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The Effect of Liquid Organic Fertilizer (LOF) Rabbit Urine on the Growth and Yield of Three Varieties of Shallots (*Allium ascalonicum* L.)

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Abstract

Background: Shallots (*Allium ascalonicum L.*) are a commodity that contributes significantly to the country's foreign exchange, holding high economic value. Rabbit urine, when processed into liquid organic fertilizer, provides plants with the macro and micro nutrients they need. This study aims to investigate the interaction between liquid organic fertilizer concentrations derived from rabbit urine and three varieties on the growth and yield of shallots. **Method:** The method chosen for this study was a Completely Randomized Design (CRD) consisting of two treatment factors: three varieties of shallots (Bima Brebes, Bauji, and Tajuk) and five levels of rabbit urine LOF concentration (0, 100, 250, 400, and 550 ml/L). and obtained 15 combinations (V1, V2, V3 and K1, K2, K3, K4, K5). **Results:** Significant interaction occurred in the number of leaves aged 7–14 HST. The Bima variety showed the best vegetative growth, while the Tajuk variety produced the highest number of bulbs. A concentration of 550 ml/l gave the highest results in plant length, number of leaves, and wet and dry weight of the stover. **Conclusion:** Rabbit urine LOF concentration of 550 ml/l is effective in increasing the growth and yield of shallots, especially in the Bima variety.

Keywords: Shallots; Liquid Organic Fertilizer; Rabbit Urine

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Introduction

One of the contributors to the country's foreign exchange and possessing high economic value from the vegetable group commodity (horticulture) is the shallot (*Allium ascalonicum L.*) (Simatupang, 2022). Shallots are not only an essential ingredient in everyday cooking, but also a horticultural product with high demand in the domestic and global markets. One vital step to increase shallot production is selecting the right variety to be planted in the lowlands.

Not only the selection of varieties, but also improving cultivation techniques and the use of appropriate fertilizers, contribute significantly to increasing shallot production. The use of organic fertilizers has been proven to enhance soil fertility, improving the biological, physical, and chemical characteristics of the soil while also encouraging the activity of beneficial soil microorganisms that support plant growth (Archana & Seran, 2023). Liquid organic fertilizer is a solution from the results of the decomposition of organic materials originating from plant residues, agro-industrial waste, animal waste, and human waste that contains more than one nutrient and goes through a fermentation process (Warintan et al., 2021). One type of urine that can be used as an organic fertilizer liquid is rabbit urine.

According to research by Rosniawaty et al. (2018), rabbit urine can be utilized as an effective liquid organic fertilizer due to its high content of vital nutrients essential for plant

growth. Rabbit urine contains phosphorus, potassium, and nitrogen as the primary nutrients needed by plants. The nutrient content in rabbit urine includes a total nitrogen (N-total) of 2.11%, exceeding the levels in cow urine, which contains a total nitrogen (N-total) of 1.79%. In addition, rabbit urine contains 0.62% C-organic, 1.1% P2O5, and 0.5% K2O (Lestari et al., 2024).

In a previous study, Sembiring et al. (2017) discussed the effect of rabbit urine fertilizer doses on several tomato varieties, showing that rabbit urine can generally increase plant growth. This study highlights the potential of rabbit urine as a viable liquid organic fertilizer for various plant types, including shallots. Nurrohman et al. (2014) also stated that the fermentation of bitter extract and liquid rabbit feces, as a source of nutrients, can increase plant growth in hydroponic mustard greens cultivation. Research indicates that rabbit urine can serve as a valuable source of nutrients in various cultivation methods. Previous observations regarding the effect of rabbit urine on shallot growth have been carried out by Simamora et al. (2013).

In the study by Simamora et al. (2013), using a concentration of 0-250 ml/L, only the Bima Brebes variety of shallots was used. The results of this study showed that liquid organic fertilizer rabbit urine had a very significant effect on the parameters of plant height, number of shoots per clump, number of cloves per sample, wet weight of bulbs per sample, wet weight of bulbs per plot, dry weight of bulbs per sample and dry weight of bulbs per plot. According to previous researchers, Simamora et al. (2013) stated that this study can be continued to determine the optimal dose of rabbit urine LOF. The purpose of this study was to assess the interaction of the concentration of liquid organic fertilizer rabbit urine from three varieties of shallots on growth and yield. The results of this study are expected to provide the public with information on the optimal concentration of liquid organic fertilizer derived from rabbit urine for promoting the growth and yield of various red onion plant varieties.

Method

This research was conducted in Dusun Blere (7°26'35" S, 112°28'49" E), Sebani Village, Tarik District, Sidoarjo Regency, at an altitude of approximately 25 meters above sea level. This research was conducted from January to February 2024. The selected materials were red onion seeds of the Bima Brebes, Bauji, and Tajuk Varieties, obtained from UD. Sumber Makmur Mandiri. The method used was the Completely Randomized Design (CRD) method with two treatment factors. The first factor was the red onion variety (V), with three levels: V1 = Bima Brebes, V2 = Bauji, and V3 = Tajuk. The second factor was rabbit urine LOF (K) with five levels: K1 = 0 mL/L, K2 = 100 mL/L, K3 = 250 mL/L, K4 = 400 mL/L, and K5 = 550 mL/L. Both factors were combined to yield 15 combination treatments, which were repeated three times. Each experimental unit consisted of three individual plants, resulting in a total of 135 individual plants.

Procedure Parameters

The parameters observed were plant length (cm), number of leaves per clump (strand), number of bulbs per clump (fruit), bulb diameter, weight of wet onion stalks (grams), weight of dry onion stalks (grams), and bulb weight loss (%).

Plant Length

Observation of plant length was carried out by measuring the length of the shallot plant from the surface of the soil to the tip of the longest leaf using a ruler. Observation of plant length was carried out when the plant was 7 to 56 HST, with an observation interval of once every 7 days.

Number of Leaves per Cluster (Strand)

Observation of the number of leaves is done by counting the total number of shallot leaves, with the criterion that the leaves have grown ideally. Observation of the number of leaves is conducted from 7 HST to 56 HST, with an observation interval of 7 days.

Number of Bulbs per Cluster (Fruit)

Observation of the number of bulbs is done by counting the number of shallot bulbs. The calculation of the number of bulbs is done after harvest.

Bulb Diameter (mm)

The measurement of the bulb diameter is performed on all shallot bulbs after the drying process, which is conducted directly under sunlight from 06:00 to 12:00 for 10-14 days. Measurements are taken at the midpoint of the bulb using a caliper.

Weight

Weight of Wet Scaffold (g)

Weighing the wet shallot stalks is done after the bulbs are harvested. The criteria for the weight of the stalk are in the form of roots, bulbs, and leaves, which are first cleaned of dirt that sticks to them and then weighed using an analytical scale in grams.

Dry Stork Weight (g)

The dry weight of shallots was observed after harvest and after 10-14 days of drying, grouped by dose and repetition, and then dried under direct sunlight. Furthermore, the plants were cleaned of dirt and soil that had stuck to them, and then the roots, tubers, and leaves were weighed using an analytical scale in grams.

Tuber Weight Loss (%)

Observations were made on each sample. Tuber shrinkage parameters were calculated using the formula:

Weight Loss: BB – BK / BB x 100%

Information:
BB = Wet Weight
BK = Dry Weight

Data Analysis

ANOVA will analyze the data obtained to determine the effect of the treatment if the results of the diversity analysis indicate a real impact of the treatment. After that, carry out BNT (Smallest Real Difference) at a level of 5% with the formula (Rahmawati & Erina, 2020):

$$\text{BNT } \alpha = t\frac{\alpha}{2} db_g x \sqrt{\frac{KT\ Error}{Replication}}$$

Information:
α : Treatment Level
dbg : Degree of Error Freedom
t : Treatment
r : Replication
KTG : Center Square Error

Result and Discussion

Plant Length

Overall, Table 1. illustrates the impact of different shallot varieties and rabbit urine LOF concentrations on plant length at various growth stages. This provides essential information for determining the optimal varieties and fertilizer concentrations to enhance shallot growth.

Table 1. Average Length of Shallot Plants at 7-56 HST Effect of Rabbit Urine LOF Concentration and Varieties

Variety	Average Plant Length (cm)							
	Growth Time (HST)							
	7	**14**	**21**	**28**	**35**	**42**	**49**	**56**
Bima	7,87 c	25,71 b	35,80 b	43,67 b	46,13 b	45,63 b	49,22 c	50,61 b
Bauji	5,78 a	22,68 a	34,27 a	39,33 a	43,44 a	44,73 ab	47,46 b	49,07 b
Tajuk	7,33 b	22,49 a	33,38 a	39,11 a	42,68 a	43,02 a	45,34 a	46,88 a
BNT 5%	0,20	1,19	1,11	1,57	1,81	1,74	1,70	1,68
Rabbit Urine LOF Concentration (ml/l)	**Average Plant Length (cm)**							
	Growth Time (HST)							
	7	**14**	**21**	**28**	**35**	**42**	**49**	**56**
0	6,63a	24,48	34,00	40,19	43,72	43,48	46,70	47,98
100	6,64 a	22,61	34,26	40,28	43,83	44,67	46,56	47,78
250	6,94 b	23,76	34,39	40,59	43,80	44,56	47,19	49,11
400	7,19 b	23,48	34,85	40,54	44,09	44,69	47,85	49,33
550	7,56 c	23,80	34,91	41,93	44,98	44,93	48,41	50,06
BNT 5%	0,27	tn	tn	tn	tn	tn	tn	tn

Note: Numbers followed by the same letter in the same column for the same treatment show no significant difference in the 5% BNT test; tn = not significant (Source: Processed Data, 2024)

It is known that the length of shallot plants at the age of 7-56 HST with superior varieties, namely Bima (V1), increases yields every week. At the age of 7 HST, the Bima variety has shown superiority with an average plant length of 7.87 cm. This advantage continued in observations of the age of 14 HST with a length of 25.71 cm, 21 HST with a length of 35.80 cm, 28 HST with a length of 43.67 cm, 35 HST with a length of 46.13 cm, 42 HST with a length of 45.63 cm, 49 HST with a length of 49.22 cm, and reached its peak at 56 HST with an average plant length of 50.61 cm. The concentration of liquid organic fertilizer did not significantly affect the length of shallot plants at the age of 14-56 HST, except for the length of plants 7 HST, where the best concentration was 550 ml/l. This is similar to the research of Wuryantoro et al. (2022) on leafy onion plants, which found that the administration of liquid organic fertilizer can increase plant height due to the high nitrogen content in rabbit urine, which stimulates vegetative growth. Number of Leaves

There was an interaction between the treatment of various varieties and the concentration of liquid organic fertilizer of rabbit urine in the vegetative phase, namely in the parameter of the number of leaves aged 7-14 HST. An average temperature of 22.8°C-33.9°C is the ideal temperature for the growth of shallots, because temperatures that are too high or too low can inhibit leaf growth. The Bima Brebes variety demonstrated the best performance in terms of leaf number, attributed to its genetic adaptation and ability to utilize nutrients effectively. Liquid organic fertilizer derived from rabbit urine contains essential nutrients such as potassium (K), nitrogen (N), phosphorus (P), and other microelements that support plant growth (Viqri et al., 2021). Research by Nugrah et al. (2023) on shallots showed that increasing the concentration of liquid organic fertilizer of rabbit urine increased the availability of nitrogen and phosphorus in the soil, which directly contributed to the vegetative growth of the plant.

Table 2. Average Number of Leaves of Shallot Plants at 7 and 14 HST Effect of Rabbit Urine LOF Concentration and Types of Varieties

Variety	Average Number of Leaves (Strands) at Age 7 HST				
	Variety Concentration of Liquid Organic Fertilizer Rabbit Urine (ml/l)				
	0	**100**	**250**	**400**	**550**
Bima	6,56 de	6,56 de	6,22 cde	7,56 ef	8,78 f
Bauji	2,44 ab	1,78 ab	1,67 a	2,00 ab	2,22 ab
Tajuk	5,22 cd	6,78 de	3,44 bc	6,89 de	4,56 c
BNT 5%	**1,70**				
Variety	**Average Number of Leaves (Strands) at Age 14 HST**				
	Concentration of Liquid Organic Fertilizer Rabbit Urine (ml/l)				
	0	**100**	**250**	**400**	**550**
Bima	17,44 ef	17,56 ef	17,22 def	18,56 fg	19,67 g
Bauji	12,44 ab	10,78 a	11,11 a	12,22 ab	12,22 ab
Tajuk	15,33 cd	17,67 fg	13,78 bc	17,89 fg	15,56 cde
BNT 5%	**2,06**				

Source: Processed Data, 2024

It is known that the provision of liquid organic fertilizer from rabbit urine can increase the number of leaves of shallot plants at the age of 7 HST. In the Bima variety, the provision of liquid organic fertilizer from rabbit urine at a concentration of 550 ml/L yielded the highest number, with an average value of 8.78, but was not significantly different from the provision of a concentration of 400 ml/L, with an average value of 7.56. Table 2 shows that the provision of liquid organic fertilizer from rabbit urine can increase the number of leaves of shallot plants at the age of 14 HST. In the Bima variety, the provision of liquid organic fertilizer from rabbit urine at a concentration of 550 ml/L yielded the highest number, with an average value of 19.67. Still, it was not significantly different from the provision of a concentration of 400 ml/L, with an average value of 20.62, and was not substantially different from the Tajuk variety at concentrations of 100 ml/L and 400 ml/L. Sari et al., (2019) showed that the more leaves formed, the more photosynthesis results will increase so that food reserves will increase so that they can be used as a substrate in the respiration process to produce the energy needed in the growth and development of plants so that the large number of leaves can support good generative growth in bulb weight and number of bulbs.

Table 3. Average Number of Leaves of Shallot Plants at 21-56 HST Effect of Rabbit Urine LOF Concentration and Types of Varieties

Variety	**Average Number of Leaves (Blades)**					
	Growth Time (HST)					
	21	**28**	**35**	**42**	**49**	**56**
Bima	32,09 b	39,60 b	46,47 b	53,44 b	61,87 b	66,49 b
Bauji	19,71 a	26,31 a	29,69 a	36,44 a	42,64 a	48,24 a
Tajuk	29,51 b	37,71 b	45,69 b	50,91 b	57,42 b	62,36 b
BNT 5%	**3,43**	**5,37**	**5,10**	**6,37**	**4,74**	**4,488**
Rabbit Urine LOF Concentration (ml/l)	**Average Number of Leaves (Blades)**					
	Growth Time (HST)					
	21	**28**	**35**	**42**	**49**	**56**
0	24,85	31,96	37,89	40,44	50,26	55,44
100	27,15	34,78	40,37	46,63	53,00	57,74
250	26,19	35,67	40,19	47,30	53,52	58,70
400	29,15	35,52	40,67	48,48	55,26	60,89
550	28,19	34,78	43,96	51,81	57,85	62,37
BNT 5%	**tn**	**tn**	**tn**	**tn**	**tn**	**tn**

Source: Processed Data, 2024

Table 3. demonstrates that the variety treatment has a highly significant effect on the length of shallot plants. The Bima variety (V1) showed the best results with a consistent increase in the number of leaves every week. The average number of leaves on the Bima variety shallot plants peaked at the age of 56 days with an average plant length of 66.49 cm. A concentration of 550 ml/l of water is the best to support the growth of the number of leaves of shallot plants. At the age of 56, HST reached an average of 62.37. Research by Nasruddin et al. (2021) on shallot plants demonstrated that plants treated with LOF showed higher efficiency in fertilizer use compared to inorganic fertilizers. Meanwhile, research by Qalby et al. (2019) has proven that the use of liquid organic fertilizer at the right concentration can increase the number of leaves in horticultural plants, including shallots, due to the increased availability of macro- and micro-nutrients that are essential for leaf growth.

Number of Bulbs

Table 4 illustrates the effect of rabbit urine LOF concentration on the average number of bulbs in various shallot varieties.

Table 4. Average Number of Bulbs in Shallot Plants

Variety	Average Number of Tubers (Fruit)
Bima	9,87 ab
Bauji	9,13 a
Tajuk	11,80 b
BNT 5%	**1,62**
Rabbit Urine LOF Concentration (ml/l)	**Average Number of Tubers (Fruit)**
0	8,22 a
100	11,11 b
250	9,89 ab
400l	10,89 b
550	11,22 b
BNT 5%	**2,09**

Source: Processed Data, 2024

The results of the study prove that the variety treatment has a significant effect on the number of shallot bulbs. The Tajuk variety showed the highest results, with several bulbs of 11.80, which is significantly more than those of other varieties. The concentration of liquid organic fertilizer from rabbit urine at 550 ml/l produced a very high number of bulbs, which was 11.22, while the lowest result was at 0 ml/l, with several bulbs of 8.22. These results are supported by research by Suharni et al. (2019) on corn plants, which shows that the use of liquid organic fertilizer increases the number of bulbs due to enhanced enzymatic and soil microbial activity, contributing to the growth and development of the bulbs.

Bulb Diameter

The average diameter of shallot bulbs when given rabbit urine can be observed in Table 5.

Table 5. Average Bulb Diameter

Variety	Average Tuber Diameter (mm)
Bima	24,22 b
Bauji	19,98 a
Tajuk	23,32 b
BNT 5%	**2,23**
Rabbit Urine LOF Concentration (ml/l)	**Average Tuber Diameter (mm)**
0	22,85
100	21,09
250	23,19
400	21,86
550	23,53
BNT 5%	**tn**

Source: Processed Data, 2024

The results of the study prove that the variety treatment has a very significant effect on the number of shallot bulbs. The Bima variety has the largest bulb diameter among other varieties, with an average of 24.22 mm, followed by 23.32 mm for the Tajuk variety and 19.98 mm for the Bauji variety. Meanwhile, the treatment of liquid organic fertilizer with a concentration of rabbit urine had a significant effect on the diameter of the shallot bulbs, with a concentration of 550 ml/L showing the best results, at an average of 23.53 mm. Research by Sihombing et al. (2023) on shallot plants proved that the application of liquid organic fertilizer rich in nitrogen and potassium can increase the bulb diameter because these two elements are essential for the formation and enlargement of the bulbs.

Wet Stove Weight

The provision of rabbit urine had a significant effect on the weight of the wet stove. The weight of the damp stove is listed in Table 6.

Table 6. Average Weight of Wet Stove

Variety	Average Wet Stove Weight (g)
Bima	100,33 b
Bauji	81,93 a
Tajuk	96,19 b
BNT 5%	**12,93**
Rabbit Urine LOF Concentration (ml/l)	**Average Wet Stove Weight (g)**

0	60,67 a
100	95,42 b
250	93,92 b
400	99,88 bc
550	114,20 c
BNT 5%	**16,70**

Source: Processed Data, 2024

The results of the study prove that the variety treatment has a significant effect on the weight of the wet stove of shallot plants. The best variety treatment was the Bima variety with the highest average damp weight of 100.33 grams, and the lowest average was Bauji at 81.93 grams. The treatment of the liquid organic fertilizer concentration of rabbit urine had a very significant effect on the wet weight of shallot bulbs. A concentration of 550 ml/l showed the best results with an average value of 114.20 grams. Setiyowati et al. (2018) found that increasing the concentration of liquid organic fertilizer could increase the weight of the bulb due to increased nutrient availability, which supports vegetative growth and dry matter accumulation.

Dry Bulb Weight

The provision of rabbit urine had a significant effect on the weight of the dry bulb. The weight of the dry bulb is listed in Table 7.

Table 7. Average Dry Bulb Weight

Variety	**Average Dry Weight of Stove (g)**
Bima	75,94 b
Bauji	52,99 a
Tajuk	67,48 b
BNT 5%	**10,60**
Rabbit Urine LOF Concentration (ml/l)	**Average Dry Weight of Stove (g)**
0	43,75 a
100	64,03 b
250	65,39 b
400	70,95 bc
550	83,22 c
BNT 5%	**13,69**

Source: Processed Data, 2024

The results of the study demonstrated that the treatment with various concentrations of liquid organic fertilizer derived from rabbit urine had a highly significant effect on the dry weight of shallot plants. The Bima variety had the highest dry weight of 75.94 grams, but this difference was not statistically significant compared to the Tajuk variety. The average dry weight of the bulbs with the highest concentration of liquid organic fertilizer, rabbit urine, was 550 ml/l, with a weight of 83.22 grams. However, this concentration was not significantly different from the concentration of 400 ml/l, which produced 70.95 grams.

Bulb Weight Loss

The results showed that the variety had better storage capacity, providing additional benefits for farmers who wanted to store their harvest before selling it, while the concentration of liquid organic fertilizer rabbit urine did not affect it. This suggests that liquid organic fertilizer, such as rabbit urine, plays a more significant role in the active growth phase than in its effect after harvest. The Bauji variety had the highest bulb weight loss value of 0.36 grams. In the treatment of liquid organic fertilizer with a rabbit urine concentration of 100 ml/L, the highest bulb weight loss value was 0.34 grams. The average results of tuber weight loss with the provision of rabbit urine are presented in Table 8.

Table 8. Average Bulb Weight Loss

Variety	**Average Weight Loss of Tuber (g)**
Bima	0,24 a
Bauji	0,36 c
Tajuk	0,30 b
BNT 5%	**0,05**

Rabbit Urine LOF Concentration (ml/l)	Rata-rata Susut Bobot Umbi (g)
0	0,28
100	0,34
250	0,31
400	0,30
550	0,27
BNT 5%	**tn**

Source: Processed Data, 2024

The Bima variety consistently shows the best performance in terms of wet stalk weight, dry stalk weight, tuber diameter, number of leaves, and plant length. The Tajuk variety is superior in the number of tubers produced. The influence of this variety is crucial to consider in efforts to enhance the yield and quality of shallot production. According to Sinaga et al. (2021), selecting the right variety is vital for shallot cultivation, as each variety responds differently to environmental conditions and agronomic treatments. Superior varieties tend to have higher yield potential.

Conclusions

Overall, this study demonstrated that the use of rabbit urine LOF, particularly at a concentration of 550 ml/L, yielded excellent results in enhancing the growth and production of shallot plants in both vegetative and generative parameters. The Bima variety showed a fantastic response to the application of rabbit urine LOF, except for the number of bulbs parameter, where the Tajuk variety was superior, and the weight loss parameter, where the Bauji variety showed the highest value. This study offers valuable guidance for shallot farmers on selecting the optimal variety and concentration of rabbit urine LOF to enhance yields.

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Declaration statement

The authors report no potential conflict of interest.

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