 0.05-2.38% crude fiber; 24-63% moisture content; 5-17% ash content; 0.9-5% calcium (Ca) content; and 1-1.9% phosphorus (P) content. In general, fish waste contains nutrients such as N (nitrogen), P (phosphorus), and K (potassium), which are components of organic fertilizer. The analysis of fish waste content shows that fish waste contains 64.78% nitrogen (N), 49.39% phosphorus (P), and 31.16% potassium (K) (Ibrahim, Sabban, and Mahmud, 2023).

In addition to fish waste organic fertilizer, another source of organic fertilizer that contains sufficient nutrients to meet the needs of soybean plants is Trikompos. Trichokompos can improve soil structure, maintain soil moisture, and act as a nutrient reservoir needed by plants during their development and fruit enlargement process (Nurnawati, Syarifuddin, and Samsu, 2020). According to Wardah (2021), Trichokompos contains the following nutrient elements: water: 49%, K: 2.52%, N: 1.77%, P: 2.71%, Ca: 1.12%, and Mg: 0.45%, Therefore, given the high nutrient content beneficial to plants, it can be concluded that Trichokompos plays a crucial role in plant growth processes.

2. METHOD

This study was conducted at the Experimental Farm of the Faculty of Agriculture, University of Islam Sumatra Utara, Jl. Karya Wisata, Gedung Johor, Medan Johor District, Medan City, at an elevation of approximately 25 meters above sea level. The study was conducted from February to May 2024.

This research used a factorial Randomized Complete Block Design (RCBD), namely: The first factor was Liquid Organic Fertilizer from Fish Waste consisting of 4 levels, namely: L_0 = Without Liquid Organic Fertilizer from Fish Waste (Control), L_1 = Liquid Organic Fertilizer from Fish Waste 100 ml/polybag, L_2 = Liquid Organic Fertilizer from Fish Waste 200 ml/polybag, L_3 = Liquid Organic Fertilizer from Fish Waste 300 ml/polybag. The second factor was Trichokompos consisting of 4 levels, namely: T_0 = Without Trichokompos (Control), T_1 = Trichokompos Fertilizer 12.5 tons/ha (62.5 g/polybag), T_2 = Trichokompos Fertilizer 25 tons/ha (125 g/polybag), T_3 = Trichokompos Fertilizer 37.5 tons/ha (187.5 g/polybag). The parameters observed were plant height (cm), number of branches (branches), stem diameter (cm).

3. RESULTS AND DISCUSSION

3.1 Plant Height

The results of observations and analysis of soybean plant height at 4 weeks after planting (WAP) show that the treatment of liquid organic fertilizer from fish waste and trichokompos had a significant effect on plant height at 4 WAP. Meanwhile, the interaction between the two treatments of Fish Waste Liquid Organic Fertilizer and Trichokompos did not have a significant effect on soybean plant height growth at 4 WAP.

The results of the mean difference test of the effect of Liquid Organic Fish Waste Fertilizer and Trichokompos on soybean plant height growth can be seen in Table 1.

Table 1. Plant Height with Treatment of Liquid Organic Fertilizer from Fish Waste and Trichokompos at 4 WAP

Liquid Organic Fish Waste Fertilizer (L)	Trichokompos (T)				Average L
	T_0	T_1	T_2	T_3	
L_0	31,67	31,83	32,25	32,25	32,00 c
L_1	35,46	36,46	38,34	41,23	37,87 b
L_2	39,09	41,66	40,91	41,08	40,69 a
L_3	40,83	41,91	40,92	42,73	41,60 a
Average T	36,76 b	37,97 ab	38,11 ab	39,32 a	

Note: Numbers followed by different letters in the same column are significantly different based on the DMRT 5% test.

Table 1 shows that the application of Liquid Organic Fish Waste Fertilizer has a significant effect on the height growth of soybean plants at 4 weeks after planting (WAP). The highest average plant height growth was observed in treatment L3 (Fish Waste Liquid Organic Fertilizer 300 ml/polybag) at 41.60 cm, which was not significantly different from treatment L2 (Fish Waste Liquid Organic Fertilizer 200 ml/polybag) at 40.69 cm, but significantly different from treatment L1 (Fish Waste Liquid Organic Fertilizer 100 ml/polybag) at 37.87 cm and treatment L0 (no treatment) at 32.00 cm. Based on the analysis of the composition of Fish Waste Liquid Organic Fertilizer, it contains C-Organic 1.52%; N-Total 0.37%; P_2O_5 0.12%; K_2O 0.14%. It is suspected that Fish Waste Liquid Organic Fertilizer contains rich nutrients such as nitrogen, phosphorus, and potassium, which are essential for optimal plant growth. Additionally, liquid organic fertilizer from fish waste enhances nutrient availability for plants by stimulating soil microorganism activity, which aids in the decomposition of organic matter into forms more easily absorbed by plants. With increased nutrient availability and soil biological activity, soil fertility also improves, providing a better environment for root growth. Healthy and strong roots will allow plants to absorb more nutrients and water, which ultimately contributes to better soybean plant height growth at 4 WAP.

This is consistent with recent research conducted by Sari et al. (2023), which shows that the application of liquid organic fertilizer made from fish waste has a positive effect on the growth and yield of soybean plants. Fish waste-based liquid organic fertilizer contains macro and micro nutrients required by plants, as well as bioactive compounds such as amino acids, phytohormones, and enzymes that can enhance plant growth and development (Gholami et al., 2021).

Good plant growth can increase vegetative growth such as plant height. With the application of liquid organic fertilizer, soybean plant height showed good results because the liquid organic fertilizer applied can be utilized by plants to grow and develop. This is in line with the statement by Sabilu et al. (2015) that organic fertilizer treatment produces significant differences in nutrient content in soybean plant stems.

The relationship between plant height and liquid organic fertilizer from fish waste can be seen in Figure 1.

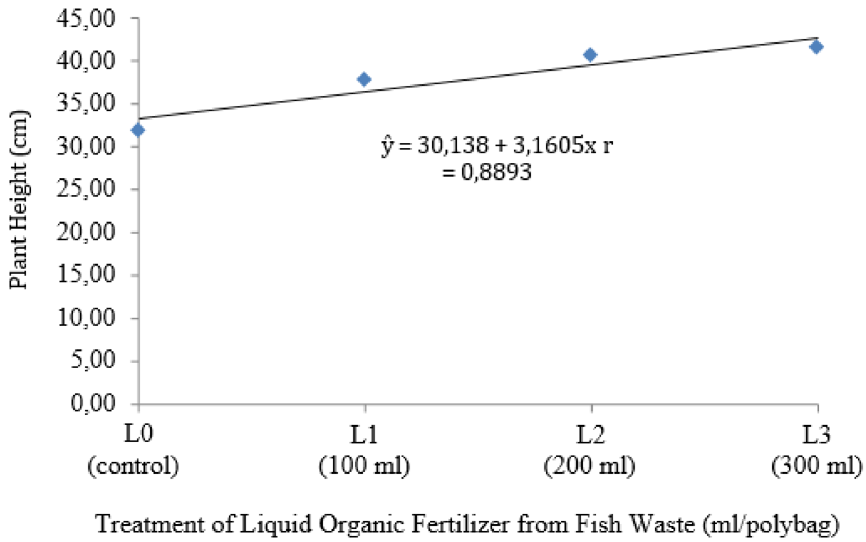

Figure 1. Relationship between Plant Height and Liquid Organic Fertilizer from Fish Waste

Figure 1, shows that 300 ml/polybag of liquid organic fish waste fertilizer can effectively promote the height growth of soybean plants, forming a linear equation $\hat{y}$ = 30.138 + 3.1605x with a correlation coefficient of 88.93% (r = 0.8893), meaning that 88% of soybean plant height is influenced by fish waste liquid organic fertilizer. This aligns with research conducted by Rahmah et al. (2023), which states that the application of fish waste liquid organic fertilizer has a positive correlation with soybean plant vegetative growth, particularly in terms of plant height. The higher the dose of liquid organic fertilizer from fish waste applied, the higher the soybean plant growth obtained. Plant growth is related to the availability of nutrients and water in the soil absorbed by the roots, which can influence plant height growth (Widiastuti and Latifah, 2016). The nutrients contained in POC are required by plants in sufficient quantities, thereby increasing metabolic processes such as biomolecular synthesis. This leads to more complete and rapid cell division, elongation, and tissue maturation, resulting in faster increases in volume and weight, ultimately improving plant growth (Lingga and Marsono, 2005).

Table 1, shows that the Trichokompos treatment had a significant effect on the height growth of soybean plants at 4 WAP. The highest average height growth was observed in treatment T3 (Trichokompos 187.5 g/polybag), which was 39.32 cm, and this was not significantly different from treatment T2 (Trichokompos 125 g/polybag) at 38.11 cm and treatment T1 (Trichokompos 62.5 g/polybag) at 37.97 cm, but significantly different from treatment T0 (no treatment) at 36.76 cm. It is suspected that Trichokompos contains beneficial microorganisms that enhance nutrient availability and stimulate root growth. Trichokompos contains a large number of beneficial microorganisms, such as bacteria and fungi, which aid in the decomposition of organic matter and improve soil structure. The activity of these microbes increases the availability of nutrients in the soil and helps plants absorb nutrients more efficiently. In addition, Trichokompos also enhances plant root growth, allowing plants to absorb more water and nutrients from the soil.

This is in line with recent research conducted by Nuraeni, Suryanto, and Nugroho (2023), which states that the application of Trichokompos has a positive effect on the growth and yield of soybean plants. Trichokompos is an organic fertilizer containing soil microorganisms such as Trichoderma sp. and organic materials like compost, which can improve the physical, chemical, and biological properties of soil and provide nutrients for plants (Simanungkalit et al., 2021).

According to Lorenza, et al. (2016), tall plants will have many leaves and a high leaf area index due to the close correlation between these plant growth traits. Increasing the dose of Trichokompos fertilizer does not necessarily mean that the observed yield values will also increase. The growth response of plants to Trichokompos fertilizer treatment tends to show significant results, indicating that there is an optimal dose that will produce the best growth. The increase in soybean plant height may be due to the influence of adding organic Trichokompos material, based on research by Fitrah and Amir (2015), which found that the application of organic fertilizer can enhance plant growth. Rosita et al. (2005) stated that plant growth increases with the age of the plant. This increase in plant growth is due to the addition of nutrients through the addition of organic matter.

The relationship between plant height and Trichokompos can be seen in Figure 2.

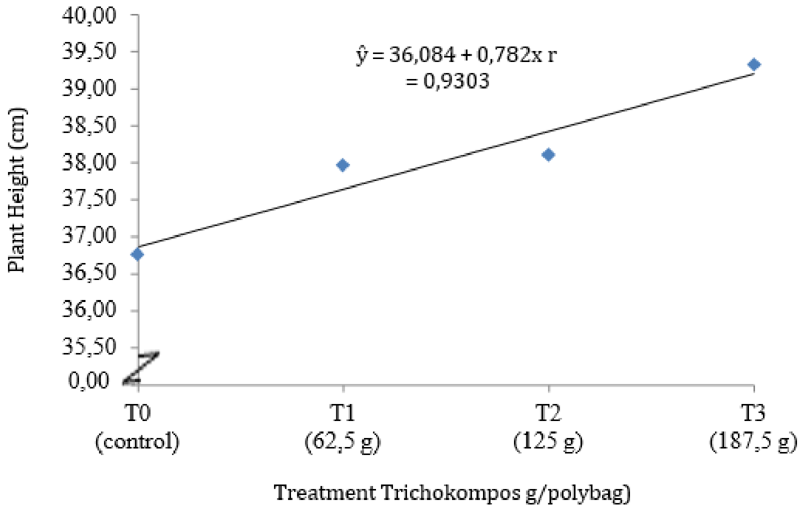

Figure 2. Relationship between Plant Height and Trichokompos Fertilizer

Figure 2, shows that Trichokompos fertilizer at 187.5 g/polybag can effectively promote soybean plant height growth, forming a linear equation $\hat{y} = 36.084 + 0.782x$ with a correlation coefficient of 93.03% ($r = 0.9303$), meaning that 93% of soybean plant height is influenced by Trichokompos fertilizer. This is supported by research conducted by Sutanto et al. (2023), which states that there is a very strong positive correlation between Trichokompos dosage and soybean plant vegetative growth, particularly in terms of plant height. The higher the Trichokompos dose applied, the higher the soybean plant growth obtained. According to Yuniarti et al. (2017), one of the efforts that can be made for soil management is through the use of compost, which can improve the physical, chemical, and biological properties of the soil, considering that Inceptisol soil itself is immature soil.

3.2 Number of Branches (branches)

The results of observations and analysis of the number of soybean branches at 4 weeks after planting (WAP) show that the application of liquid organic fertilizer from fish waste has a significant effect on the growth of soybean branches at 4 WAP. Meanwhile, Trichokompos and the interaction between the two treatments of Liquid Organic Fish Waste Fertilizer and Trichokompos did not have a significant effect on the growth of the number of branches at 4 WAP.

The results of the mean difference test of the effect of Fish Waste Liquid Organic Fertilizer and Trichokompos on soybean branch growth can be seen in Table 2.

Table 2. Number of Branches with Fish Waste Liquid Organic Fertilizer and Trichokompos Treatment at 4 WAP

Liquid Organic Fish Waste Fertilizer (L)	Trichokompos (T)				Average L
	T_0	T_1	T_2	T_3	
L_0	6,17	6,67	5,50	6,50	6,21 b
L_1	5,67	6,33	6,00	6,33	6,08 b
L_2	6,17	7,17	6,67	6,33	6,59 ab
L_3	7,00	7,50	7,17	6,67	7,09 a
Average T	6,25	6,92	6,34	6,46	

Note: Numbers followed by different letters in the same column are significantly different based on the DMRT 5% test.

Table 2, shows that the application of Liquid Organic Fish Waste Fertilizer has a significant effect on the growth of soybean plant branches at 4 weeks after planting. The highest average number of branches was observed in treatment L3 (Fish Waste Liquid Organic Fertilizer 300 ml/polybag), which was 7.09 branches, and this was not significantly different from treatment L2 (Fish Waste Liquid Organic Fertilizer 200 ml/polybag), which was 6.59 branches. Treatment L2 was not significantly different from treatment L1 (Fish Waste Liquid Organic Fertilizer 100 ml/polybag) at 6.08 branches, but was significantly different from treatment L0 (no treatment) at 6.21 branches. Treatment L1 was not significantly different from L0. Based on the analysis of the content of Fish Waste Liquid Organic Fertilizer: C-Organic 1.52%; N-Total 0.37%; P2O5 0.12%; K2O 0.14%. It is suspected that liquid organic fish waste fertilizer contains various essential nutrients such as nitrogen, phosphorus, and potassium, which support optimal plant growth, including branch formation. Additionally, the enhanced nutrient availability provided by fish waste liquid organic fertilizer stimulates plant branch growth. Beyond nutrients, fish waste liquid organic fertilizer also boosts soil biological activity, which can improve soil structure, enhance water and nutrient retention, and support branch growth.

This is in line with research conducted by Sari, Suryanto, and Nugroho (2022), which states that the application of liquid organic fertilizer from fish waste can improve the growth and development of soybean plants, including in terms of the number of branches. Liquid organic fertilizer from fish waste contains macro and micro nutrients as well as bioactive compounds such as amino acids, phytohormones, and enzymes that can stimulate vegetative growth in plants, such as stem elongation and branch formation (Gholami et. al., 2021).

According to Lingga (2015), nitrogen plays a role in stimulating growth, such as stems, leaves, and roots, and is very important in the formation of fat proteins and other compounds. Additionally, nitrogen is involved in the formation of chlorophyll, which is essential for the photosynthesis process. This aligns with Sutedjo's (2010) statement that plants deficient in nutrients exhibit older-colored leaves, with the tips of older leaves wilting, slowed growth, and even excessive growth, wilting, and halted root growth, which prevents an increase in the number of leaves. According to Rian, W. (2016), a deficiency in nitrogen nutrients can inhibit the growth of vegetative parts such as leaves, stems, and roots.

According to Made (2010), plants require high levels of nutrients to carry out metabolic processes, especially during the vegetative period. The nutrients absorbed are used to facilitate photosynthesis and enzyme activity in cell division so that they can form perfect plant organs such as roots, stems, and leaves. Like other living things, plants also need sufficient nutrients for their survival. These nutrients are nutrients, both macro and micro, that support the production and growth processes. Some of the nutrients required by plants and found in eco-enzymes are Nitrogen (N), Phosphorus (P), and Potassium (K). Nitrogen is an essential nutrient for promoting vegetative growth, protein formation, chlorophyll, and nucleic acids, so it must be available to plants. (Rahma, 2018). Phosphorus (P) for plants can promote root development, flower emergence, fruit ripening, seed formation, and plays an important role in energy storage and distribution throughout plant cells (Jalaluddin and Syafrina, 2017). Potassium (K) plays a role in the vegetative growth of plants by improving the transport of assimilates, regulating the opening and closing of stomata to reduce water consumption, and increasing plant immunity to avoid pest or disease attacks (Mahdiannoor and Syarifudin., 2016).

The relationship between the number of branches and liquid organic fertilizer from fish waste can be seen in Figure 3.

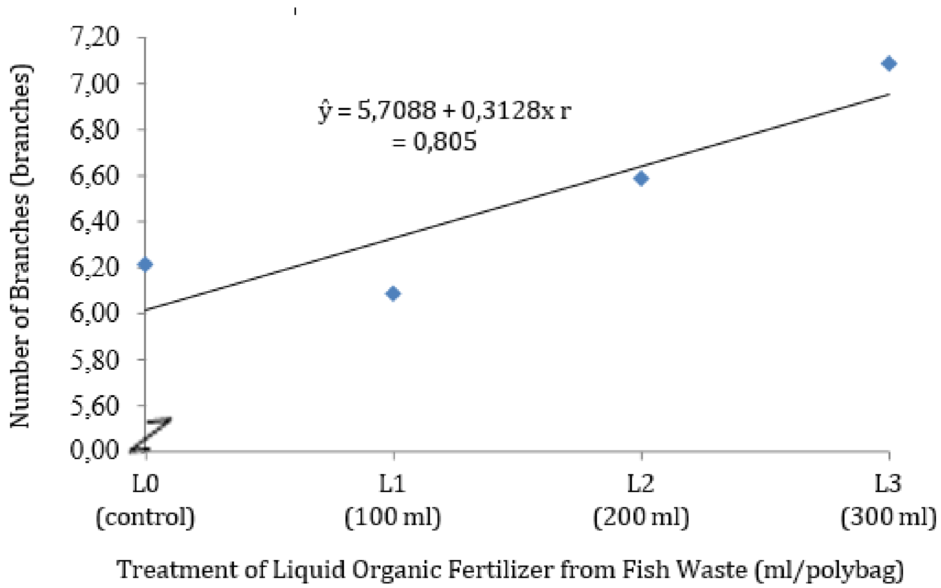

Figure 3. Relationship between Number of Branches and Liquid Organic Fertilizer from Fish Waste

Figure 3, shows that 300 ml/polybag of Fish Waste Liquid Organic Fertilizer can effectively stimulate the growth of soybean branches, forming a linear equation $\hat{y}$ = 5.7088 + 0.3128x with a correlation coefficient of 805% (r = 0.805), which means that 80% of the number of soybean branches is influenced by Liquid Organic Fish Waste Fertilizer. This is supported by research conducted by Rahmah et al. (2023), which states that there is a strong positive correlation between the dose of Liquid Organic Fish Waste Fertilizer and the vegetative growth of soybean plants, including the parameter of the number of branches.

Table 2, shows that the Trichokompos treatment had no significant effect on the growth of soybean branches at 4 weeks after sowing. This means that there was no significant difference in the number of branches between the treatment using Trichokompos and the treatment without Trichokompos. However, there were differences in the number of branches in each treatment. The highest average number of branches was found in treatment T1 (Trichokompos 62.5 g/polybag) at 6.92 branches, followed by treatment T3 (Trichokompos 187.5 g/polybag) at 6.46 branches, treatment T2 (Trichokompos 125 g/polybag) at 6.34 branches, and treatment T0 (no treatment) at 6.25 branches. This indicates that while Trichokompos does not have a significant overall effect, certain Trichokompos treatments may have varying effects on soybean branch growth.

This is in line with research conducted by Nuraeni, Suryanto, and Nugroho (2023), which states that the application of Trichokompos does not have a significant effect on the growth of soybean branches during the early vegetative phase. Although it contains soil microorganisms such as Trichoderma sp. and organic materials such as compost that can improve soil conditions, the effect of Trichokompos on the number of soybean branches is not yet clearly visible in the early growth phase.

According to Pujiasmanto (2013), organic fertilizers contain various nutrients, so that different doses will produce different plant growth responses, depending on the plant's need for nutrients contained in the organic material applied to the soil and plants. This is supported by Hikmawati (2015), who states that the amount of fertilizer needed depends on the amount of nutrients required by the plant. Organic fertilizers have a complete nutrient content because they contain both macro and micro nutrients, albeit in small quantities.

Another factor contributing to the lack of significant differences between treatments is the suspected use of organic materials that are not yet fully decomposed, usually due to the organic materials taking too long to decompose because of their high C/N ratio. The microorganisms present in immature compost are still actively decomposing the compost material, so when applied to plants, the microorganisms will take nitrogen from the soil. This will cause the plants to compete with the decomposing microorganisms for nitrogen in the soil. The microorganisms can take nitrogen from the plants more quickly, causing the plants to become nitrogen-deficient.

3.3 Stem Diameter (cm)

The results of observations and analysis of soybean stem diameter at 4 weeks after planting (WAP) show that the application of liquid organic fertilizer from fish waste has a significant effect on the growth of soybean stem diameter at 4 WAP. Meanwhile, Trichokompos and the interaction between the two treatments of Liquid Organic Fish Waste Fertilizer and Trichokompos did not have a significant effect on stem diameter growth at 4 WAP.

The results of the mean difference test of the effect of Liquid Organic Fish Waste Fertilizer and Trichokompos on soybean stem diameter growth can be seen in Table 3.

Table 3. Stem Diameter with Fish Waste Liquid Organic Fertilizer and Trichokompos Treatment at 4 WAP

Liquid Organic Fish Waste Fertilizer (L)	Trichokompos (T)				Average L
	T_0	T_1	T_2	T_3	
L_0	3,70	3,78	3,95	3,62	3,76 c
L_1	3,62	3,90	3,82	4,18	3,88 bc
L_2	3,92	4,28	3,88	3,98	4,02 ab
L_3	4,25	4,02	4,30	4,28	4,21 a
Average T	3,87	4,00	3,99	4,02	

Note: Numbers followed by different letters in the same column are significantly different based on the DMRT 5% test

Table 3, shows that the application of liquid organic fertilizer from fish waste had a significant effect on the growth of soybean stem diameter at 4 weeks after planting. The highest average stem diameter was observed in treatment L3 (Fish Waste Liquid Organic Fertilizer 300 ml/polybag), which was 4.21 cm, and this was not significantly different from treatment L2 (Fish Waste Liquid Organic Fertilizer 200 ml/polybag), which was 4.02 cm. Treatment L2 was not significantly different from treatment L1 (Fish Waste Liquid Organic Fertilizer 100 ml/polybag) at 3.88 cm. Treatment L1 was not significantly different from treatment L0 (no treatment) at 3.76 cm. Based on the analysis of the composition of Fish Waste Liquid Organic Fertilizer: C-Organic 1.52%; N-Total 0.37%; P_2O_5 0.12%; K_2O 0.14%. It is suspected that Fish Waste Liquid Organic Fertilizer contains nutrients such as nitrogen, phosphorus, and potassium, which are important for plant growth. The nutrients provided by liquid organic fertilizer from fish waste stimulate the growth and development of soybean plants, including stem diameter growth. Additionally, liquid organic fertilizer from fish waste enhances soil microorganism activity, which aids in the decomposition of organic matter and improves nutrient availability for plants. As a result, soybean plants are able to absorb more nutrients and water from the soil, which directly contributes to increased stem diameter growth at 4 MST. Thus, the use of liquid organic fertilizer from fish waste is an effective strategy for improving the growth and health of soybean plants in the early growth phase.

This is in line with research conducted by Sari, Suryanto, and Nugroho (2023), which states that the application of liquid organic fertilizer from fish waste can enhance the vegetative growth of soybean plants, including stem diameter parameters. Fish waste-based liquid organic fertilizer contains macro and micro nutrients as well as bioactive compounds such as amino acids, phytohormones, and enzymes that can stimulate plant growth and development, including stem diameter enlargement (Gholami et al., 2021).

According to Fauzan and Susylowati (2016), their research states that liquid organic fertilizer has a very significant effect on plant growth when applied appropriately, which may be due to the addition of the right concentration of POC, which is very useful for meeting the macro and micro nutrient requirements of soybean plants. Yunita et al.

(2016) also stated that by applying POC to soybean plants, nutrients such as N, P, and K, as well as other elements contained in Liquid Organic Fertilizer from Fish Waste, can be easily absorbed by soybean plants, thereby enabling the photosynthesis process to occur more optimally. To achieve optimal production, soybean plants require special treatment in the field. Soil preparation is one option considered to enhance soybean production.

The relationship between stem diameter and liquid organic fertilizer from fish waste can be seen in Figure 4.

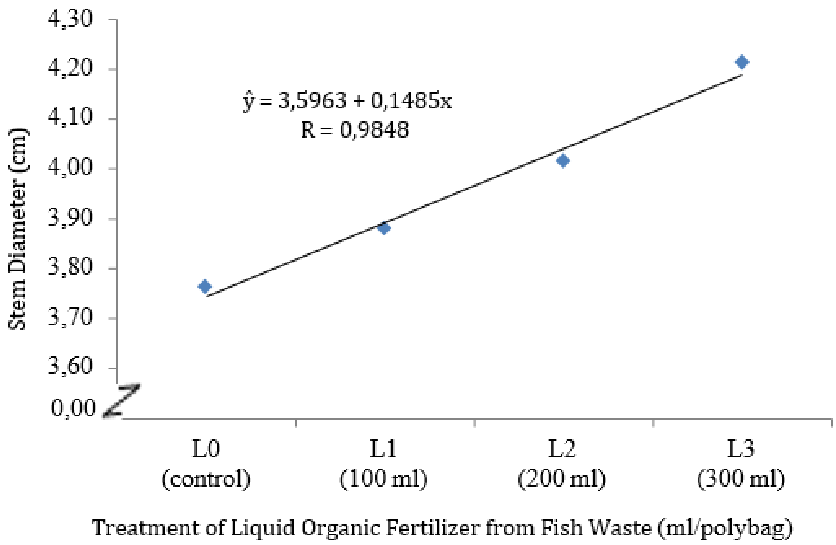

Figure 4. Relationship between Stem Diameter and Liquid Organic Fertilizer from Fish Waste

Figure 4, shows that 300 ml/polybag of Liquid Organic Fish Waste Fertilizer can effectively stimulate the growth of soybean stem diameter, forming a linear equation $\hat{y} = 3.5963 + 0.1485x$ with a correlation coefficient of 98.48% (r = 0.9848), meaning that 98% of soybean stem diameter is influenced by Fish Waste Liquid Organic Fertilizer. This is supported by research conducted by Rahmah et al. (2023), which states that there is a very strong positive correlation between the dosage of Liquid Organic Fish Waste Fertilizer and the vegetative growth of soybean plants, including the stem diameter parameter. The higher the dosage of Liquid Organic Fish Waste Fertilizer applied, the larger the stem diameter formed in soybean plants.

Table 3, shows that the Trichokompos treatment had no significant effect on the growth of soybean stem diameter at 4 MST. However, there were differences in stem diameter among the treatments. The highest average stem diameter was observed in treatment T3 (Trichokompos 187.5 g/polybag) at 4.02 cm, followed by T1 (Trichokompos 62.5 g/polybag) at 4.00 cm, treatment T2 (Trichokompos 125 g/polybag) at 3.99 cm, and treatment T0 (no treatment) at 3.87 cm. This is likely due to variations in the composition or dosage of Trichokompos used, which may not have consistently impacted stem diameter growth. Additionally, environmental and genetic factors of the plants may also play a role in determining the plants' response to Trichokompos treatment. Although there was no significant overall effect, differences in stem diameter between treatments may be attributed to these factors, as well as the complex interaction between Trichokompos and soil conditions.

These results are consistent with the research conducted by Nuraeni, Suryanto, and Nugroho (2023), which stated that the application of Trichokompos did not have a significant effect on the growth of soybean stem diameter in the early vegetative phase. Although it contains soil microorganisms such as Trichoderma sp. and organic materials like compost that can improve soil conditions, the effect of Trichokompos on soybean plant stem diameter has not yet been clearly observed during the early growth phase.

According to Novizan (2010), the application of trichokompos fertilizer will greatly assist plants in growing and developing properly. The elements N, P, and K are macronutrients absorbed by plants from the soil, required in sufficient quantities; if these elements are deficient, plant growth will be hindered. Atmojo (2003) states that organic matter serves as an energy source for soil microorganisms. The addition of organic matter to the soil increases microbial activity, particularly decomposition and mineralization of organic matter in the soil. Increased decomposition and mineralization lead to higher nutrient availability in the soil. Lingga (2015) states that the use of organic fertilizer plays a significant role in improving soil conditions and resistance to erosion, enhancing soil structure, and making the soil more fertile. The smallest leaf area is produced without trichokompos fertilizer, as there are no supporting factors to create more fertile soil conditions.

4. CONCLUSIONS

The application of liquid organic fish waste fertilizer had a significant effect on plant height, number of leaves, and stem diameter. The best treatment was observed in L3 (300 ml of liquid organic fish waste fertilizer per polybag). Trichokompos had a significant effect on plant height but did not affect the number of branches or stem diameter. The best treatment was found in T3 (Trichokompos 187.5 g/polybag). The interaction between the application of Liquid Organic Fish Waste Fertilizer and Trichokompos did not significantly affect any of the observed parameters. The best treatment was the interaction of treatment L3T3 (Fish Waste Liquid Organic Fertilizer 300 ml/polybag with Trichokompos fertilizer 187.5 g/polybag).

5. ACKNOWLEDGE

Thank you to the dean and colleagues at the Agrotechnology Study Program, Faculty of Agriculture, University of North Sumatra for their support in this research.

6. REFERENCE

Anggarseti, 2023. "Pengaruh Konsentrasi Pupuk Organik Cair Limbah Ikan terhadap Pertumbuhan Dan Hasil Bawang Daun (Allium fistulosum)". Jurnal Media Pertanian, Vol. 8 (1)

Atmojo. S.W. 2003. "Peranan Bahan Organik terhadap Kesuburan Tanah dan Upaya Pengelolaannya". Universitas Sebelas Maret Press: Surakarta

Diah, S. 2018. "Pengaruh Pemberian Cendawan Mikoriza Arbuskula terhadap Pertumbuhan dan Produksi Edamame". ilmu kesehatan, Vol, 2 (2).
Fauzan, S dan Susylowati. 2016. "Pengaruh Jenis dan Konsentrasi Pupuk Organik Cair terhadap Pertumbuhan dan Hasil Tanaman Sawi (Brassica juncea L.) Varietas Tosakan". Jurnal Agrifor. 8 (1)
Fitrah, A dan Amir, N. 2015. "Pengaruh Jenis Pupuk Organik Padat dan Cair terhadap Pertumbuhan dan Produksi Tanaman Seledri (Apium graveolens L.) di Polybag". Jurnal Klorofil 10 (1) : 43 - 48.
Gholami, A., Akhavan Sabet, M., & Alipour, H. 2021. "Pengaruh Pupuk Organik Cair Limbah Ikan terhadap Pertumbuhan, Produktivitas, dan Kualitas Tanaman Kedelai (Glycine max L.)." Jurnal Ilmu Tanah dan Lingkungan, 23 (2), 112 – 120
Hikmawati. (2015). Dasar-dasar Ilmu Tanah dan Pemupukan. Jakarta: Bumi Aksara
Ibrahim, R., Sabban, H., & Mahmud, S. A. 2023. "Pengaruh Pupuk Organik Cair (POC) Limbah Ikan terhadap Pertumbuhan dan Hasil Tanman Sawi". Jurnal Prosiding Seminar Nasional, Vol. 3 (1).
Jalaluddin ZAN dan Syafrina R, 2017. "Pengolahan Sampah Organik Buah- Buahan Menjadi Pupuk dengan Menggunakan Effektive Mikroorganisme". Jurnal Teknologi Kimia Unimal, 5 (1) :17 – 29.
Lingga, P. dan Marsono. 2005. Petunjuk Penggunaan Pupuk. Penebar Swadaya, Jakarta.
Lingga, P. 2015. Hidroponik Bercocok Tanam Tanpa Tanah. Jakarta: Penebar Swadaya
Lorenza, E., M. Chozin dan N. Setiawati, 2016. "Hubungan Antar Sifat Jagung Manis yang Dibudidayakan Secara Organik". Akta Agrosia. Vol. 19 (2) : 129 – 138
Made, S.2010. "Respon Berbagai Populasi Tanaman Jagung Manis (Zea mays saccharata sturt.) terhadap Pemberian Urea". Jurnal Agroland 17 (2) : 138-143
Mahdiannoor Istiqomah N dan Syarifuddin, 2016. "Aplikasi Pupuk Organik Cair terhadap Pertumbuhan dan Hasil Tanaman Jagung Manis". Ziraa'Ah Jurnal Ilmu-Ilmu Pertanian, 41 (1) : 1–10
Murdaningsih , & Rahayu, P. S. 2021. "Aplikasi Pupuk Organik Cair Limbah Ikan Pada Tanaman Mentimun (Cucumis sativus. L)". Jurnal of Sustainable Drayland Agriculture, Vol. 14 (1).
Novizan. 2010. Petunjuk Pemupukan yang Efektif. Agromedia Pustaka. Jakarta
Nuraeni, R., Suryanto, A., & Nugroho, A. 2023. "Pengaruh Dosis Trichokompos terhadap Pertumbuhan dan Hasil Tanaman Kedelai (Glycine max L.)". Jurnal Agronomi Indonesia, 51 (2), 118 – 125
Nurnawati, A. A., Syarifuddin, R. N., & A. Samsu, A. K. 2020. "Identifikasi Pengaruh Dosis Pemupukan Tricohokompos terhadap Fase Awal Pertumbuhan Tanaman Jagung Unggu Antioksidan". Jurnal Pangan, Vol. 29 (03)
Pertanian, K. 2020. Rencana Strategi (RENSTRA) Aneka Kacang Dan Umbi. Jakarta: Kementrian Pertanian
Pujiasmanto, Bambang. 2013. "Perkuat Ketahanan Pangan Nasional Kita". Naskah Ketahanan Pangan pada Insiprasi Vol 4 No. 76. https://fp.uns.ac.id
Rahma, M. Y. (2018). The Effect of Doses Organic and Inorganic Fertilizer To Growth and Production. Klorofil
Rahmah, A., Nugraha, Y., & Suryadi, E. 2023. "Korelasi Dosis Pupuk Organik Cair Limbah Ikan terhadap Pertumbuhan dan Hasil Tanaman Kedelai (Glycine max L.)". Jurnal Pertanian Tropik, 10 (1), 28 – 37

Rian Wicaksono, 2016. "Pemanfatan Zeolit Untuk Peningkatan Efektivitas Kompos Eceng Gondok Pada Pertumbuhan dan Hasil Cabai Merah Di Tanah Pasir Pantai Selatan Yogyakarta". Universitas Muhammadiyah Yogyakarta. Yogyakarta. Skripsi. Hal 26 – 27

Rosita, S., Raharjo, M.D. dan Kosasih, M. 2005. "Pola Pertumbuhan dan Serapan Hara N, P, K Tanaman Bangle". Jurnal Littri 11 (1) : 32-36

Sabilu, Y., Fatimah, U.N., Nurbaiti, Haryanto, B., 2015. "Pemanfaatan Pupuk Organik untuk Pertanian Berkelanjutan". Prosiding Seminar Nasional Lahan Suboptimal 2015

Sari, N.K., Suryanto, A., & Nugroho, A. 2022. "Pengaruh Pupuk Organik Cair Limbah Ikan terhadap Pertumbuhan Vegetatif Tanaman Kedelai (Glycine max L.)". Jurnal Agronomi Indonesia, 50 (3), 251 – 258

Sari, N.K., Suryanto, A., & Nugroho, A. 2023. "Pengaruh Pupuk Organik Cair Limbah Ikan terhadap Pertumbuhan dan Hasil Kedelai (Glycine max L.)". Jurnal Agronomi Indonesia, 51 (1), 18 – 26.

Simanungkalit, R.D.M., Saraswati, R., & Hastuti, R.D. 2021. "Pupuk Organik Hayati Trichokompos untuk Meningkatkan Kesuburan Tanah dan Produktivitas Tanaman". Jurnal Ilmu Tanah dan Lingkungan, 23 (1), 47 – 55

Sudiarti, D. 2018. "Pengaruh Pemberian Cendawan Mikoriza Arbuskula (CMA) terhadap Pertumbuhan Kedelai Edamame (Glyxine max)". Jurnal Sains Health, Vol. 2 (2)

Sutanto, R., Widyastuti, Y., & Suryadi, E. 2023. "Analisis Korelasi Dosis Trichokompos terhadap Pertumbuhan dan Hasil Tanaman Kedelai (Glycine max L.)". Jurnal Pertanian Tropik, 10 (2), 112 – 121

Sutedjo, M. 2010. Pupuk dan Cara Pemupukan. Jakarta: Rineka Cipta

Wardah, Utami, K. B., & Syamsuddin, A. 2021. "Pengaruh Lama Fermentasi terhadap Kualitas Nitrogen, Fospor dan Kalium Pada Pupuk Trichokompos". Jurnal Perternakan, Vol. 20 (2)

Waryanti, 2013. "Studi Pengaruh Penambahan Sabut Kelapa pada Pembuatan Pupuk Cair dari Limbah Air Cucian Ikan terhadap Kualitas Unsur Hara Makro (CNPK)". Jurnal Teknik Lingkungan, Vol. 2 (04).

Widiastuti, E dan E Latifah. 2016. "Keragaan Pertumbuhan dan Biomassa Varietas Kedelai (Glycine max (L)) di Lahan Sawah dengan Aplikasi Pupuk Organik Cair". Jurnal Ilmu Pertanian Indonesia. 21 (2) : 90 – 97

Yuniarti, A., T. Nurmala., E. Solihin., dan N. Syahfitri, 2017. "Pengaruh Dosis Pupuk Silika Organik terhadap Silika Tanah dan Tanaman, Pertumbuhan dan Hasil Hanjeli (Coix lacryma-jobi L.)". J. Agrosains dan Teknologi.

Yunita, M. Hendrawan, Y. & Yulianingsih, R., 2016. "Analisis Kuantitatif Mikrobiologi Pada Makanan Penerbangan (Aerofood ACS) Garuda Indonesia Berdasarkan TPC (Total Plate Count) dengan Metode Pour Plate". Jurnal Keteknikan Pertanian Tropis dan Biosistem. Vol. 3. 3. pp 237-248