Vol. 6 (2024) No.2
ISSN:2655-3023

JERAMI
Indonesian Journal of Crop Science

Research Article

The Production of Shallots (Allium ascalonicum L.) in Response to the Application of Liquid Organic Fertilizer From Marine Fish Waste and Tithonia

Yopa Dwi Mutia, Aslan Sari Thesiwati, Ermawati, Muhammad Afif

Department of Agrotechnology, Faculty of Agriculture, Tamansiswa University, Padang, West Sumatra, Indonesia.

Article Info

Received:
20 October 2023

Accepted:
28 December 2023

Published:
29 February 2024

Competing Interest:
The authors have declared that no competing interest exists.

Corresponding Author:
Yopa Dwi Mutia, Department of Agrotechnology, Faculty of Agriculture, Tamansiswa University, Padang, West Sumatra, Indonesia
Email: yopamutia@unitas-pdg.ac.id

Abstract

Fish waste and Tithonia diversifolia are the essential ingredients of organic fertilizer. Several researchers have already tested these two materials, which have high plant nutrient content. This study aims to determine the effect of liquid organic fertilizer from marine fish waste and tithonia application on shallot (Allium ascalanicum L.) production. The research was conducted in Kuranji Subdistrict, Kuranji District, Padang City, West Sumatra, Indonesia, at 15 meters above sea level from November 2022 to March 2023. The experiment used a completely randomized design (CRD) with six treatments and four replications, resulting in 24 experimental units. The data were analyzed using analysis of variance (ANOVA) with a significance level of 5%. If there was a significant effect, Duncan's New Multiple Range Test was conducted at a significance level of 5%. The treatments consisted of 0, 10, 20, 30, 40, and 50 ml/L. The application of liquid organic fertilizer from marine fish waste and tithonia at 40ml/L is the most effective for shallot production, yielding the highest production per hectare at 12.13 tons/ha.

Keywords: organic fertilizer, plant nutrient, production, shallots, yield

1. Introduction

Shallots (Allium ascalonicum L.) are an essential and highly valued vegetable commodity in Indonesia due to their numerous benefits as a food seasoning and traditional medical ingredient. The SS Sakato variety (Solok, West Sumatra) is an exciting type of shallot to be developed. The SS Sakato variety of shallots, developed by the Center for Tropical Horticulture Studies, IPB, is an exciting type with superior qualities that make it suitable for cultivation in cold regions and throughout the year. The superiority of SS Sakato shallots in comparison to others is well-established, and their unmatched potential for growth and production is widely recognized.

The liquid organic fertilizer used in this experiment is made from marine fish waste and Mexican sunflower (*Tithonia diversifolia*). According to research by Zahara *et al.* (2012), the application of fish waste significantly affects several observation variables. Besides being a nutrient source, fish waste-based fertilizers can also induce *Rhizobacteria* sp., which play a role in produce plant growth hormones around the plant roots. The growth hormones are auxin, cytokinin, and gibberellin (Zahro *et al.*, 2018). *Tithonia diversifolia*, a prolific and abundant wild plant, has a relatively high biomass content, ranging from 3.3% to 5.5% for nitrogen (N), 0.2% to 0.5% for phosphorus (P), and 2.3% to 5.5% for potassium (K). The advantage of using *Tithonia diversifolia* as an organic material lies in its abundant biomass production, wide adaptability, ability to grow in marginal lands, faster decomposition rate, and high nutrient content, which are beneficial for improving soil productivity and increasing crop production (Nurrohman *et al.*, 2014).

Zahro *et al.* (2018) found that variations in the concentration of fish waste-based liquid organic fertilizer significantly influenced the growth of the number of fruits and the height of red chili plants (*Capsicum annum* L). The treatment with liquid organic fertilizer at a concentration of 45% exhibited the best effect on the number of fruits and the height of red chili plants.

2. Materials and Methods

This research was conducted in Kuranji Village, Kuranji District, Padang City, West Sumatra, with an altitude of 15 meters above sea level, from November 2022 to March 2023. The materials used in this experiment were SS Sakato shallot variety seeds, liquid organic fertilizer from marine fish waste and tithonia, and NPK pearl fertilizer 15-15-15. The tools used included a hoe, rake, plastic rope, scissors, knife, fermentation container for liquid organic fertilizer, hand sprayer, agricultural spraying equipment, digital scale, calipers, pH meter, measuring tape, ruler, raffia rope, and writing utensils.

The experiment employed a completely randomized design (CRD) consisting of 6 levels of liquid organic fertilizer from marine fish waste and tithonia treatments with concentrations: 0 ml/L (P0), 10 ml/L (P1), 20 ml/L (P2), 30 ml/L (P3), 40 ml/L (P4), 50 ml/L (P5). Each treatment was replicated four times, producing 24 experimental units or plots. Each plot comprised 50 shallot plant populations and 6 sample plants. The data collected were analyzed using analysis of variance (ANOVA) with a significance level of 5%, and if significant, Duncan's New Multiple Range Test was conducted at a significance level of 5%. The parameters observed included the number of bulbs per clump, bulb diameter, wet bulb weight per clump, dry bulb weight per clump, wet bulb weight per plot, dry bulb weight per plot, and bulb yield per hectare.

3. Results and Discussion

Table 1 shows that the lowest number of bulbs per clump was observed in the treatment with 10 ml/L, with a total of 6.20 bulbs, while the highest was recorded in the treatment with 30 ml/L, with a total of 7.75 bulbs. Liquid organic fertilizer from marine fish waste and tithonia can enhance shallot bulb production, attributed to its potassium (K) content of 1.34%. According to Kusuma (2012), nutrient balance, especially potassium, plays a crucial role in carbohydrate and protein synthesis for bulb formation. This finding is supported by Nurrohman *et al.* (2014), Zahara *et al.* (2012), and Zahro *et al.* (2018).

Kusuma (2012) and Rahayu *et al.* (2016) have indicated that nutrients such as nitrogen (N), phosphorus (P), and potassium (K) play significant roles in bulb formation, with potassium being essential for bulb development. Potassium enhances photosynthesis activity and chlorophyll content in leaves, thereby increasing the plant's dry weight. As an essential nutrient, plants require potassium in large quantities. According to Rosmarkam and Yuwono (2011), potassium functions in carbohydrate formation and transportation and increases carbohydrate and sugar levels in fruits.

The most minor bulb diameter was observed in the treatment with 0 ml/L, measuring 1.97 cm, while the largest diameter was recorded in the treatment with 40 ml/L, measuring 2.37 cm. Compared to the diameter size described for SS Sakato shallots in Appendix 5, the sizes meet the criteria. This is attributed to the liquid organic fertilizer from marine fish waste and tithonia containing 2.64% phosphorus (P), which influences generative growth and the resulting bulb count, thus leading to larger bulb diameters. Fansyuri and Armaini (2019) also stated that Soil nutrients, significantly phosphorus greatly influence shallot bulb formation. In addition to the causative factor of nutrients, Rohim (2019) said that the number of saplings is related to the size of the shallot bulbs to be planted, shallots that have a large bulb size, the number of saplings will be less.

Table 1. The number of bulbs and bulb diameter of shallots per clump with the application of various concentrations of liquid organic fertilizer from marine fish waste and tithonia.

Concentration (ml/L)	Number of bulbs per clump (bulbs)	Bulb diameter (cm)
0	6,20 C	1,97 BC
10	6,87 B	2,04 BC
20	6,70 BC	2,05 BC
30	7,75 A	1,94 C
40	7,41 AB	2,37 A
50	7,29 AB	2,13 B
KK = 6,32 %		KK = 5,07%

Numbers followed by the same uppercase letter are not significantly different according to the Duncan's New Multiple Range Test (DNMRT).

Table 2. The wet weight and dry weight of shallot bulbs per clump with the application of various concentrations of liquid organic fertilizer from marine fish waste and tithonia.

Concentration(ml/L)	Wet weight of shallot bulbs per clump (g)	Dry weight (g)
0	43,75 B	39,70 B
10	44,23 B	40,33 B
20	46,75 B	42,91 B
30	54,79 A	49,41 A
40	55,22 A	51,13 A
50	54,88 A	51,04 A
KK = 4,91 %		KK=5,1%

Numbers followed by the same uppercase letter are not significantly different according to the Duncan's New Multiple Range Test (DNMRT) at 5% significance level.

Table 3. The wet weight and dry weight of bulbs per plot, as well as the bulb yield per hectare of shallots, with the application of various levels of liquid organic fertilizer from marine fish waste and tithonia.

Concentration (ml/L)	Wet weight of bulbs per plot (kg)	Dry weight of bulbs per plot (kg)	Bulb yield per hectare (ton)
0	2,11 B	1,95 B	9,74 B
10	2,14 B	1,97 B	9,86 B
20	2,24 B	2,08 B	10,38 B
30	2,60 A	2,36 A	11,78 A
40	2,63 A	2,43 A	12,13 A
50	2,58 A	2,42 A	12,11 A
KK = 3,9 %		KK = 4,49 %	KK = 4,49 %

Numbers followed by the same uppercase letter are not significantly different according to Duncan's New Multiple Range Test (DNMRT) at a 5% significance level.

Table 2 shows that the most negligible wet weight of bulbs per clump was observed in the treatment with 0 ml/L, measuring 43.75 g, while the largest was recorded in the treatment with 40 ml/L, measuring 55.22 g. The application of liquid organic fertilizer from marine fish waste and tithonia influenced the increase in the wet weight of shallot bulbs, attributed to the 7.42% nitrogen (N) content in liquid organic fertilizer from marine fish waste and tithonia, which is required during the vegetative stage, and 1.34% potassium (K) for optimizing photosynthesis processes during the generative phase of shallot plants. The most negligible dry weight of bulbs per clump was observed in the treatment with 0 ml/L, measuring 39.7 g, while the largest was recorded in the treatment with 40 ml/L, measuring 51.13 g. The application of liquid organic fertilizer from marine fish waste and tithonia liquid organic fertilizer affected the increase in the dry weight of shallot bulbs. This is due to the 1.34% potassium (K) content in liquid organic fertilizer from marine fish waste and tithonia, which enhances plant growth and photosynthesis.

The nitrogen (N) nutrient facilitates chemical processes that produce nucleic acids, which play a role in the cell nucleus during cell division. This contributes to the formation of well-developed leaf layers and subsequently leads to the growth of shallot bulbs. Additionally, the high potassium (K) content results in the presence of K+ ions that bind water in plants, accelerating and optimizing the process of photosynthesis. Enhanced photosynthesis can stimulate the formation of larger shallot bulbs. Meanwhile, phosphorus (P) is a significant component of nucleic acids and plays a role in cell division. Phosphorus functions in root formation, which enhances the absorption of nutrients such as N, K, and other essential nutrients (Irawan *et al.*, 2017).The nutrients that are fulfilled cause plant growth to be maximized so that the photosynthesis process goes well and optimizes the formation of chlorophyll (Siregar, 2017). Increasing the result of photosynthesis will increase food reserves that can be stored, which can affect the weight of the plants consumed (Purnama et al., 2013). Table 3 shows that the most negligible wet weight of bulbs per plot was observed in the treatment with 0 ml/L, measuring 2.11 kg, while the largest was recorded in the treatment with 40 ml/L, measuring 2.63 kg. The most negligible dry weight of bulbs per plot was observed in the treatment with 0 ml/L, measuring 1.95 kg, while the largest was recorded with 40 ml/L, measuring 2.43 kg. The application of liquid organic fertilizer from marine fish waste and tithonia influenced the weight of shallot bulbs. This is attributed to the 7.42% nitrogen (N), 2.64% phosphorus (P), and 1.34% potassium (K) content in liquid organic fertilizer from marine fish waste and tithonia, which are required by shallot plants for bulb yield. Phosphorus (P) plays a significant role in root growth and development, stimulating root growth as a protein base, aiding in assimilation and respiration, accelerating flowering and fruiting processes, and seed and fruit formation (Zhang *et al.*, 2018). According to Salisbury and Ross (1995), cited by Lestari (2018), the accumulation of photosynthesis products in leaves is used for carbohydrate formation, which is then translocated for bulb formation; thus, the water content in tissues will affect the increase in wet bulb weight. Wahyuningsih *et al.* (2017) stated that high nutrient absorption causes the photosynthesis process to be high, and this will increase the growth of tubers. Sutedjo (2010) stated that the availability of good nutrients can increase the fresh weight and dry weight of shallot bulbs produced by the plant.

The most negligible bulb yield per hectare was observed in the treatment with 0 ml/L, measuring 9.74 tons/ha, while the largest was recorded in the treatment with 40 ml/L, measuring 12.13 tons/ha. The average wet weight of shallot plants obtained in the research was 12.13 tons/ha

4. Conclusions

Based on the research results, the best concentration of liquid organic fertilizer from marine fish waste and tithonia is 40 ml/L, which resulted in the highest bulb yield per hectare of 12.13 tons/ha. Liquid organic fertilizer from marine fish waste and tithonia with a concentration of 40 ml/L can increase the growth and yield of SS Sakato shallots.

References

[1] Fansyuri, H,dan Armaini. 2019. Pengaruh Pemberian Pupuk Guano Terhadap Pertumbuhan Dan Produksi Tanaman Bawang Merah (Allium ascalonicum L.).JOM FAPERTA Vol. 6 Edisi 1 Fakultas Pertanian Universitas Riau. : 6-7.

[2] Irawan D, Idwar. Munarti. 2017. Pengaruh pemupukan N, P, K terhadap pertumbuhan dan hasil bawnag merah (Allium ascalanicum L.) varietas birma Brebes dan Thailand di tanah Ultisol. Jurnal online mahasiswa fakultas pertanian Universitas Riau. 4 (1) : 1 – 14.

[3] Kusuma, A. V. C. 2012. Pengaruh Lama Penyimpanan Umbi Bibit dam Dosis Perimbangan Pupuk terhadap Pertumbuhan serta Hasil Umbi Bawang Merah (Allium ascalonicum L.). [Skripsi]. Fakultas Pertanian Universitas Sebelas Maret. Surakarta.

[4] Lestari, C. 2018. Karakteristik Agronomis Bawang Merah (Allium ascalonicum L.) Varietas Bima Akibat Pengaruh Jenis Media Tanam pada Teknik Vertikultur. [Skripsi]. Karawang: Fakultas Pertanian Universitas Singaperbangsa Karawang.

[5] Nurrohman, M., A. Suryanto dan K.P. Wicaksono. 2014. Penggunaan Fermentasi Ekstrak Paitan (Tithonia diversifolia L.) dan Kotoran Kelinci Cair sebagai Sumber Hara pada Budidaya Sawi (Brassica juncea L.) secara Hidroponik Rakit Apung. Jurnal Produksi Tanaman, Vol. 2 (8): 649 – 657.

[6] Purnama, R. H., S. J. Santosa dan S. Hardiatmi. 2013. Pengaruh Dosis Pupuk Kompos Enceng Gondok dan Jarak Tanam terhadap Pertumbuhan dan Hasil Tanaman Sawi (Brassica juncea L.). Infofarm, 12(2): 95-107.

[7] Rahayu, S., Elfarisna., Rosdiana. 2016. Respon Pertumbuhan dan Produksi Tanaman Bawang Merah (Allium ascalonicum

L.) dengan Penambahan Pupuk Organik Cair. Jurnal Agrosains dan Teknologi. 1 (1) : 9-18.
[8] Rohim, A. 2019. Pengaruh Ukuran Benih dan Jarak Tanam terhadap Pertumbuhan dan Hasil Bawang Merah (Allium ascalonicum) Varietas Bima Brebes. Jurnal AgroSainTa. 3(1)
[9] Rosmarkam, A., dan Yuwono, N.W. 2011. Ilmu Kesuburan Tanah. Kanisius. Yogyakarta. Hal 58-59;104.
[10] Siregar, (2017). Respon Pemberian Nutrisi ABmix pada Sistem Tanam Hidroponik terhadap Pertumbuhan dan Produksi Tanaman Sawi (Brassica juncea). Animal Science and Agronomy Panca Budi, 2(2): 18-24
[11] Sutedjo, M., 2010. Pupuk dan Cara Pemupukan. Rineka Cipta, Jakarta.
[12] Wahyuningsih, E., Herlina, N., dan Setyono, Y.T. 2017. Pengaruh Pemberian PGPR (Plant Growth Promoting Rizhobacteria) dan Pupuk Kotoran Kelinci Terhadap Pertumbuhan dan Hasil Tanaman Bawang Merah (Allium ascalonicum L.). Jurnal Produksi Tanaman. Vol. 5 No. 4. ISSN : 2527-8452.
[13] Zahara, S.A., Sasli, I. dan Sirojul, A.M. 2012. Pengaruh Pemberian Limbah Ikan terhadap Efektivitas Pemupukan pada Tanaman Kedelai di Tanah Gambut. J. Sains Pertanian Equator. 2(2).
[14] Zahro, F., Kusrina dan S. M. Setyawati. 2018. Perbandingan Variasi Konsentrasi Pupuk Organik Cair Dari Limbah Ikan terhadap Pertumbuhan Cabai Merah (Capsicum annum L.). 1 (1) ; 50-57.
[15] Zhang, W., Chen, X.-X., Liu, Y.-M., Liu, D.-Y., Du, Y.-F., Chen, X.-P., Zou, C.-Q. 2018. The Role of Phosphorus Supply in Maximizing the Leaf Area, Photosynthetic Rate, Coordinated to Grain Yield of Summer Maize. Field Crops Research, 219: 113-119.