J. Pijar MIPA, Vol. 18 No. 2, March 2023: 265-273 ISSN 1907-1744 (Print)
DOI: 10.29303/jpm.v18i2.3448 ISSN 2460-1500 (Online)

THE EFFECT OF VERMICOMPOST ON GROWTH OF SHALLOTS (*Allium ascalonicum* L.)

Lina Maulina*, Karnan, and Ahmad Raksun
Biology Education Study Program, Faculty of Teacher Training and Education, University of Mataram, Mataram, Indonesia
*Email: maulinaislam29@gmail.com

Received: March 21, 2022. Accepted: September 14, 2022. Published: March 31, 2023

Abstract: Shallots have long been cultivated by farmers intensively because shallots have a high economic value, so they become a source of income for farmers. Shallots are annual plants belonging to monocotyledonous plants that have multi-layered tubers formed from layers of leaves that enlarge and unite with cylindrical leaves. The soil fertility level influences shallots' growth, development, and production, requiring additional fertilizers. One of the good fertilizers used is vermicompost. Vermicompost is an organic fertilizer containing microbes and elements required for plant growth. This study aims to determine vermicompost's effect on shallot growth (Allium ascalonicum L.). This study used a completely randomized design with ten replications. The treatment levels consisted of P0 = 0 grams of vermicompost per 1 kg of soil, P1 = 40 grams of vermicompost per 1 kg, P2 = 80 grams of vermicompost per 1 kg of soil, and P3 = 120 grams of vermicompost per 1 kg of soil. Parameters observed were the number of leaves, number of tubers, plant height, wet weight, dry weight, and chlorophyll content of shallot. The research data were analyzed using ANOVA and Duncan's Multiple Range Test at the 5% level. The results showed that the addition of vermicompost had a significant effect on the number of leaves and chlorophyll content of the shallot but had no significant impact on the number of bulbs, plant height, wet weight, and dry weight of the shallot.

Keywords: *Vermicompost, Growth, Shallots*

INTRODUCTION

Using chemical fertilizers for a long time and continuously can harm the environment. The impacts include, among others, soil and water pollution, which decreases soil fertility [1]. One alternative to prevent environmental pollution and produce healthy food is organic fertilizers. Organic fertilizers can create a soil environment with good physical, chemical, and biological soil properties for plants. The use of organic fertilizers can also improve the quality of crop production [2]. One of the good organic materials used as fertilizer is vermicompost.

Vermicompost is an organic fertilizer that contains microbes and elements needed for plant growth [3]. Vermicompost contains humic acid, which results from the decomposition process of organic matter consisting of organic substances. Also, it has a complex molecular structure containing active groups to stimulate and activate biological processes in living organisms in the soil [4].

Vermicompost can increase 1.33% of the number of leaves; 8.79% fresh canopy weight or 35.00 ton/ha; 8.35% dry crown weight on mustard greens; 1.41% N-total soil; 5.56% P-available soil; 3.11% C-organic soil; 0.07% soil pH and 12.89% total population of soil microorganisms. The higher the dose of vermicompost given, the higher the nutrient content in the soil [5]. Provision of 15 tons/ha and 10 tons/ha of vermicompost can increase growth plant height, number of leaves, tuber diameter, number of cloves, fresh weight of bulbs per plant, dry wind weight of bulbs per plant, and dry wind weight of garlic bulbs [6].

Vermicompost has non-toxic properties, is rich in macro and micronutrients, is natural, and can loosen marginal soils (dry and nutrient-poor). Vermicompost has advantages over other organic fertilizers, which can neutralize soil pH and have higher macro elements [7]. The advantage of vermicompost as organic fertilizer is that it has a low C/N ratio, so it can increase the activity of microorganisms that are beneficial for agriculture and can, increase the absorption of N, P, and K, and help overcome environmental pollution problems. Damaged soil structures due to the use of inorganic fertilizers can be slowly repaired with vermicompost. In addition, vermicompost contains almost all the nutrients needed by plants. It is also hydrophilic, which can cause the surrounding soil to become moist and loose, fertilize microorganisms beneficial to plants, and fertilize plants [8].

Shallots are one of the vegetable commodities that have important meaning for the community regarding their economic value and nutritional content [9]. Shallots include spice plants that act as seasonings for cooking and are also used as ingredients in traditional medicine. Shallots have long been cultivated by farmers intensively because shallots have a high economic value, so they become a source of income for farmers [10]. The benefits of Shallots for health are unquestionable. Shallots are very rich in content needed by the human body, such as fiber, vitamin C, potassium, and folic acid [11].

Shallots can grow on crumbly or loose soil, fertile, and with lots of nutrients. Fertilizer is one of the main sources of nutrients that determine the growth rate and production of vegetables. Each nutrient has its role and can show certain symptoms in plants if its availability in the soil is very less [12].

The growth, development, and production of Shallots are influenced by the level of soil fertility, which in the process, requires additional fertilizer to fertilize it. Vermicompost can be a solution because it is environmentally friendly, has the advantage of improving physical, chemical, and biological properties, neutralizing the pH of the soil, and containing nutrients needed by plants. Therefore, research was conducted on "The Effect of Vermicompost on Growth of Shallots (Allium ascalonicum L.)."

RESEARCH METHODS

This research was conducted from September to November in the Green House, Faculty of Agriculture, University of Mataram, West Nusa Tenggara.

The tools used in this study were small and large shovels, a hoe, a soil sieve, a sack, a camera, a 20 x 15 cm polybag, a sprayer, a ruler, *digital* scales, mortar, and pestle, a test tube, test tube rack, spectrophotometer. Furthermore, the materials used in the study were shallot seeds, soil, vermicompost, water, labels, aluminum foil, and 70% alcohol.

This research uses Ranca Completely Randomized (CRD) non-factorial using treatment levels P0 = 0 grams of vermicompost per 1 kg of soil, P1 = 40 grams of vermicompost per 1 kg of soil, P2 = 80 grams of vermicompost per 1 kg of soil, and P3 = 120 grams of vermicompost per 1 kg of soil with ten replications, thus obtained 4 x 10 = 40 experimental units.

The implementation of this research consists of (1) Persianpan places, (2) preparation of planting media, (3) preparation of seeds, (4) planting, (5) maintenance, and (6) harvesting. Parameters observed were the number of leaves, tubers, plant height, wet weight, dry weight, and chlorophyll content of Shallots.

The research data were analyzed using ANOVA and Duncan's Multiple Range Test at the 5% level.

RESULTS AND DISCUSSION

Number of Bulbs

The data in Figure 1 shows that the highest level of treatment for bulbs was in treatment P1 (addition of vermicompost fertilizer of 40gr) with an average number of shallot bulbs of 7 bulbs. Furthermore, the lowest treatment level for the number of bulbs was the P3 treatment (addition of vermicompost fertilizer of 120gr), with an average number of shallot bulbs of 5.6.

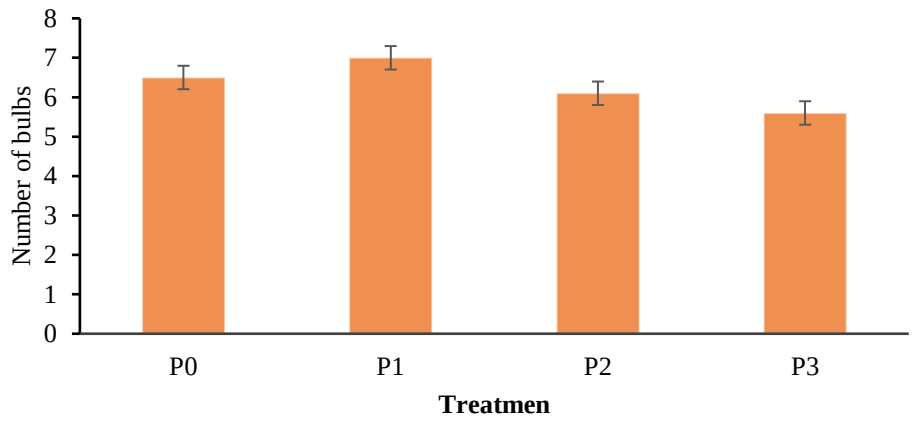

Figure 1. Diagram of the average number of onion bulbs

The effect of adding vermicompost on the number of shallot bulbs can be seen from the Anova test results in table 1, which shows that the addition of vermicompost has no significant effect on the number of shallot bulbs. This study's results align with research [13], which stated that vermicompost had no significant effect on the number of cloves per sample of Shallots. The results also agree with the research results [4] that state that the application of vermicompost did not significantly affect the number of bulbs per clump of shallots.

Bulb growth is included in the reproductive phase, where plant growth and development consists of two phases: the vegetative and reproductive phases. The growth and development or enlargement and maturation of food storage organs characterize the reproductive phase. This reproductive phase requires a large supply of carbohydrates in the form of starch and sugar. However, the vegetative phase also requires a large supply of carbohydrates [14], so if the planting medium on Shallots lacks nutrients, it will affect the number of tubers produced.

Table 1. Test results in Anova number of onion bulbs

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10,600	3	3.533	2.456	.079
Within Groups	51,800	36	1.439		
Total	62,400	39			

Number of Leaves

Figure 2 above shows that the number of leaves in treatments P1 and P2 was higher than in treatment P0 as a control. However, in the P3 treatment, the mean number of leaves was lower than P0. Test results ANOVA addition of vermicompost on shallots significantly affected the number of leaves of Shallots. It is because the p-value (sig) is 0.003 < 0.005. The results of the ANOVA test are presented in table 2.

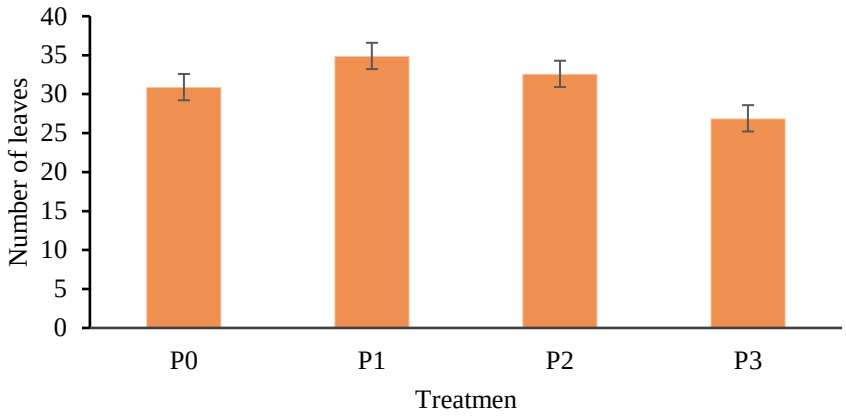

Figure 2. Diagram of the average number of spring onions

Table. 2. Anova test results on the amount of green onion

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	341,675	3	113.892	5.670	.003
Within Groups	723,100	36	20.086		
Total	1064,775	39			

The results of this study align with the results of research [15] that the application of vermicompost has a significant effect on the number of leaves of kailan plants with vermicompost treatment of 15 tons/ha showing the highest value compared to the treatment without vermicompost. Vermicompost fertilizer significantly affected the number of green mustard leaves [16].

The addition of vermicompost significantly affects the number of leaves of Shallots because vermicompost has nutrients needed by plants, especially in terms of leaf formation. It is in line with the statement, vermicompost has nutrients plants need, such as N, P, K, Ca, and Mg [17]. One of them is the element N, which plays an important role in a plant's vegetative growth. The vegetative phase occurs in the developing of new roots, leaves, and stems. So that if the vegetative phase is more dominant than the reproductive phase, then more carbohydrates are synthesized so that it shows excessive stem, leaf, and root development [14,18].

Table. 3. Duncan's further test results on the amount of leek

Code	Treatment Dose	Average
P0	0 gr vermicompost	30,90ab
P1	40 grams of vermicompost	34.90a
P2	80 gr vermicompost	32.60a
P3	120 gr vermicompost	26.90b

Notes: The average value followed by the same letter in the same column is not significantly different at the 5% Duncan test level

Significant results on the number of leaves of the shallot plant resulted in denied further testing. The further test used is Duncan's Multiple Range Test at a 5% level. It is to find out the best treatment. The following are the results of Duncan's Advanced Test of the number of spring onions presented in table 3, which shows that the treatment of P1 (dose of 40 g of vermicompost) was significantly different from that of P3 but not significantly different from that of P0 and P2.

Plant height

The height of the shallot plant that was added with vermicompost on the growing media showed higher yields than the control variable. The best shallot plant height was still obtained from the P1 treatment, which was 39.1 cm. It can be seen in Figure 3.

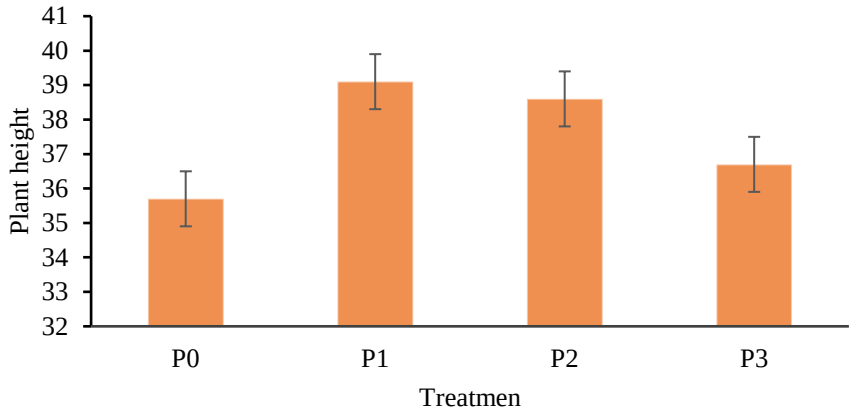

Figure 3. Diagram of the average plant height of shallots

Although all shallot plant heights were above the average shallot plant height without the addition of vermicompost fertilizer, the ANOVA test results showed that the effect of adding vermicompost had no significant effect on plant height. The results of the ANOVA test can be seen in table 4. This study's results align with research [19], which stated that the application of vermicompost did not increase plant height in Mallika black soybeans. These results also agree with the results of research [20] that the application of vermicompost fertilizer did not significantly affect the height of edamame soybeans. This result also agrees with the results of research [21], which stated that the application of vermicompost did not significantly affect the growth and yield of red spinach.

The P element influences the height of the shallot plant in the planting medium. Elemental P affects the growth and development of plants because it has an active role in the process of energy transfer in cells in the form of ATP. With the presence of ATP, plants can carry out various metabolic processes and use the results of this metabolism to support their growth [22]. The lack of P in the Shallots media affects the development of plant organs, which can be hampered because the plant has not optimally absorbed it.

Table. 4. The results of the ANOVA test on the height of the shallots

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	76,475	3	25,492	1,733	.178
Within Groups	529,500	36	14,708		
Total	605,975	39			

Gross weight

The results of the measurement of the wet weight of Shallots in Figure 4 shows that the P1 treatment level has a higher average than the control or P0 treatment level. The level of treatment P1 is the treatment with the highest average value of 43.5 gr. The addition of vermicompost at 40 g increased the wet weight of Shallots. The results of weighing the wet weight of Shallots were followed by the Anova test, as shown in table 5.

The addition of vermicompost fertilizer to the wet weight yield of shallots obtained a p-value (sig) of 0.061 which means it is greater than 0.05, so the results are insignificant. The insignificant results showed that adding vermicompost fertilizer to Shallots had no significant effect on the wet weight of Shallots. It is presumably due to the lack of nutrients in the planting media so that they have yet to be absorbed optimally by plants. The results of this study align with the results of statement [23], which states that the lack of breakdown of nutrients to meet plant needs is one of the factors that affect plant production. So that the better the plant absorbs nutrients, it can increase the

wet weight and dry weight of the shallot plant. It also agrees with the statement [24], which states that there is no real effect in applying fertilizer to plants due to the vermicompost fertilizer given has not been able to be absorbed optimally by plants, resulting in stunted plant growth.

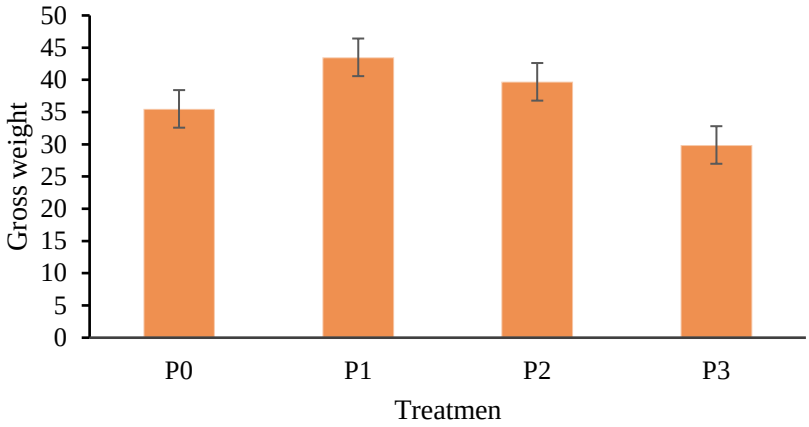

Figure 4. Diagram of the average wet weight of shallots

Table 5. The results of the ANOVA test on the wet weight of shallots

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1021,100	3	340,367	2,686	.061
Within Groups	4562,000	36	126,722		
Total	5583,100	39			

The wet weight of the plant is related to the number of tubers, leaves, and plant height. But the most influential is the number of tubers in the shallot plant. The number of bulbs of Shallots is insignificant due to the lack of nutrients, so they have not been absorbed optimally. Where the state of nutrients for plants is one of the factors that can affect the level of plant production. Therefore the amount and nutrients available in the soil must be balanced. Thus, the needs of plants must be balanced so that plants can grow and produce well. If nutrient requirements are met, plants can grow more optimally and produce maximum production [25]. Biosynthesis that does not run smoothly will affect the wet-weight yield of plants.

Dry Weight

The data in Figure 5 shows that the P3 treatment with the addition of vermicompost fertilizer of 120 g has the lowest average value of the dry weight parameter of shallots, which is 12 g. Then the highest level of dry weight treatment was P1 treatment with vermicompost fertilizer of 40 g, with an average dry weight of Shallots weighing 20.8 g.

The ANOVA test results in table 6 show that the p-value (sig) on the dry weight of Shallots is less than 0.05. So that the addition of vermicompost did not significantly affect the dry weight of Shallots.

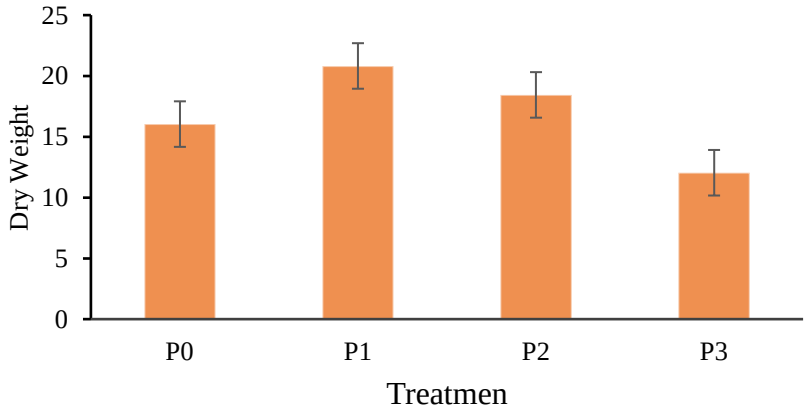

Figure 5. Diagram of the average dry weight of shallots

Table 6. The results of the ANOVA test on the dry weight of shallots

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	424,075	3	141.358	2,588	.068
Within Groups	1966,300	36	54,619		
Total	2390.375	39			

The addition of vermicompost did not significantly affect the wet weight and dry weight of Shallots. It is the same with the wet weight yield of Shallots that the occurrence is insignificant due to lack of nutrients, so plants have not optimally absorbed them. It is in line with research [5], which states that adding vermicompost fertilizer to the yield of wet weight and dry weight of Shallots is still below the production standard per plant. This factor is because vermicompost fertilizer has not been able to meet the needs of nutrients, especially N, which is important for plant growth, wet weight, and dry weight. It is suspected that the energy produced is only used by plants to meet their energy needs to grow normally. The dry weight of the plants was not significantly different, indicating that the accumulation of organic compounds that were successfully synthesized between the treatments was the same. This is presumably due to the inhibition of the growth phase resulting in a significant decrease in biomass, the insignificant number of tubers, and the small size resulting in low dry weight yield.

Chlorophyll Content

Increasing the level of treatment on Shallots resulted in increased chlorophyll content in the leaves of Shallots. The average value of the chlorophyll content of shallots is presented in Figure 6. So, adding vermicompost fertilizer reacted with the chlorophyll content of shallots. It can be seen from the results of the ANOVA test for the chlorophyll content of scallions which is presented in table 7.

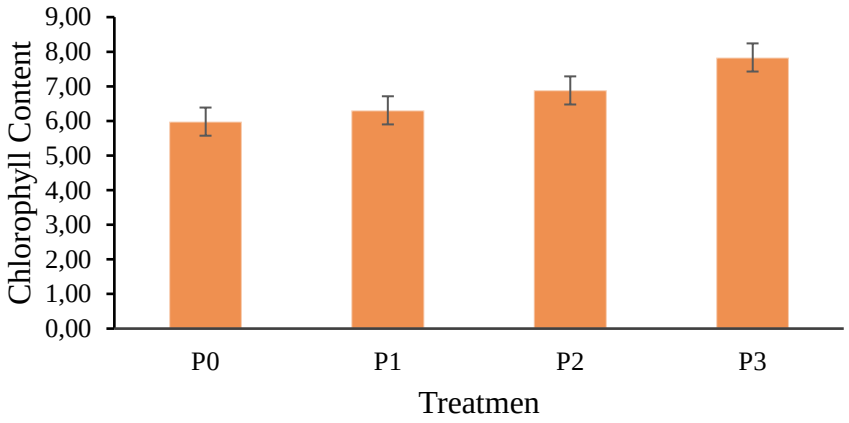

Figure 6. Diagram of the average chlorophyll content of scallions

Table 7. Anova test results on the chlorophyll content of shallots

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	19,815	3	6.605	3.837	.018
Within Groups	61,967	36	1,721		
Total	81.782	39			

The results showed that the addition of vermicompost had a significant effect on the chlorophyll content of the shallot plant because it had a significant value, namely the p-value (sig) < 0.005. Vermicompost fertilizer plays an important role in Shallots because the application of vermicompost can increase nitrogen levels in the soil [23]. The availability of N in the soil will increase nitrogen uptake to form more chlorophyll. It will increase the rate of photosynthesis. Increasing the rate of photosynthesis can increase the number of carbohydrates produced, so that it affects plant growth, including leaf formation. Vermicompost fertilizer has a high N content. Significant results on chlorophyll contentThis resulted in the need for Duncan's further test. Table 8 shows that the treatment of P3 (dose of 120 g of vermicompost) was 7.834, significantly different from P0 and P1 but not significantly different from P2.

Table 8. Duncan's further test results on the chlorophyll content of scallions

Code	Treatment Dose	Average
P0	0 gr vermicompost	5,981 b
P1	40 grams of vermicompost	6,307b
P2	80 gr vermicompost	6,882ab
P3	120 gr vermicompost	7,834a

Notes: The average value followed by the same letter in the same column is not significantly different at the 5% DMRT test level

The highest growth of Shallots in terms of the growth rate of the number of tubers, number of leaves, plant height, wet weight, and dry weight was the level in treatment P1 (40 g vermicompost). The average number of tubers of the P1 treatment (40 g of vermicompost) was higher than the average growth of tubers of other treatments. The average number of P1 tubers (40 g of vermicompost) was 7, while the other treatments were 5 to 6 tubers on average. For the number of leaves, while other treatments had an average number of leaves as much as 26-32, at the level of P1 (40 gr vermicompost), the average number of leaves was 34.9. The average plant height in the P1 treatment (40 g vermicompost) was 39 cm while the average height of the other treatment plants was 35-38 cm. Likewise, with the wet and dry weights of Shallots, the P treatment (40 g vermicompost) was the best treatment from other treatments. The average wet weight and dry weight of shallots in treatment P1 (40 g vermicompost) were 43.5 g and 20.8 g, respectively, while the other treatments were 29.5-39.7 gr and 12-18 gr. It further clarifies that the appropriate level of vermicompost fertilizer is 40 g.

Based on the observational data that the P1 treatment (40 g vermicompost) on the growth of Shallots had better results than the shallot plant growth in the P2 treatment (80 g vermicompost), but the results of the P2 treatment (80 g vermicompost) were still higher than control variable. The decrease in shallot plant growth occurred in the P3 treatment (120 g of vermicompost), which was even lower than the control variable. This decrease is likely due to the excess nutrient content in the growing media, resulting in less than optimal growth and yield of shallots—abnormal growth caused by plants absorbing nutrients that exceed their needs for metabolism. Nutrients or nutrients have a major role in plant metabolism. It functions as a component of organic compounds, in energy storage, in plant structures, as cofactors for enzymes, and in electron transfer reactions. Plant growth will be hampered or disrupted if nutrients, especially sodium or heavy metals, are in excess in the soil [27]. It is in line with the statement [28], which states that a plant will grow and develop if the required nutrients are available enough to be absorbed by plants. Giving the wrong dose can give less than optimal plant production growth and yield. It is supported by the statement [29], which states that using vermicompost alone or in a very large ratio composition of more than 75% reduces plant yield components.

Vermicompost also has a high C-Organic content and can balance nutrients in the soil and provide nutrients for plants, with the availability of balanced and sufficient nutrients that will have a good effect on plant development [30-32]. Vermicompost fertilizer can improve the physical properties of the soil, namely improving soil structure and increasing the ability to hold water. Vermicompost fertilizer also has complete nutrients, causing a more balanced availability of nutrients in the soil [33]. Many microbes and their high activity will accelerate mineralization or the release of nutrients from worm droppings into forms available for plants. Vermicompost can improve soil chemistry by increasing the ability to absorb cations as a source of macro and micronutrients, increasing pH in acidic soils [34].

Vermicompost contains nutrients that are beneficial for plants. In addition, vermicompost can also be used as a source of nutrients for soil microorganisms to accelerate the decomposition of organic matter [35]. Vermicompost can help provide nutrients for plants, has the nutrients needed by plants, can hold water, can neutralize soil pH, has high macro and microelements that are useful for plant growth, and is environmentally friendly [36-37].

Besides increasing the population of soil organisms that play a role in maintaining soil health, the effect of organic fertilizers can also suppress various diseases and improve plant health. Each type of fertilizer has a different amount of nutrient content, physiological reactions, solubility, and working speed. The method and time of application are different for each type of plant or type of soil, so the amount given is different. The amount of nutrients needed in the growth process in plants is different for each type of plant and the same type of plant with varying production levels [38].

CONCLUSION

The addition of vermicompost significantly affected the shallot's number of leaves and chlorophyll content. Still, it did not significantly affect the number of bulbs, plant height, wet weight, and dry weight of the shallot.

REFERENCES

[1] Setiawan, I.G.P, Niswati, A., Hendarto, K., & Yusnaini, S. (2015). Effect of Vermicompost Dosage on the Growth of Pakcoy (Brassica rapa L.) Plants and Changes in Some Chemical Properties of Ultisols in Taman Bogo. J. Tropical Agrotech, 3(1), 170–173.

[2] Supriati, R., Darmi, & Serli, M. (2011). The Role of Earthworm (Pontoscolex Corethrurus Fr. Mull) Population on Growth and Production of Organic Onion (Allium ascalonicum L.). Biological Conservation, 7(2), 1–55.

[3] Susanna, Tjut Chamzurni, & Pratama, A. (2010). Dosage and Frequency of Worms for Control of Fusarium Wilt Disease in Tomato Plants. J. Floratek, 5, 152–163.

[4] Fauzi, M., Hapsoh, & Ariani, E. (2018). The Effect of Vermicompost Fertilizer and P Fertilizer on the Growth and Yield of Shallots (Allium ascalonicum L.). JOM UR, 5(1), 1–4.

[5] Pratama, T.Y, Nurmayulis, & Rohmawati, I. (2018). Responses to Several Doses of Organic Vermicompost Fertilizer to the Growth and Yield of Mustard (Brassica juncea L.) Different Varieties. AGROLOGIA, 7(2), 81–89.

[6] Firmawini, E. (2018). Growth and Yield of Garlic (Allium Sativum L.) Due to Application of Organic Fertilizer Kascing.

[7] Saragih, MK (2018). Response of Growth and Production of Sweet Corn (Zea Mays Saccharata Sturt L.) Towards Application of Vermicompost and NPK. Methodagro, 4(2), 9–12.

[8] Dwiastuti, S., Sajidan, & Suwarno. (2015). Relationship of Earthworm Density and Worm Density on Various Land Uses in Gondangrejo, Karanganyar Regency, Central Java. Biology, Science, Environment, and Learning, 12(1), 838–842.

[9] Sumarni, N., & Hidayat, A. (2005). Shallot Cultivation Technical Guide. Bandung: Vegetable Crops Research Institute.

[10] Farida, E., Ulpah, S., & Edy, TS (2018). Application of Vermicompost Fertilizer and Nasa Poc on Growth and Production of Shallots (Allium ascalonicum L.). Journal of Agricultural Dynamics, 34(3), 255–264.

[11] Syawal, Y., Marlina, & Kunianingsih, A. (2019). The Effect of Baglog Compost Composition on the Growth and Yield of Shallots (Allium ascalonicum L.). Sriwijaya Service Journal, 7(1), 671–677.

[12] Tambunan, W.A, Sipayung, R., & Sitepu Ezra, F. (2014). Growth and Production of Shallots (Allium Ascalonicum L.) by Application of Biological Fertilizers in Various Planting Media. Online Journal of Agrotechnology, 2(2), 825–836.

[13] Sembiring, N., Damanik, BSJ, & Ginting, J. (2013). Response of Growth and Production of Yellow Onion (Allium Ascalonicum L,) to Application of Vermicompost Compost and NPK Fertilizer. Online Journal of Agroecotechnology, 2(1), 266-278.

[14] Zulkarnain. (2014). Fundamentals of Horticulture. Jakarta: Earth Literacy.

[15] Akbar, H.D, Aini, N., & Herlina, N. (2018). The Effect of Different Doses of Vermicompost Fertilizer and Planting Distance on the Growth and Yield of Kailan (Brassica oleraceae L. var alboglabra) plants. Journal of Crop Production, 6(6), 1066–1073.

[16] Sinda, K.M.N.K, Kartini, N.L, & Atmaja, IWD (2015). Effect of Vermicompost Fertilizer Dosage on Yield of Mustard (Brassica juncea L.), Chemical and Biological Properties. Tropical Agroecotechnology, 4(3), 170–179.

[17] Atmaja, I.W.D (2018). Soil Biotechnology Textbook. Denpasar: University

[18] Hidayatullah, W., Rosmawaty, T., & M., N. (2020). The Effect of Fertilizers with Vermicompost and Npk Mutiara 16:16:16 on the Growth and Yield of Okra (Abelmoschus Esculentus (L.) Moenc.) And Shallots (Allium Ascalonicum L.) With Intercropping System. Journal of Agricultural Dynamics, 36(April), 11–20.

[19] Saputra, R.R, Purwanti, S., & Rogomulyo, R. (2012). Effect of vermicompost vermicompost on growth and yield of two varieties of soybean (Glycine Max (L.) Merrill). Vegetalika, 1(1), 1–14.

[20] Jasmine. (2018). The Response of Worm Applications on Growth and Yield of Fresh Edamame Pods. National Seminar on Sustainable Agricultural Development Based on Local Resources, 1, 101–111.

[21] Hardiane, K., Maryani, Y., & Kusdiarti, L. (2012). Effect of Light Intensity and Dosage of Vermicompost Fertilizer on Growth and Yield of Red Spinach (Amaranthus tricolor L.). 57(10), 1150–1159.

[22] Kusumaningrum, I., Hastuti, RB, & Haryanti, S. (2007). Effect of Juice of Sargassum crassifolium with Different Concentrations on Growth of Soybean (Glycine max (L) Merill) Plants. Anatomy and Physiology Bulletin, 15(2), 17–23.

[23] Krisnawati, S., Darini, MT, & Darnawi. (2019). Effect of Planting Media Composition and Dosage of Vermicompost Fertilizer on Growth and Yield of Tomato Variety of Diamond (Solanum lycopersicum L.). Agroust Scientific Journal, 2(1), 43–55.

[25] Raharja, J., Akmal, I. and, & Mahbub, A. (2018). Growth and Yield of Soybean (Glycine max L Merrill) with the application of vermicompost and liquid organic fertilizer.
[26] Adam, IA, Mohamad, N., & Yudhy, W. (2019). Response of Two Varieties of Shallots (Allium ascolonicum L.) to Application of Organic Fertilizer and Inorganic Fertilizer. Journal of Agrotechnology Merdeka Pasuruan, 3(2), 15–21.
[27] Taiz, L., & Zeiger, E. (2002). Plant Physiology Third Edition. Sunderland Massachutts : Sinaure Associates.
[28] Subrata, Bhaskara Anggarda Gathot, and, & Martha, BE (2017). Growth Response and Yield of Three Caisim Varieties Towards Application of Biomethagreen Liquid Organic Fertilizer. Journal of Floratek, 12, 90–100.
[29] Mance, A., Sunar, D., & Sastro, Y. (2016). Effect of Zeolite and Vermicompost Planting Media Composition Level on Growth and Pakchoy (Brassica rapa L.). AGRISIA, 9(1), 1–20.
[30] Abror, M., & Widyastuti. (2019). Effect of Vermicompost Fertilizer and EM4 (Effective Microorganism) on Growth and Production of Tomato Plants (Lycopersicon Esculentum.). Nabatia, 16(2), 67–76.
[31] Raksun, A., Merta, I. W., Mertha, I. G., & Ilhamdi, M. L. (2022). The effect of vermicompost and NPK fertilizer on the growth of Spinach (Amaranthus tricolor). *Jurnal Pijar Mipa*, *17*(5), 691-695.
[32] Raksun, A., Ilhamdi, M. L., wayan Merta, I., & Mertha, I. G. (2021). The Effect of vermicompost and NPK fertilizer on tomato (Solanum lycopersicum) growth. *Jurnal Pijar Mipa*, *16*(5), 688-694.
[33] Marpaung, R.G, & Marianus, L. (2019). Growth Response and Production of Shallots (Allium Ascalonicuml) Tuktuk Varieties Due to Application of Vermicompost and Npk Fertilizers. Journal of AGROTEKDA, 3(1), 46–54.
[34] Nurdiana, D., Maesyaroh, SS, & Karmilah, M. (2019). The Effect of Application of Vermicelli Fertilizer and Liquid Organic Fertilizer on the Growth and Yield of Shallots (Allium ascalonicum L.). JAGROS, 4(1), 160–172.
[35] Roslim, D.I, Nastiti, D.S, & Herman. (2013). Morphological Characters and Growth of Three Types of Local Earthworms Pekanbaru on Two Kinds of Growth Media. Biosciences: Journal of Biology & Biology Education, 5(1), 1–9.
[36] Pelungkun, R. (2010). Earthworm Livestock Business Lumbericus rubellus. Jakarta: Self-help spreader.
[37] Iskandar, S. (2022). The effect of air quality due to household waste sewers on the growth of cayenne pepper (Capsicum frustescens L.). *Jurnal Pijar Mipa*, *17*(1), 79-82.
[38] Supriyanto, L., Dukat, D., & Sukanata, IK (2016). Effect of Planting Media Composition of Vermicompost Fertilizer and Liquid Organic Fertilizer on Growth and Yield of Cucumber (Cucumis sativus L.) Pluto Cultivars. Journal of Agrijati, 30(2), 52–63.