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Increasing Red Onions (*Allium ascalonicum* L.) Growth and Yield by Providing Goat Urine LOF Concentration and Paclobutrazol Retardant

Wanda Mudhalifah[1], Didik Utomo Pribadi[1], Sukendah[1,*]

Abstract
Shallots (*Allium ascalonicum* L.) are an economically important horticultural crop that contributes to national consumption, farmer income, and foreign exchange earnings. This study aimed to determine the optimal concentrations of goat urine liquid organic fertilizer (LOF) and the plant growth regulator (PGR) paclobutrazol for enhancing shallot growth and yield. The experiment was conducted using a factorial arrangement in a Split-Plot Design with two factors and three replications. The main plot consisted of four levels of goat urine LOF (0, 100, 150, and 200 mL/L), while the subplot consisted of four levels of paclobutrazol (0, 100, 250, and 300 ppm). The results showed significant interactions between goat urine LOF and paclobutrazol on leaf and tiller numbers. Application of goat urine LOF at 100 mL/L produced the largest bulb diameter, whereas the absence of paclobutrazol (0 ppm) resulted in the greatest plant height. These findings indicate that moderate concentrations of goat urine LOF, combined with limited or no paclobutrazol application, can optimize shallot growth and yield.

Keywords: Concentration, Goat Urine, Growth Retardant, Red Onion, Split Plot Design (RPT)

1. Introduction

Shallots (*Allium ascalonicum* L.) are a vegetable commodity with high economic value, contributing to national consumption, farmer income, and foreign exchange earnings. In Indonesia, shallots are a key horticultural crop with diverse benefits. Shallots can be propagated either from seed or by planting clusters of young bulbs in nutrient-rich soil. The growing season varies depending on climate and cultivar, but typically lasts three to four months (Nasution et al., 2024). In East Java, particularly in Madiun Regency, shallot production has declined, which is attributed to the inadequate application of cultivation and fertilization technologies. Fertilization practices in the region rely heavily on chemical inputs, resulting in a gradual decline in soil fertility due to excessive and continuous use of inorganic fertilizers. As a result, shallot plants become more susceptible to pests, diseases, and extreme weather, highlighting the need to improve cultivation techniques and optimize soil function to sustain production. Efforts to enhance shallot productivity and soil fertility include the application of liquid organic fertilizer (LOF).

One of the liquid organic fertilizers used in this study is a fertilizer based on goat urine. Goat urine is abundantly available but remains underutilized in several regions, including Pucanganom Village, Kebonsari District, Madiun Regency, where it can serve as an alternative source of liquid organic fertilizer. Sitepu (2019) reported that applying goat urine liquid organic fertilizer at 100 mL/L increased shallot growth and yield, particularly in plant height, bulb number, and fresh weight. Similarly, Sidik et al. (2023) found that paclobutrazol application significantly influenced plant height, leaf number, stalk biomass, and production per hectare. However, previous studies did not specifically examine the combined effects of goat urine liquid organic fertilizer and paclobutrazol. The present study addresses this gap by directly investigating their interaction on shallot yield, with the expectation of providing valuable insights for increasing shallot production.

Liquid organic fertilizers can reduce dependence on chemical fertilizers while creating new economic

*Correspondence: sukendah@upnjatim.ac.id
1) Universitas Pembangunan Nasional “Veteran” Jawa Timur - Jl. Rungkut Madya, Gn. Anyar, Kec. Gn. Anyar, Surabaya, Jawa Timur 60294, Indonesia

opportunities for local communities. Goat urine–based liquid fertilizer acts rapidly because its nutrients are pre-digested and readily absorbed through both roots and leaves (Syahputra, 2022). In addition to organic fertilizers, plant growth regulators (PGRs) can be employed to enhance shallot productivity and quality. Among these, paclobutrazol is a growth-retarding PGR that suppresses gibberellin activity in the upper plant regions, thereby reducing cell division and directing more photosynthates to lower tissues. As a result, vegetative growth in the upper plant parts is suppressed, indirectly promoting tuber formation (Salta et al., 2023).

2. Material and Methods

This research was conducted in Pucanganom Village, Kebonsari District, Madiun Regency, East Java, at coordinates 7°45′30.6″S and 111°29′45.6″E, with an altitude of approximately 67 meters above sea level. The tools used were hoes, meters, rulers, analytical scales, spray tanks, hand sprayers, shovels, knives, buckets, calipers, watering cans, plant labels, jerry cans, funnels, cameras, and stationery. The materials used were shallot bulbs of the Tajuk variety, water, soil, EM4, brown sugar, goat urine, growth regulator Paclobutrazol, insecticide Delta 25 EC, and fungicide Antracol 70 WP.

This study is a factorial experiment arranged using a Split-Plot Design (RPT). This experiment consists of 2 factors and is repeated 3 times. The first factor is the concentration of goat urine liquid organic fertilizer, with the main plot consisting of four treatment levels: without goat urine LOF (control), 100 ml/liter, 150 ml/liter, and 200 ml/liter. The second factor is the concentration of Paclobutrazol retardant, consisting of four treatment levels: without Paclobutrazol (control), 100 ppm, 250 ppm, and 300 ppm.

The parameters observed in this study included plant length (cm), number of leaves (strands), number of tillers, wet weight of tubers per clump (g), dry weight of tubers per clump (g), wet weight of tubers per unit area (kg), dry weight of tubers per unit area (kg), tuber water content (%), tuber diameter (mm), and number of tubers.

The observation results were analyzed statistically using fingerprint analysis—variety (ANOVA) based on Split Plot Plan (RPT). If the results show a real influence, it will be continued with a test of honest significant difference (HSD) at the 5% level using Microsoft Excel 2013. The research stages are presented in the following flow chart:

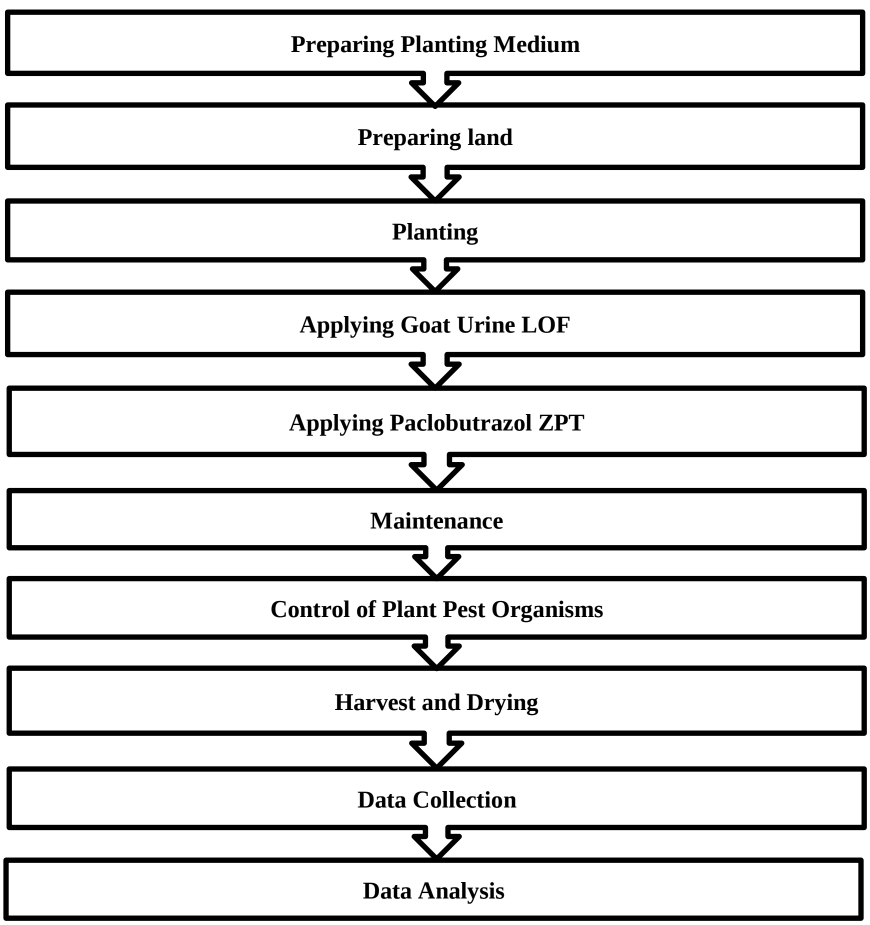

Figure 1. Research Flow Diagram

3. Results and Discussion

3.1. Plant Length

The data analysis results indicated that the combination of goat urine LOF concentration and paclobutrazol did not significantly affect the length of shallot plants between 14 and 42 days after planting (HST). The average lengths of shallot plants under individual treatments of goat urine, LOF concentration, and paclobutrazol are presented in Table 1.

Table 1 Average Length of Shallot Plants Due to Single Treatment of Goat Urine LOF Concentration and Paclobutrazol at 14-42 HST

Treatment	**Average Length of Shallot Plants (cm)**				
	14 HST	**21 HST**	**28 HST**	**35 HST**	**42 HST**
Goat Urine LOF Concentration (ml/liter)					
0	20.01±0.23	26.19±0.35	26.81±0.30	27.00±0.24	26.14±0.19
100	20.08±0.09	26.53±0.32	27.22±0.26	26.83±0.20	26.14±0.20
150	20.14±0.09	26.25±0.22	26.97±0.16	26.22±0.26	26.06±0.25
200	20.33±0.14	26.42±0.15	27.33±0.11	26.42±0.30	25.83±0.19
BNJ 5%	tn.	tn.	tn.	tn.	tn.
Paclobutrazol Concentration (ppm)					
0	20.14±0.13	26.83±0.19 b	27.33±0.19	27.28±0.17 b	
		25.92±0.26 a		26.25±0.26 a	
100	20.08±0.12	26.22±0.23 ab	26.83±0.24	26.14±0.28 a	
		26.42±0.33 ab		26.81±0.22 ab	26.47±0.16 b
250	20.14±0.12		26.95±0.19		25.86±0.19 ab
					25.56±0.18 a
300	20.21±0.21		27.22±0.26		26.28±0.21 ab
BNJ 5%	Mr.	0.85	tn.	0.91	0.63

Description: Numbers followed by the same letter in the same column and treatment. The same show, no real difference on test BNJ 5%. tn = not significant

Table 1 shows that at 21 days after planting, there was no significant difference in the length of shallot plants between those given paclobutrazol and those not given paclobutrazol, especially at concentrations of 250 ppm and 300 ppm. However, there was a significant difference in the length of plants not treated with paclobutrazol (control) and those treated with paclobutrazol at a concentration of 100 ppm. At 35 days after planting, there was a significant difference in the length of shallot plants not given paclobutrazol (control) and those given paclobutrazol at concentrations of 100 ppm and 250 ppm. However, there was no significant difference in the length of shallot plants given paclobutrazol, especially at concentrations of 100 ppm, 250 ppm, and 300 ppm. At 42 days after planting, there was no significant difference in the length of shallot plants between those treated with paclobutrazol and those not treated, especially at concentrations of 100 ppm and 300 ppm. However, there was a significant difference in the length of plants that were not treated with paclobutrazol (control) and those treated with paclobutrazol at a concentration of 250 ppm.

The concentration of paclobutrazol used in this study showed an effect; the higher the concentration of paclobutrazol used, the more inhibited the plant's growth was. This finding aligns with research by Aldini et al. (2022), showing that paclobutrazol plays a role in inhibiting leaf growth and stem elongation. This result is evident at the ages of 21 HST, 35 HST, and 42 HST. The length of shallot plants that were not given paclobutrazol experienced a significant increase in size. However, concentrations of 100 ppm, 250 ppm, and 300 ppm showed the effect of paclobutrazol on plant length; the higher the concentration of paclobutrazol, the shorter the length of the shallot plants.

3.2. Number of Leaves

The data analysis results show that the combination treatment of goat urine LOF and paclobutrazol concentrations had an interactive effect on the number of leaves of shallot plants at 42 days after planting (HST). The average number of leaves in shallot plants under the combined treatments of goat urine LOF and paclobutrazol concentrations is presented in Table 2.

Table 2 shows that the number of leaves on shallot plants without goat urine LOF treatment did not show a significant difference between paclobutrazol treatment concentrations. The goat urine LOF concentration of 100 ml/liter and paclobutrazol concentration of 100 ppm resulted in 15.11 strands of leaves, which was significantly different from the 7.67 strands of leaves observed at the goat urine LOF concentration of 200 ml/liter and paclobutrazol concentration of 100 ppm. The goat urine LOF concentration of 150 ml/liter did not differ significantly between paclobutrazol treatments. The goat urine LOF concentration of 200 ml/L was substantially different from the paclobutrazol concentration of 100 ppm, but had no significant effect on the other paclobutrazol treatment concentrations. This result indicates that the combination of a goat urine LOF concentration of 100 ml/L and a paclobutrazol concentration of 100 ppm yielded the best results in terms of the number of shallot leaves at 42 days after planting. The combined effect of goat urine LOF and paclobutrazol is not linear, meaning that increasing the concentration does not always increase leaf number; rather, it inhibits and decreases leaf number, although there are numerical variations. However, if not supplemented with goat urine LOF, paclobutrazol is also ineffective because it has no inhibitory effect.

Table 2 Average Number of Shallot Leaves Due to Single Treatment of Goat Urine LOF Concentration and Paclobutrazol at 42 Days After Planting

Plant Age (HST)	Goat Urine LOF Concentration (ml/liter)	Number of leaves (blades)			
		Paclobutrazol Concentration (ppm)			
		0	100	250	300
42	0	13.78 ±1.63 ab	12.44 ±2.37 ab	12.33 ±0.57 ab	11.78 ±1.25 ab
	100	11.34 ±0.88 ab	15.11 ±1.09 b	9.55 ±1.68 ab	14.34 ±1.20 ab
	150	13.00 ±1.83 ab	10.44 ±1.06 ab	12.78 ±1.09 ab	11.44 ±0.88 ab
	200	13.67 ±0.83 ab	7.67 ±1.02 a	12.22 ±0.48 ab	8.89 ±1.34 ab
	BNJ 5%	7.13			

Description: Numbers followed by the same letter in the same column and treatment. The same shows no real difference on test BNJ 5%

This result is consistent with research by Sugiharto et al. (2022), which indicates that paclobutrazol functions to inhibit gibberellin synthesis, thereby slowing stem elongation but encouraging lateral growth, such as the development of leaves and shoots. Growth energy is not directed towards stem elongation; thus, it can increase the number of photosynthetic organs, one of which is the leaf. In this study, plants treated with paclobutrazol showed a greater number of leaves compared to the control (without paclobutrazol). This result indicates that paclobutrazol is effective in improving the architecture of shallot plants, making them more compact and leafy, which potentially increases the plant's photosynthetic ability.

3.3. Number of Offspring

Results data analysis show that the combination treatment, involving the concentration of goat urine LOF and paclobutrazol, exhibited an interaction on the number of shallot seedlings at 35 days after planting. The average number of shallot seedlings in the combination treatment concentration of Goat urine LOF and paclobutrazol is presented in Table 3.

Table 3 Average Number of Shallot Plant Offshoots Due to Single Treatment of Goat Urine LOF Concentration and Paclobutrazol at 35 Days After Planting

Plant Age	Goat Urine LOF Concentration (ml/liter)	Number of Offspring (Children)			
		Paclobutrazol Concentration (ppm)			
		0	100	250	300
35	0	5.78 ±0.29 ab	5.45 ±0.62 ab	4.55 ±0.22 a	5.33 ±0.51 ab
	100	5.00 ±0.19 ab	6.56 ±0.48 b	5.00 ±0.19 ab	4.89 ±0.29 a
	150	4.78 ±0.29 a	4.89 ±0.11 ab	5.33 ±0.50 ab	4.89 ±0.40 ab
	250	5.11 ±0.29 ab	4.78 ±0.59 a	4.56 ±0.11 a	4.34 ±0.33 a
	BNJ 5%	1.76			

Description: Numbers followed by the same letter in the same column and row. The same show, with no real difference; on test, BNJ is 5%.

Table 3 shows that the number of shallot plant tillers without goat urine LOF treatment did not differ significantly between paclobutrazol treatment concentrations. The goat urine LOF concentration of 100 ml/liter yielded the highest result significantly at a paclobutrazol concentration of 100 ppm, namely 6.56 tillers, which was significantly different from the results obtained at other paclobutrazol concentrations. The goat urine LOF concentration of 150 ml/liter did not differ considerably between paclobutrazol treatment concentrations. The goat urine LOF concentration of 250 ml/liter did not differ significantly from the control. This finding suggests that there is an optimal interaction between the two treatments, which is synergistic at medium concentrations, but not at high concentrations.

The interaction between goat urine LOF and paclobutrazol treatment showed good synergy. The nutrients provided by LOF support metabolic processes and cell division, while paclobutrazol regulates growth, ensuring it does not focus on stem elongation. According to Siswadi et al. (2022, the combination of organic fertilizer and PGR can provide the best results in increasing vegetative parameters, such as the number of leaves and the number of tillers, due to the balance between nutrition and hormonal regulation. Thus, applying the right combination of goat urine LOF and paclobutrazol concentrations can enhance the vegetative growth potential of the Tajuk variety of shallots, particularly in terms of leaf number and tiller count, which are key indicators of successful cultivation.

3.4. Tuber Diameter

Results analysis data show that the treatment combination of goat urine LOF and paclobutrazol did not provide a significant interaction on the diameter of the shallot bulbs. Meanwhile, the treatment of goat urine LOF concentration alone had an effect. Which real to diameter shallot bulbs? The average diameter value of shallot bulbs in the treatment concentration of LOF goat urine and paclobutrazol is presented in Table 4.

Table 4 Average Diameter of Shallot Bulbs Due to Treatment with Goat Urine LOF and Paclobutrazol Concentrations

Treatment	Tuber Diameter (mm)
Goat Urine LOF Concentration (ml/liter)	
0	29.72±0.38 b
100	30.25±0.25b
150	22.82±0.42 a
250	22.56±0.54 a
BNJ 5%	1.59
Paclobutrazol Concentration (ppm)	
0	26.15±1.26
100	26.26±1.28
250	26.61±1.01
300	26.33±1.12
BNJ 5%	tn.

Description: Numbers followed by the same letter in the same column and treatment. The same show, no real difference in test BNJ 5%. tn = not significant.

Table 4 shows that the diameter of the shallot bulbs without goat urine LOF treatment was 29.72 mm. This diameter was not significantly different from that treated with goat urine LOF at a concentration of 100 ml/liter (30.25 mm), but was significantly different from that treated with goat urine LOF at concentrations of 150 ml/liter (22.82 mm) and 250 ml/liter (22.56 mm). The highest bulb diameter was obtained at a concentration of 100 ml/L, namely 30.25 mm, followed by the control without goat urine LOF treatment, which was 29.72 mm. Meanwhile, the lowest bulb diameter was obtained at a concentration of 250 ml/liter, namely 22.56 mm. This finding indicates that increasing the concentration of goat urine LOF actually decreases the bulb diameter.

The single paclobutrazol concentration treatment, which had no significant effect, produced the highest average value at a concentration of 250 ppm, namely 26.61 mm, while the lowest value was observed in the treatment without paclobutrazol, at 26.15 mm. All treatments produced a relatively uniform bulb diameter of around 26 mm. This result indicates that paclobutrazol at a concentration range of 0-300 ppm does not significantly affect the diameter of shallot bulbs, so the greatest effect on bulb diameter comes from the goat urine LOF treatment, not paclobutrazol.

The single factor of goat urine liquid organic fertilizer (LOF) concentration significantly affected bulb diameter, wet weight, dry weight, and number of bulbs. The results showed that the application of goat urine liquid organic fertilizer (LOF) did not significantly affect the length of plants and the number of leaves in the Tajuk variety of shallots. Several factors, including the quality of the fertilizer, the characteristics of the variety, and environmental conditions, may contribute to this finding. One cause is the suboptimal availability of nutrients in goat urine LOF. Goat urine LOF generally contains nitrogen in the form of ammonia or urea, which requires a complete fermentation process to convert into a form available to plants (nitrate). The goat urine fermentation in this study was conducted for only 7 days and had not yet reached the optimal level of decomposition. If the fermentation process is not optimal, the plant cannot efficiently absorb the nutrients(Rasmito et al., 2019). In addition, the physiological characteristics of the Tajuk variety also play a role. The Tajuk variety of shallots tends to have relatively stable vegetative growth, meaning the number of leaves and plant height do not easily change drastically, especially in the early vegetative phase. Plant energy is more focused on bulb formation after the leaf phase is reached (Muliana et al., 2024). Shallots typically direct their energy toward bulb formation after a short vegetative phase. Even when given LOF, plants may still divert energy to bulb formation rather than increasing height or leaf number.

3.5. Wet Weight of Shallot Bulbs

Results analysis of the variety show that the treatment combination of goat urine LOF and paclobutrazol did not provide a significant interaction on the wet weight of shallot bulbs. At the same time, the concentration treatment with Goat urine LOF alone provides an influence on the real-to-wet weight of shallot bulbs. The average wet weight of shallot bulbs in the treatment concentration of LOF goat urine and paclobutrazol is presented in Table 5.

Table 5 Average Fresh Weight of Shallot Plants Due to Treatment with Goat Urine LOF Concentration and Paclobutrazol

Treatment	Wet Weight of Shallot Bulbs (grams)
Goat Urine LOF Concentration (ml/liter)	
0	147.48±3.60 b
100	143.65±1.31 b
150	108.07±2.22 a
250	106.18±2.16 a
BNJ 5%	16.69
Paclobutrazol Concentration (ppm)	
0	129.28±7.39
100	127.37±6.10
250	124.96±5.58
300	123.77±5.89
BNJ 5%	tn.

Description: Numbers followed by the same letter in the same column and row. The same show, No different real on test BNJ 5%. tn = not significant.

Table 5 shows that the wet weight of shallot bulbs without goat urine LOF treatment was 147.48 g. This wet weight was not significantly different from that treated with goat urine LOF at a concentration of 100 ml/liter (143.65 g), but was significantly different from that treated with goat urine LOF at a concentration of 150 ml/liter (108.07 g) and 250 ml/liter (106.18 g). The highest wet weight was obtained in the treatment without paclobutrazol, at 147.48 g, while the lowest wet weight was obtained at a concentration of 250 ml/L, at 106.18 g. This shows that increasing goat urine LOF above 100 ml/liter can significantly reduce the wet weight of the bulbs.

The single paclobutrazol concentration treatment that had no significant effect produced the highest average value, 129.28 g, in the treatment without paclobutrazol, while the lowest value was obtained at a concentration of 300 ppm, 123.77 g. This result indicates that paclobutrazol did not have a significant effect on the wet weight of shallot bulbs, although a slight downward trend was observed at higher concentrations.

The application of goat urine liquid organic fertilizer (LOF) at various concentrations significantly affected the yield components of the Tajuk variety of shallots, namely wet weight, dry weight, and the number of bulbs per clump. This finding indicates that although vegetative growth was not significantly affected, the generative components and yield responded positively to the LOF treatment. One of the main reasons is the nitrogen, phosphorus, and potassium content of goat urine LOF. Nitrogen plays a crucial role in photosynthesis and the formation of carbohydrate compounds, which are then transported to the bulb as food reserves. The provision of adequate macronutrients in this study was shown to play a significant role in supporting the growth and yield of shallots. This finding was evident in the increased activity of bulb formation, which in turn affected bulb weight. This result aligns with research by Iqbal and Ulpah (2022), showing that increased photosynthetic activity supports the formation of larger and heavier bulbs. Phosphorus also plays a crucial role in energy (ATP) synthesis and is essential for cell division and growth in the bulb. Potassium, meanwhile, helps transport photosynthetic products to storage organs, improving the quality and weight of the harvest.

3.6. Dry Weight of Red Onion Bulbs

Results analysis data show that the treatment combination of goat urine LOF and paclobutrazol did not provide a significant interaction on the dry weight of shallot bulbs. Meanwhile, the treatment of goat urine LOF concentration alone influenced the real dry weight of shallot bulbs. The average dry weight of shallot bulbs in the treatment concentration of LOF goat urine and paclobutrazol is presented in Table 6.

Table 6 shows that the dry weight of shallot bulbs that were not treated with goat urine LOF was 50.58 g. This dry weight was not significantly different from that treated with goat urine LOF at a concentration of 100 ml/liter (50.21 g), but was significantly different from that treated with goat urine LOF at a concentration of 150 ml/liter (39.36 g) and 250 ml/liter (36.83 g). The highest dry weight of shallot bulbs was obtained in the treatment without goat urine LOF, namely 50.58 g, while the lowest dry weight of shallot bulbs was obtained at a concentration of 250 ml/liter, namely 36.83 g. This finding suggests that excessively high concentrations of goat urine LOF can be detrimental to growth, as evidenced by a decrease in the dry weight of shallot bulbs. According to Sutriana et al. (2023), Liquid organic fertilizer contains many macronutrients, micronutrients, hormones, and amino acids that are essential for plant growth. Furthermore, liquid organic fertilizers contain several microorganisms that improve soil fertility, supporting plant growth and development, including increased dry weight.

The single paclobutrazol concentration treatment that did not significantly affect the yield resulted in the highest average value at a concentration of 250 ppm, specifically 45.42 g, while the lowest value was obtained at a concentration of 300 ppm, specifically 42.92 g. This result suggests that paclobutrazol has no significant effect on the dry weight of shallot bulbs, although variations in the numbers are observed. This finding differs from research conducted by Sidik et al. (2023), which stated that the application of paclobutrazol can increase the yield of dry stalk weight per plant. This difference is attributed to the soil characteristics at the research location.

Table 6 Average Dry Weight of Shallot Bulbs Due to Treatment with Goat Urine LOF and Paclobutrazol Concentrations

Treatment	Dry Weight of Shallot Bulbs (grams)
Goat Urine LOF Concentration (ml/liter)	
0	50.58±0.78 b
100	50.21±0.47 b
150	39.36±2.39 a
250	36.83±0.83 a
BNJ 5%	6.56
Paclobutrazol Concentration (ppm)	
0	44.04±2.09
100	44.61±2.19
250	45.42±2.62
300	42.92±2.23
BNJ 5%	tn.

Description: Numbers followed by the same letter in the same column and row. The same show, No different real on test BNJ 5%. tn = not significant.

3.7. Wet Weight of Red Onion Bulbs Per Unit Area (1 m 2)

Results data analysis show that the single factor concentration of goat urine LOF and Paclobutrazol did not have a significant effect on the wet weight of shallots per unit area. The average value of the wet weight of shallot bulbs per unit area in the treatment concentration of LOF goat urine and paclobutrazol is presented in Table 7.

Table 7 Average Fresh Weight of Shallot Bulbs Per Unit Area Due to Single Treatment of Goat Urine LOF Concentration and Paclobutrazol

Treatment	Wet Weight of Bulbs Per Unit Area (kg)
Goat Urine LOF Concentration (ml/liter)	
0	5.30±0.13 b
100	5.17±0.05 b
150	3.89±0.08 a
250	3.82±0.08 a
BNJ 5%	0.60
Paclobutrazol Concentration (ppm)	
0	4.65±0.27
100	4.58±0.22
250	4.49±0.20
300	4.45±0.21
BNJ 5%	tn.

Description: Numbers followed by the same letter in the same column and row. The same shows no real difference on test BNJ 5%. tn = not significant.

Table 7 shows that the wet weight of shallot bulbs per unit, which was not treated with goat urine LOF, was 5.30 kg. This weight was not significantly different from that given by goat urine LOF treatment at a concentration of 100 ml/liter, namely 5.17 kilograms, but was significantly different from that given by goat urine LOF treatment at a concentration of 150 ml/liter (3.89 kg) and 250 ml/liter (3.82 kg). The highest wet weight of shallot bulbs per unit was obtained in the treatment without goat urine LOF, namely 5.30 kilograms, while the lowest dry weight of shallot bulbs was obtained at a concentration of 250 ml/liter, namely 3.82 g. This result suggests that excessively high concentrations of goat urine LOF can be detrimental to growth, as evidenced by a decrease in the dry weight of shallot bulbs.

The single paclobutrazol concentration treatment that had no significant effect produced the highest average value, namely 4.65 kg, without paclobutrazol concentration. The lowest value was obtained at a concentration of 300 ppm, namely, 4.45 kg. This finding indicates that paclobutrazol has no significant effect on the fresh weight of shallot bulbs per unit area, although variations in the numbers are observed. This finding differs from the research conducted by Ayu et al. (2022), which showed that treating shallot plants with a growth regulator concentration of 45 mg/l Paclobutrazol had a significant effect on the fresh weight of the bulbs. This result demonstrates that excessively high concentrations can inhibit growth too strongly, including the formation of bulbs.

3.8. Dry Weight of Red Onion Bulbs Per Unit Area (1 m 2)

Results data analysis show that the single-factor concentration of goat urine LOF and Paclobutrazol did not have a significant effect on the dry weight of shallots per unit area. The average value of the dry weight of shallot bulbs per unit area in the treatment concentration of LOF goat urine and paclobutrazol is presented in Table 8.

Table 8 Average Dry Weight of Shallot Bulbs Per Unit Area Due to Single Treatment of Goat Urine LOF Concentration and Paclobutrazol

Treatment	Tuber Dry Weight Per Unit Area (kg)
Goat Urine LOF Concentration (ml/liter)	
0	1.82 b
100	1.80 b
150	1.41 a
250	1.32 a
BNJ 5%	0.23
Paclobutrazol Concentration (ppm)	
0	1.58
100	1.60
250	1.63
300	1.54
BNJ 5%	tn.

Description: Numbers followed by the same letter in the same column and row. The same shows no real difference in test BNJ 5%. tn = not significant.

Table 8 shows that the dry weight of shallot bulbs per unit, which was not treated with goat urine LOF, was 1.82 kg. This weight was not significantly different from that given by goat urine LOF treatment at a concentration of 100 ml/liter, namely 1.80 kilograms, but was significantly different from that given by goat urine LOF treatment at a concentration of 150 ml/liter (1.41 kg) and 250 ml/liter (1.32 kg). The highest dry weight of shallot bulbs per unit was obtained in the treatment without goat urine LOF, namely 1.82 kilograms, while the lowest dry weight of shallot bulbs was obtained at a concentration of 250 ml/liter, namely 1.32 g. This finding aligns with research by Rianti et al. (2022), which shows that excessively high concentrations of goat urine LOF can be antagonistic to growth, as indicated by a decrease in the dry weight of shallot bulbs.

The single paclobutrazol concentration treatment, which had no significant effect, produced the highest average value, namely the shallot plants given a paclobutrazol concentration of 250 ppm, with a yield of 1.63 kg. The lowest yield was obtained at a concentration of 300 ppm, with a yield of 1.54 kg.

3.9. Water Content of Shallots

Results analysis data show that the single factors of goat urine LOF concentration and Paclobutrazol did not have a significant effect on the water content of shallot bulbs. The average water content of shallot bulbs in the treatment concentration of LOF goat urine and paclobutrazol is presented in Table 9.

Table 9 Average Water Content of Shallot Bulbs Due to Single Treatment of Goat Urine LOF Concentration and Paclobutrazol

Treatment	Water content (%)
Goat Urine LOF Concentration (ml/liter)	
0	65.57±0.63
100	65.04±0.06
150	63.68±1.81
250	65.33±0.14
BNJ 5%	tn.
Paclobutrazol Concentration (ppm)	
0	65.69±0.61
100	65.00±0.08
250	63.53±1.79
300	65.40±0.22
BNJ 5%	tn.

Description: Numbers followed by the same letter in the same column and row. The same shows no real difference in test BNJ 5%. tn = not significant.

Table 9 shows that shallot plants treated with goat urine LOF and paclobutrazol concentrations alone had no significant effect on the water content parameters of shallots. The highest average value was found for those not treated with goat urine LOF at 65.57% and the lowest was at a concentration of 150 ml/liter at 63.68%. Likewise, in the paclobutrazol treatment, paclobutrazol-treated shallot plants had no significant effect on the water content parameters of the shallot bulbs. The highest average value was observed in those not treated with paclobutrazol, at 65.69%, while the lowest value was found at a concentration of 250 ppm, at 63.53%. In this study, significant differences were observed between treatments. This result indicates that there is stability in the water content of shallots between treatments. The use of goat urine LOF and paclobutrazol did have physiological effects, but not on the water content parameters of the bulbs. This finding aligns with research (Mukarrama et al., 202), which states that environmental and genetic factors of varieties are more dominant in influencing water content, rendering differences in treatment unable to provide a statistically significant impact.

3.10. Number of Bulbs

Results data analysis show that the treatment combination of goat urine LOF and paclobutrazol did not provide a significant interaction on the number of shallot bulbs. Meanwhile, the treatment of goat urine LOF concentration alone influenced the number of shallot bulbs. Average value of the number of shallot bulbs in the treatments concentration LOF goat urine and paclobutrazol in a single presentation is presented in Table 10.

Table 10. Average Number of Bulbs in Shallot Plants Due to Treatment with Goat Urine LOF Concentration and Paclobutrazol

Treatment	Number of Red Onions (grams)
Goat Urine LOF Concentration (ml/liter)	
0	7.36±0.24 b
100	7.36±0.27 b
150	6.22±0.20 a
250	6.14±0.19 a
BNJ 5%	0.78
Paclobutrazol Concentration (ppm)	
0	6.72±0.28
100	6.92±0.34
250	6.86±0.26
300	6.58±0.26
BNJ 5%	tn.

Description: Numbers followed by the same letter in the same column and row. The same shows no real difference in test BNJ 5%. tn = not significant.

Table 10 shows that the number of bulbs without goat urine LOF treatment was 7.36 bulbs. The number of bulbs was not significantly different from those treated with goat urine LOF at a concentration of 100 ml/liter (7.36 bulbs), but was significantly different from those treated with goat urine LOF at a concentration of 150 ml/liter (6.22 bulbs) and 250 ml/liter (6.14 bulbs). The highest number of bulbs was obtained at a concentration of 0 ml, namely 7.36 bulbs, which was also not significantly different from 100 ml/liter, namely 7.36 bulbs, while the lowest number of bulbs was obtained at a concentration of 250 ml/liter, namely 6.14 bulbs. This finding suggests that the optimal concentration is 100 ml/L or not given at all (control), as it can have a significant effect on the number of shallot bulbs. A too high concentration of goat urine LOF can reduce the yield of shallot bulbs.

The single paclobutrazol concentration treatment that had no significant effect produced the highest average value at a concentration of 100 ppm, specifically 6.92 bulbs, while the lowest value was obtained at a concentration of 300 ppm, specifically 6.58 bulbs. All paclobutrazol concentration treatments yielded a relatively uniform number of bulbs, approximately 6 bulbs. This finding indicates that paclobutrazol, at concentrations ranging from 0 to 300 ppm, does not significantly affect the number of shallot bulbs.

Variety also responds quite well to nutrient intake during the tuber formation phase. As the plant enters the generative phase, after reaching its maximum leaf count, it begins to divert energy and resources to the tubers. At this point, nutrient availability from LOF becomes crucial in supporting growth and increasing tuber numbers. These results align with research by Aezad et al. (2024) and Afrendi et al. (2024) (https://www.wikihow.com/10).

Paclobutrazol did not significantly affect yield parameters, including tuber diameter, wet and dry weight, and tuber number. This finding could be due to several factors. First, paclobutrazol primarily affects the morphology and early physiology of the plant, suppressing elongation growth and increasing leaf number, but does not directly impact the tuber filling process. Paclobutrazol actually encourages tillering by suppressing the growth of elongation hormones and triggering lateral growth, thus increasing the number of tillers. However, it does not increase the number of tubers because tuber formation requires the accumulation of photosynthesis products and stable plant conditions, while increasing tillering can actually trigger competition for resources such as light, water, and nutrients. As a result, tuber yield per plant does not increase because resources are divided to support more shoots. Plant yield is generally strongly influenced by a combination of nutrient availability, lighting, and hormonal balance. If sufficient nutrients or an optimal environment are not present, paclobutrazol will not significantly increase yield (Rugayah et al., 2022).

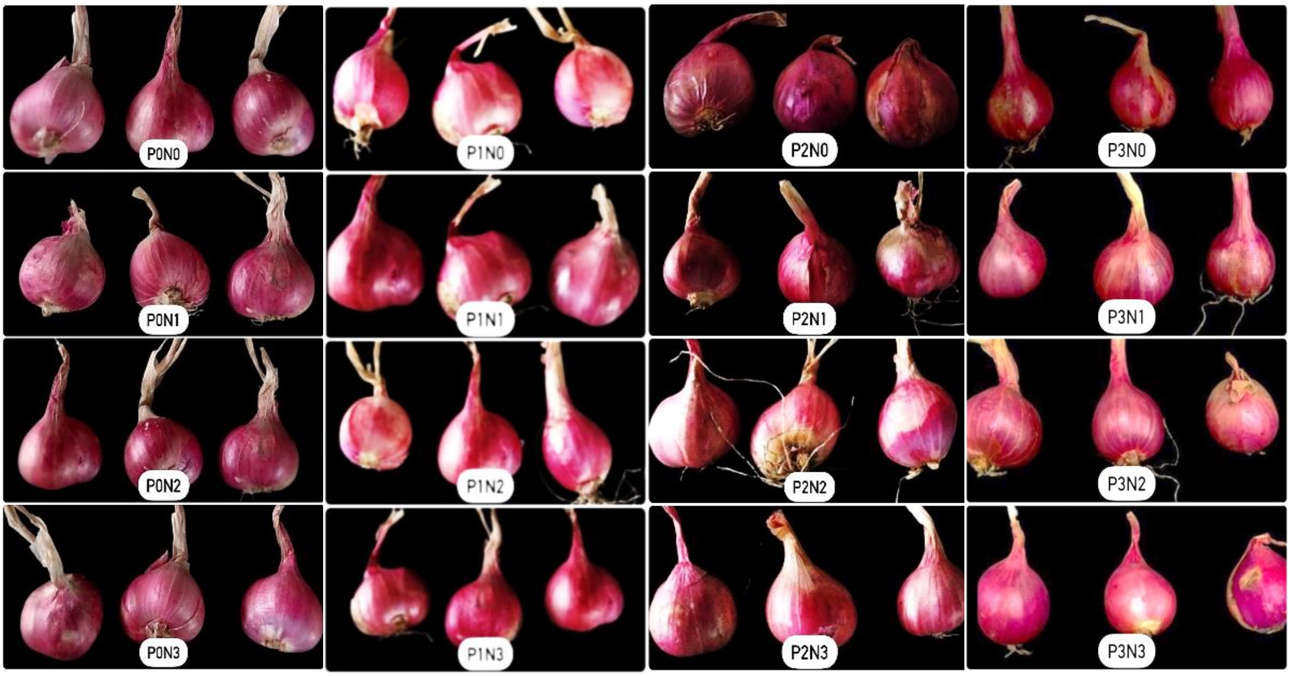

Figure 2. Shallot Samples of the Kabuk Variety Between Treatments

4. Conclusion

This study *concluded* that the combination of goat urine LOF at 100 mL/L and paclobutrazol at 100 ppm significantly interacted to influence the number of leaves and tillers. The application of goat urine LOF at 100 mL/L did not differ significantly from the control but produced the best results for tuber diameter, fresh and dry tuber weight, fresh and dry yield per unit area, water content, and tuber number. Paclobutrazol concentration also significantly affected plant growth; higher concentrations inhibited vegetative growth, resulting in shorter plants with a more compact morphology.

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