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The Effect of Biofertilizer Application and Storage Period of Bulb on the Growth and Yield of Shallot Cultivar Bima

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Abstract

The shallot (Allium Ascalonicum L) is one of the leading horticultural commodities that has high economic value. Efforts to increase shallot yields are carried out by providing fertilizer and treating seeds. This research aimed to determine the interaction between the effect of Liquid Organic Biofertilizer (LOB) concentration and the bulb storage period on the growth and yield of shallot. The research was conducted in Baros Village, Kejiwaan District, Brebes Regency with a period of June–August 2023. The experimental design used was a randomized complete block design with a factorial pattern. The treatment consisted of two factors, namely LOB concentration (0, 4, 8, and 12 ml /L) and bulb storage periods (1, 2, and 3 months), and all treatments were repeated three times. The variables observed were plant height, number of tillers, number of leaves, root volume, number of bulbs, bulb diameter, fresh weight of bulbs per cluster, fresh weight of bulbs per plot, dry weight of bulbs per cluster, and dry weight of bulbs per plot. The results showed that there was a significant interaction between the effect of LOB concentration and the bulb storage period on the number of leaves at 21 DAP, 28 DAP, 35 DAP, root volume at 45 DAP, and 60 DAP, plant growth rate at 30-45 DAP, number of bulbs per plant, bulb diameter, fresh bulb weight per cluster, fresh bulb weight per plot, dry bulb weight per cluster and dry bulb weight per plot. LOB treatment of 8 ml/L and bulb storage period of 3 months gave the best results, namely 5.24 kg/plot of dry bulbs.

Keywords: *Bulbs; LOB biofertilizer; shelf life of seeds.*

1. INTRODUCTION

The shallot (Allium ascalonicium L) is a horticultural commodity that produces bulbs and is classified as a spice vegetable. The bulbs and leaves are widely used, especially as a complement to cooking spices. Apart from that, shallots can also be used as a medicine for high blood pressure, diabetes, dysentery, flatulence, and wounds, because they contain enough nutrients, such as protein, riboflavin, and lime (Advinda, 2018). According to Azmi, Hidayat, and Wiguna (2011), shallot bulbs contain the compound alliin or allicin so they have an antiseptic effect. Allin or allicin compounds are converted by the allicin lyase enzyme into pyruvic acid, ammonia, and anti-microbial allicin which are bacterial.

Shallot plants require sufficient nutrients for their growth and development. The addition of organic materials is expected to increase the growth and yield of shallots by improving the chemical, physical, and biological properties of the soil. According to Sataral et al., (2021) providing biological fertilizer can increase the yield of shallot plants. Liquid

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Organic Biofertilizer (LOB) is a biological fertilizer that contains several bacteria, including Azotobacter sp., Azopirillum sp., Lactobacillus sp., Pseudomonas sp., and Bacillus sp. Azotobacter sp. and Azoprillum sp. is an aerobic bacteria that functions to fix nitrogen. Pseudomonas sp. and Bacillus sp. are phosphate-solubilizing bacteria. These bacteria can convert unavailable forms of nitrogen and phosphate into available forms so that plants can absorb them well (Siagian et al., 2019).

Apart from organic materials and nutrients, the quality of shallot seeds can also affect their growth and yield. One of the factors that affects the quality of shallots is the bulb storage period (Karim et al., 2015). Seed quality correlates with seed viability. Seeds with high viability will also provide high yields. Shallot bulbs as planting material have been stored for a minimum of 2 months, with the best storage period being 3-4 months so that they are resistant to disease attacks and have high growth capacity (Andriani, 2020). Storage periods that are less than or exceed the best storage time will affect the viability and vigor of the seeds.

This research aims to determine the effect of Liquid Organic Biofertilizer (LOB) concentration and bulb storage period on shallot growth and yield. Through careful experiments, we investigated how variations in LOB concentration and bulb storage time can affect plant growth rates and shallot yields. Thus, this research is expected to provide deeper insight into optimizing the use of LOB in increasing the productivity and quality of shallot plants.

2. METHOD

The research was carried out in Baros Village, Kejiwaan District, Brebes Regency, which is located at an altitude of ±22 m above sea level (asl). The soil type is included in the Alluvial soil type with a pH of 5.57. The time for conducting the research was from 25 May 2023 to 20 August 2023. The experimental design used was a randomized complete block design with a factorial pattern consisting of two factors, namely the concentration of Liquid Organic Biofertilizer (LOB) (0,4,8,12 mL/L) and the bulb storage period of shallot cv. Bima Brebes (1, 2, and 3 months). All treatments were repeated three times so that there were 36 experimental units. The plot size is 2 meters x 1.2 meters, with a trench width of 0.5 meters and a plant spacing is 20 cm x 15 cm.

Basic fertilizer is given 7 days before planting in the form of biological fertilizer with a concentration of 10 ml/l and a dose of 60 ml of solution/plot. As a treatment, biological fertilizer is given at a concentration according to the treatment at a dose of 60 mL of solution/plot, which is sprayed onto the surface of the soil around the shallot plants. The seeds used are seeds that have been stored with a storage period according to the treatment, calculated from the time of harvest.

The variables observed were plant height at 14, 21, 28, and 35 DAP, number of tillers per clump, number of leaves per clump, root volume at 30 DAP, plant growth rate at 30-45 DAP, and 45-60 DAP, number of bulbs per cluster, the diameter of bulbs per cluster, fresh weight of bulbs and dry weight of bulbs observed after harvest. Data were analyzed using analysis of variance and the post hoc test is Duncan's Multiple Range Test (DMRT) at a significance level of 5%. Data processing was carried out using the SPSS version 25 program.

3. RESULT AND DISCUSSION

3.1 Plant height

The results of the analysis showed that there was no interaction between LOB concentration and bulb storage period on plant height at all ages of observation.

Independently, LOB concentration had no significant effect on plant height at 14 and 21 DAP, but there are significant effect at 28 and 35 DAP. The bulb storage period did not significant effect on plant height at all ages of observation.

Table 1. Average plant height due to different LOB concentrations and seed shelf life.

No	Treatment	Plant height (cm)			
		14 DAP	21 DAP	28 DAP	35 DAP
LOB Concentration					
1	Without LOB	21,09 a	24,50 a	25.58 a	29.99 a
2	LOB 4 ml/L	22,04 a	24,82 a	27.17 a	30.88 a
3	LOB 8 ml/L	22,24 a	24,79 a	29.48 b	33.18 b
4	LOB 12 ml/L	21,46 a	23,69 a	25.48 a	28.84 a
Bulb storage period					
1	Bulb 1 month old	21,87 a	24,66 a	27.30 a	29.94 a
2	Bulb 2 months old	21,22 a	23,31 a	26.10 a	31.50 a
3	Bulb 3 months old	22,04 a	25,38 a	27.38 a	30.72 a

Note: Numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the 5% significance level.

Table 1 shows that at 28 and 35 DAP, a LOB concentration of 8 mL/L provided the best plant height compared to other treatments. LOB works in the rhizosphere area, which is believed to promote soil structure so that microorganisms in the soil can play a part in the cycle of energy, nutrients, aggregate production, and soil health. LOB biofertilizer can improve soil aggregates so that plant roots can stand firmly support plant growth and help the process of maximum growth of bulb plants (Lestari, 2015).

3.2 Number of Tiller

The results of the analysis showed that there was no interaction between LOB concentration and bulb storage period on the number of tillers per hill at all ages observed. Independently, LOB concentration had a substantial effect on the number of tillers per hill at 35 DAP. The bulb storage period did not have a significant effect on plant height at all ages of observation.

Table 2. Average number of tillers per hill due to different LOB concentrations and bulb storage period.

No	Treatment	Number of Tiller (unit)			
		14 DAP	21 DAP	28 DAP	35 DAP
LOB Concentration					
1	Without LOB	3.09 a	3,93 a	4,38 a	6.40 ab
2	LOB 4 ml/L	3.11 a	4,00 a	4,51 a	6.51 b
3	LOB 8 ml/L	3.62 a	4,29 a	5,04 a	6.09 a
4	LOB 12 ml/L	3.38 a	3,82 a	4,40 a	6.93 c
Bulb storage period					
1	Bulb 1 month old	3,28 a	4,23 a	4,80 a	6.43 a
2	Bulb 2 months old	3,20 a	3,70 a	4,23 a	6.55 a

3	Bulb 3 months old	3,42 a	4,10 a	4,72 a	6.47 a

Note: Numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the significance level of 5%.

Table 2 shows that the highest number of offspring at the age of 35 DAP was obtained from the LOB concentration treatment of 12 mL/L. This is thought to be because, at the age of 35 DAP, the shallot plants have absorbed many essential nutrients in the soil such as nitrogen, phosphorus, and potassium, which can support the growth of more shallot plants. In line with research by Jamaludin et al. (2021) which states that at the age of 35 DAP, the growth of shallot plants has reduced and the shallot bulbs and seedlings have begun to form.

3.3 Number of Leaves

The results of the analysis showed that there was no interaction between LOB concentration and bulb storage period on the number of leaves per cluster at 14 DAP, but independently LOB concentration had a significant effect on the number of leaves per cluster. The bulb storage period did not have a significant effect on the number of leaves at 14 DAP. The results of the variance analysis showed that there was an interaction between the effect of LOB concentration and the bulb storage period on the number of leaves per clump at all ages of observation.

Table 3. The average number of leaves per cluster at 14 DAP is due to different LOB concentrations and bulb storage periods.

Treatment	Number of Leaves (blade)
LOB Concentration	
Without LOB	13.04 a
LOB 4 ml/L	11.09 a
LOB 8 ml/L	12.71 a
LOB 12 ml/L	14.98 b
Bulb storage period	
Bulb 1 month old	13.48 a
Bulb 2 months old	12.62 a
Bulb 3 months old	12.77 a

Note: Numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the significance level of 5%.

Table 3 shows that a LOB concentration of 12 ml/L gave the highest number of leaves, namely 14.98 pieces, and was significantly different from other treatments. It is suspected that LOB with a concentration of 12 ml/L can provide more essential nutrients so that leaf growth becomes more optimal. Providing organic fertilizer can increase plant leaf area. Leaves play a role in capturing light and are where the photosynthesis process takes place. The development of the number of leaves will also affect plant development (Siagian et al., 2019).

Table 4. The average number of leaves per cluster at 21 DAP is due to different LOB concentrations and bulb storage periods.

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- blade----------					
L_0	18.00	a	17.13	a	12.80	a
(Tanpa LOB)	A		A		A	
L_1	14.00	a	14.87	a	13.67	a
(LOB 4 ml/L)	A		A		A	
L_2	17.47	a	14.07	a	21.87	b
(LOB 8 ml/L)	A		A		B	
L_3	16.27	a	16.87	a	13.40	a
(LOB 12 ml/L)	A		A		A	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at the 5% level.

In Table 4 it can be seen that at L0, L1, and L3, differences in the bulb storage period do not result in a different number of leaves per cluster. At U1 and U2, different LOB concentrations did not produce different leaf numbers. At a LOB concentration of 8 mL/L, a shelf life of 3 months gave the highest number of leaves. The same event happened with a shelf life of three months. The largest number of leaves was produced by a concentration of 8 mL/L. This is thought to be because there is a positive interaction between the presence of LOB at a certain concentration and the longer bulb storage period which has a positive impact on the growth of bulb leaves in the early growth phase (Roisnahadi, 2023).

Table 5. The average number of leaves per cluster at 28 DAP is due to different LOB concentrations and bulb storage periods.

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- blade----------					
L_0	20.93	a	22.20	a	15.33	a
	A		B		A	
L_1	16.87	a	17.93	a	19.07	a
	A		A		A	
L_2	22.07	a	17.67	a	26.60	b
	A		A		B	
L_3	19.40	a	20.13	a	14.53	a
	A		A		A	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at the 5% level.

Table 5 can be seen that at L0, L1, and L3, differences in the bulb storage period do not result in a different storage period of shallot bulbs is 3 months which is the best bulb storage period. Bulbs used as seeds must be stored for a minimum of 2 months, with optimal storage conditions being 3-4 months, so that they are resistant to disease attacks and maintain optimal growth ability (Andriani, 2020).

Table 6. The average number of leaves per cluster at 35 DAP is due to different LOB concentrations and bulb storage periods.

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- blade----------					
L_0	24.53	a	26.60	b	18.67	a
	A		B		A	
L_1	20.87	a	21.60	a	23.73	b
	A		A		A	
L_2	28.27	b	20.13	a	31.27	c
	B		A		C	
L_3	24.33	a	22.53	a	16.73	a
	B		A		A	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at the 5% level.

Table 6 shows that in the L2 (LOB 8 ml/L) with a bulb storage period of 3 months, the seeds produced significantly more leaves than the other treatments, namely 31.27 leaves per cluster. This is thought to be because the combination of a LOB of 8 ml/L and a bulb storage period of 3 months can produce plants that grow well and optimally. The interaction between LOB concentration and bulb storage period contributes positively to the growth of shallot leaves in the early stages of growth, as stated by Roisnahadi (2023).

3.4 Root Volume

The results of the analysis showed that there was no interaction between LOB and bulb storage period on shallot root volume at 30 DAT. Independently, LOB concentration had a significant effect on root volume at 30 DAP, and bulb storage period had no significant effect on root volume at 30 DAP.

Table 7. Average root volume at 30 DAP due to different LOB concentrations and bulb storage period.

Treatment	Root Volume (ml)
Treatment LOB	
Without LOB	3.05 a
LOB 4 ml/L	3.05 a
LOB 8 ml/L	3.61 a
LOB 12 ml/L	4.50 b
Treatment Bulb storage period	
Bulb 1 month old	3.29 a

Bulb 2 months old	3.71 a
Bulb 3 months old	3.67 a

Note: Numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the 5% significance level.

Table 7 above shows the treatment of Liquid Organic Biofertilizer (LOB) 12 ml/L which is significantly different from other treatments. It is suspected that a LOB concentration of 12 ml/L can provide more optimal nutrients. LOB works in the rhizosphere area which is expected to improve soil structure so that microorganisms in the soil can play a role in the cycle of energy, nutrients, aggregate formation, and determining soil health. LOB biofertilizer can improve soil aggregates so that plant roots can stand firmly to support plant growth and help the process of maximum growth of shallot plants (Widyastuti et al., 2015).

Table 8. Average root volume at 45 DAP due to different LOB concentrations and bulb storage period.

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- mL----------					
L_0	5.50	a	5.50	a	5.50	a
	A		A		A	
L_1	6.83	a	5.83	a	5.50	a
	A		A		B	
L_2	7.67	b	7.67	b	9.33	b
	A		A		B	
L_3	5.00	a	6.17	a	5.00	a
	A		A		A	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at 5%.

Based on the results of the analysis, showed that there was an interaction between LOB fertilizer treatment and bulb storage period when observing root volume at 45 DAP. The L2U3 treatment (LOB 8 ml/L and bulb storage period of 3 months) was significantly different from the other treatments, with a root volume of 9.33 ml. This result is thought to be obtained because the optimal storage period for shallot bulbs is 3 months and the addition of optimal LOB will add macronutrients that plants can use for root growth. Root formation in shallot is very dependent on the results of plant photosynthesis. The element that plays an important role in the formation of bulbs is phosphorus. Phosphorus functions in root formation (Nuryani, 2010).

Table 9. Average root volume at 60 DAP due to different LOB concentrations and bulb storage period.

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- mL----------					
L_0	6.00	a	5.67	a	5.50	a
	A		A		A	
L_1	6.83	b	5.83	a	5.50	a
	A		A		A	
L_2	7.67	c	7.67	b	9.33	b
	A		A		B	
L_3	5.17	a	6.17	a	5.50	a
	A		A		A	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at 5%.

Based on the results of the analysis, showed that there was an interaction between LOB fertilizer treatment and bulb storage period when observing root volume at 60 DAP. The L2U3 treatment (LOB 8 ml/L and bulb storage period of 3 months) was significantly different from the other treatments. These results suggest that LOB contains essential nutrients and microbes that support nutrient absorption by plant roots. This can increase the availability of nutrients needed for root growth and development. Components in LOB can stimulate direct root growth or increase plant growth hormone activity (Antonius et al., 2018).

3.5 Plant Growth Rate

Based on the results of the analysis, show that there is an interaction between LOB fertilizer treatment and the bulb storage period on plant growth rates (PGR) at 30-45 DAP. There was no interaction between LOB concentration treatment and bulb storage period on plant growth rate at 45-60 DAP.

Table 10. The average growth rate of plants aged 30-45 DAP is due to different LOB concentrations and bulb storage periods.

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- g/m^2/day ----------					
L_0	0.19	a	0.24	a	0.23	a
	A		A		A	
L_1	0.25	a	0.24	a	0.22	a
	A		A		B	
L_2	0.29	b	0.34	b	0.45	b
	A		A		B	
L_3	0.20	b	0.35	b	0.27	a
	A		A		B	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at the 5% level.

According to Table 10, the L2U3 treatment (LOB 8 ml/L and bulb storage period of 3 months) was significantly different from the other treatments with a growth rate of 0.45 g/m2/day. This is thought to be because the combination of a LOB of 8 ml/L and a bulb storage period of 3 months can produce plants that grow well and optimally. The application of biological fertilizers using soil treatment and apical treatment as well as a combination of both shows a higher plant response compared to the control as a conventional treatment which uses synthetic chemical fertilizers on all plant growth variables (Sutarman and Prahast, 2022). This is because LOB biofertilizer contains bacteria that play a role in providing N and P nutrients in the soil (Kumawat, 2017).

Table 11. The average plant growth rate of 45-60 DAP is due to different LOB concentrations and bulb storage periods.

Treatment	PGR 45-60 DAP ($g/m^2/day$)
Treatment LOB	
Without LOB	0.30 b
LOB 4 ml/L	036 c
LOB 8 ml/L	0.43 d
LOB 12 ml/L	0.24 a
Treatment Bulb storage period	
Bulb 1 month old	0.32 a
Bulb 2 months old	0.33 a
Bulb 3 months old	0.35 a

Note: Numbers followed by the same letter in the same column are not significantly different according to Duncan's Multiple Range Test at the 5% significance level.

Table 11 shows that in the observation of Plant Growth Rate 45-60 DAP, the treatment of 8 mL/L Liquid Organic Biofertilizer (LOB) was significantly different from the other treatments. This is thought to be because the LOB with a concentration of 8 mL/L has fulfilled the essential nutrients needed for plant growth. Sutarman and Prahasti (2022) state that the use of biological agents to provide biofertilizers that are more beneficial for plants is the most feasible alternative in efforts to restore the health and resilience of agricultural land while increasing the availability of nutrients in the soil.

3.6 Variables of Component Yield and Yield

Based on the variance analysis, there is a significant interaction between LOB fertilizer treatment and bulb storage period to the average number of bulbs per plant. LOB concentration had no significant effect on shallot bulb yield except for the LOB concentration treatment of 8 mL/L (Table 12). The bulb storage period does not have a significant effect on the bulb storage period except for the storage period of 3 months.

Table 12. Average number of bulbs per plant due to different LOB concentrations and bulb storage period.

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- bulb----------					
L_0	6.33	a	7.00	a	6.67	a
	A		A		A	
L_1	6.33	a	8.00	a	7.00	a
	A		A		A	
L_2	6.33	a	10.33	b	14.33	b
	A		B		C	
L_3	10.27	b	10.33	b	9.40	a
	A		A		A	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at the 5% level.

The number of bulbs per plant at L2U3 treatment (LOB 8 ml/L and bulb storage period of 3 months) was significantly different from the other treatments. It is suspected that LOB with a concentration of 8 mL/L can provide more essential nutrients so that growth is more optimal. Biofertilizers have the benefit of increasing the input of P and N nutrients in plant growing media, improving the physical properties of the soil for the better, optimizing the uptake of nutrients in the soil, and increasing fertility naturally (Marom et al., 2017). Optimal nutrient absorption can increase plant growth so shallot bulb formation is also optimal.

Table 13. Average bulb diameter due to different LOB concentrations and bulb storage period.

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- cm----------					
L_0	1.71	a	1.94	a	1.65	a
	A		A		A	
L_1	1.86	a	1.82	a	1.98	a
	A		A		A	
L_2	2.00	a	2.31	b	2.85	b
	A		A		B	
L_3	2.12	a	2.28	b	2.03	a
	A		A		A	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at the 5%.

Based on the variance analysis, there was a significant interaction between LOB concentration and bulb storage period to the average bulb diameter. The L2U3 treatment (LOB 8 ml/L and bulb storage period of 3 months) was significantly different from the other treatments (Table 13). This is thought to be because giving LOB can improve soil quality by increasing soil structure, water retention, and soil microbial activity. Healthier soil can provide a better environment for the growth and development of shallot bulbs, increasing shallot bulb diameter (Desta et al. 2021).

Table 14. The average weight of fresh bulbs per hill is due to different LOB concentrations and bulb storage periods.

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- Kg----------					
L_0	47.28	a	50.57	a	45.88	a
	A		A		A	
L_1	51.29	a	52.60	a	63.32	b
	A		A		A	
L_2	49.45	a	75.87	b	93.10	c
	A		B		C	
L_3	60.88	a	74.60	b	56.41	a
	A		B		A	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at the 5%.

Based on the variance analysis, there was a significant interaction between LOB concentration and bulb storage period to the average weight of fresh bulbs per hill. The L2U3 treatment (LOB 8 ml/L and bulb storage period of 3 months) was significantly different from the other treatments with a result of 93.10 g (Table 14). This is thought to be because LOB with a concentration of 8 ml/L can meet the nutritional needs of N, P, and K for plants. Element K can help the photosynthesis process in the formation of organic compounds which are transported to the storage organs, in this case, the bulbs, and at the same time improve the quality of the bulbs. Potassium also activates enzymes needed to form starch and protein (Siagian et al., 2019).

Table 15. Fresh bulb weight per plot due to different LOB concentrations and bulb storage period.

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- Kg----------					
L_0	3.31	a	3.54	a	3.17	a
	A		A		A	
L_1	3.59	a	3.68	a	4.84	b
	A		A		A	
L_2	3.46	a	4.04	a	6.53	c
	A		A		B	

L_3	4.86	b	4.51	a	3.34	a
	B		A		A	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at the 5%.

Based on the variance analysis, there was a significant interaction between LOB concentration and bulb storage period to the average weight of fresh bulbs per plot. The L2U3 treatment (LOB 8 ml/L and bulb storage period of 3 months) was significantly different from the other treatments (Table 15). The results show that LOB contains microbes and essential nutrients that support nutrient absorption by plant roots. According to Hidayati and Fathurrahman (2022), biological fertilizer with active ingredients consisting of the microbes Aspergillus niger and Azopyrilium sp. plays an important role in increasing the uptake of nitrogen (N) and phosphorus (P) elements by plants. This contributes to the provision of sufficient nutrients for plant growth and development. Gultom (2018) also said that fertilization has a crucial role in efforts to increase crop yields, and the use of fertilizer as recommended is expected to produce economically profitable results.

Table 16. Average dry bulb weight per hill due to different LOB concentrations and bulb storage period

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- Kg----------					
L_0	38.88	a	40.46	a	36.23	a
	A		A		A	
L_1	42.72	a	44.57	a	51.37	c
	A		A		A	
L_2	40.08	a	58.87	c	74.40	d
	A		B		C	
L_3	47.60	a	53.73	b	49.36	b
	A		A		A	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at the 5% level.

Based on the variance analysis, there was an interaction between LOB concentration and bulb storage period to the average dry bulb weight per hill. The L2U3 treatment (LOB 8 ml/L and bulb storage period of 3 months) was significantly different from the other treatments (Table 16). These results are thought to originate from the fact that the ideal storage period for shallot bulbs is three months and that adding LOB at the right concentration can increase the availability of nutrients in the soil that can be used for plant growth. According to Deedad (2017), factors that affect plant growth contribute to optimal production. The same applies to shallot plants, where good plant growth and production can be achieved when the supply of the required nutrients is sufficient.

Table 17. Dry bulb weight per plot due to different LOB concentrations and bulb storage period

LOB	Bulb storage period					
	U_1 (1 month)		U_2 (2 months)		U_3 (3 months)	
	---------- Kg----------					
L_0	2.72	a	2.83	a	2.54	a
	A		A		A	
L_1	2.99	a	3.12	a	3.90	b
	A		A		A	
L_2	2.81	a	3.27	a	5.24	c
	A		A		B	
L_3	3.67	a	3.86	b	2.85	a
	A		A		A	

Note: Average numbers followed by the same lowercase letters in the columns and the same capital letters in the rows are not significantly different according to Duncan's Multiple Range Test at the 5% level.

Based on Table 17, shows that there was an interaction between LOB concentration and bulb storage period to the average dry bulb weight per plot. The L2U3 treatment (LOB 8 ml/L and bulb storage period of 3 months) was significantly different from the other treatments with a dry bulb weight of 5.24 kg/plot. This is thought to be due to the potential positive interaction between the nutritional composition of LOB at certain concentrations and the longer bulb storage period on increasing the average dry bulb weight. Previous research states that the optimal combination of nutrition and seed quality plays an important role in increasing crop production (Sugiarto & Sunawan, 2020).

4. CONCLUSION

Based on the results of the research conducted, it can be concluded as follows:

1. The interaction effect between the application of LOB biofertilizer and the bulb storage period occurred in observing the growth and yield of shallot plants, namely the number of leaves aged 21 DAP, 28 DAP, 35 DAP, root volume 45 DAP, root volume 60 DAP, plant growth rate 30 -45 DAP, the average number of bulbs per plant, average bulb diameter, fresh bulb weight per cluster, fresh bulb weight per plot, dry bulb weight per cluster and dry bulb weight per plot, There is no significant effect on plant height at 14 DAP and 21 DAP, the number of tillers at 14 DAP, 21 DAP, 28 DAP, the number of leaves had an influence at 14 DAP with the LOB treatment of 8 ml/L while for shelf life there was no significant difference, and the plant growth rate at 45-60 DAP was not There was a significant difference in shelf life but in the LOB 8ml/L treatment there was an interaction effect.

2. The results of the study showed that the L2U3 treatment (LOB 8 ml/L and bulb storage period of 3 months) gave the best yield and was significantly different from other treatments in observing the dry bulb weight of 5.24 kg/plot.

References

Advinda, Linda. 2018. Basics of Plant Physiology [Indonesia]. Deepublish.

Adriani. 2020. Growth and Yield of Shallot Plants (Allium ascalonicum L.) on Shelf Life and Temperature [Indonesia]. Thesis. Sultan Syarif Kasim Riau State Islamic University.

Antonius S, Rozy Dwi Sahputra, Yulia Nuraini, Tirta Kumala Dewi. 2018. Benefits of Biological Organic Fertilizer, Compost, and Biochar on the Growth of Shallots and Their Effect on Soil Biochemistry in Pot Experiments Using Ultisol Soil [Indonesia]. Indonesian Biology Journal. 14(2): 243-250.

Azmi, C., I.M. Hidayat, and G. Wiguna. 2011. The Influence of Variety and Bulb Size on Shallot Productivity [Indonesia]. J. Hort. 21(3):206-213, 2011. Vegetable Crops Research Institute, Lembang, Bandung.

Central Statistics Agency (BPS). 2019. Shallot Production and Productivity in Indonesia [Indonesia]. Central Statistics Agency of the Republic of Indonesia

Deedad, A., Samudin and M. Ansar. 2017. Growth of shallot plants of the Lembah Palu variety given various atonic concentrations [Indonesia]. Agroland Journal, 24(1): 10-17.

Desta B, Woldetsadik K, Ali WM. 2021. Effect of Harvesting Time, Curing and Storage Methods on Storability of Garlic Bulbs. The Open Biotechnology Journal. 15: 36-45.

Gultom Amen. 2018. Response of Growth and Productivity of Shallot Plants (Alium Ascalonicum L.) to the Application of Jengkol Peel Compost and Water Hyacinth Liquid Organic Fertilizer [Indonesia]. Faculty of Agriculture, Muhammadiah University, North Sumatra. Medan.

Hidayati, F.S., Fathurrahman. 2022. The effect of petrobiofertile biofertilizer and fruit residues on the growth and production of long beans (Vigna unguiculata var. sesquapedalis) [Indonesia]. Journal of Agrotechnology, Agribusiness and Aquaculture, 2(2): 58 – 70.

Jamaludin, Krisnarini, Rakhmiati. 2021. Growth and Yield of Shallots (Allium ascalonicum L.) in Polybags Due to the Application of Various Doses of KNO3 Fertilizer [Indonesia]. Journal of Planta Symbiosa. 3(2): 19-26.

Kumawat, N. 2017. Role of Biofertilizers in Agriculture. Popular Kheti. 5(4):63–66.

Lestari Dwi Ayu. 2015. The Effect of Various Doses of Liquid Organic Biofertilizer (LOB) Application on Soil Aggregates in the Rhizosphere Area of PT Great GiantPineapple's Pineapple (Ananascomosus) Plantations [Indonesia]. Thesis.

Marom, N., Rizal, F., & Bintoro, M. (2017). Test the effectiveness of administration and concentration of PGPR (Plant Growth Promoting Rhizobacteria) on the production and quality of peanut (Arachis hypogaea L.) seeds [Indonesia]. Agriprima: Journal of Applied Agricultural Sciences, 1(2): 174–184.

Nuryani, Sri. 2010. Nutrient Uptake of N, P, K in Rice Plants with Various Durations of Use of Organic Fertilizer in Vertisol Sragen [Indonesia]. Gadjah Mada University: Yogyakarta. Journal of Soil and Environmental Sciences. 10(1): 1-13

Nugroho U, Rahmat, A. S. & Netty, E. (2017). Test the effectiveness of bulb size and the addition of urine on the growth and yield of shallot (Allium ascalonicum L.) seedlings [Indonesia]. Agriprima, Journal of Applied Agricultural Sciences, 1(2), 118-125 https://agriprima.polije.ac.id/index.php/journal/article/view/v1i2-c

Oktavia, Y., Yartiwi, and Damiri, A. 2019. Diversity of growth and feasibility level of farming three varieties of shallots: a case study in Selupu Rejang District, Rejang Lebong Regency, Bengkulu Province [Indonesia]. Indonesian Journal of Agricultural Sciences 21(2):103-107.

Rizky Ade Maulita (2018). The effect of a combination of three types of manure and a dose of Liquid Organic Biofertilizer (LOB) biological fertilizer on the growth and yield of shallots (Allium ascalonicum L.) [Indonesia].

Roisnahadi DT. 2023. Effect of Liquid Bio-Slurry Fertilizer Doses and LOB (Liquid Organic Biofertilizer) on the Growth and Yield of Kailan Plants (Brassica oleracea L.) [Indonesia]. thesis

Sataral M, Tingakene E, Mambuhu N. 2021. Combination of NPK Fertilizer with Chicken Manure Compost on the Growth and Production of Shallots (Allium ascalonicum L.) [Indonesia]. Celebes Agricultural. 1(2): 8-17

Siagian TV, Hidayat F, Tyasmoro SY. 2019. Effect of Dosing NPK and Biological Fertilizers on the Growth and Yield of Shallot Plants (Allium ascalonicum L.) [Indonesia]. Journal of Crop Production. 7(11):2151-2160.

Sugiarto S, Sunawan S. 2020. Response of single garlic (Allium sativum L.) to long-term application of simple induction and rabbit urine [Indonesia]. Journal of Agricultural Sciences. 4(2): 1-9.

Sutarman, Prahasti T. 2022. Performance Test of Trichoderma as Biological Fertilizer in Increasing Growth and Production of Shallot Plants [Indonesia]. Tropical Agrotech Journal. 10 (3): 421 - 428

Widyastuti D, Kus Hendarto, Ali Rahmat, Hayane Adeline Warganegara, Indah Listiana, Sandi Asmara. 2021. The Combination of Biofertilizer and Organic Fertilizer to Improve Shallot (Allium ascalonicum L.) Production [Indonesia]. Journal of Tropical Crop Science. 7(8): 16-21.