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Response of Peking Shallot (*Allium ascalonicum* L.) to Dolomite and Granular Guano Application on Recovered Lowland Ultisol by Goat Manure

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ABSTRACT

Shallots represent a vital commodity for the Indonesian economy and food security. It is suitable when cultivated in lowland areas with marginal soils by enhancing the chemical and physical soil properties. The application of organic materials such as goat manure, combined with granular guano or dolomite, offers a potential solution. However, excessive use of dolomite by farmers can negatively impact soil and plant health, so determining the optimal dosages of guano and dolomite, as sources of calcium, phosphorus, potassium, and magnesium, is necessary for maximizing shallot growth. The use of goat manure may reduce the requirement for additional inputs such as dolomite. To date, the combined application of guano and dolomite has not been investigated for Peking shallot varieties cultivated on Ultisol soils. This study assessed the growth and yield responses of Peking variety shallots to dolomite and guano applications on Ultisol soil amended with goat manure as a base fertilizer. The experiment employed a two-factorial, completely randomized design with three replications. The first factor was dolomite dosage at 0, 2, and 4 tons per hectare. The second factor was granulated guano dosage at 0, 100, 200, and 300 kilograms per hectare. All experimental units received goat manure-based fertilizer at a rate of 10 tons per hectare. Data were analyzed using analysis of variance (ANOVA) at a 5% confidence level, followed by Duncan's Multiple Range Test when significant effects were observed. The results indicated that neither dolomite nor granulated guano applications significantly affected the growth parameters or yield of Peking variety shallots under Ultisol soil fertility improves with long-term use, and applying goat manure further enhances its quality.

1. Introduction

Shallots, scientifically known as *Allium ascalonicum* L., are a vital crop in Indonesia, highly valued both as a culinary spice and for their significant contributions to the country's economy (Sopha *et al*., 2024). Currently, Indonesia is one of the leading shallot exporters in the ASEAN region. Thailand became the largest ASEAN country receiving Indonesian shallot exports, with 6,000 tons in 2023. Meanwhile, Indonesian shallot exports to Malaysia continued to experience a progressive increase. In 2021, the figure remained at 59.6 tons, which then increased tenfold to 612.8 tons in 2023 (Badan Pangan Nasional, 2024).

During this time, the shallots in West Sumatra are grown primarily in the highlands. One reason is that the soil has a high organic matter content, making it more fertile and crumblier.

Farmers believe this is ideal for growing shallots. In fact, shallot roots are very shallow, so adding a little organic matter to the planting hole supports plant growth. Recent research conducted by Kristina *et al*. (2023) revealed that shallots cultivated in Ultisol soil in Limau Manis achieved a remarkable yield of approximately 9.73 tons per hectare with the application of 10 tons of chicken manure per hectare. This study underscores the positive impact of organic amendments on crop yields.

Cultivating shallots in highland regions poses unique challenges compared to lowland agriculture. The cooler temperatures and increased moisture during the rainy season elevate the risk of diseases, particularly powdery mildew, which can significantly impact both yield and quality (Subari & Agustin, 2025). Furthermore, competition from other agricultural activities limits access to land that is suitable for shallot farming in the highlands.

In response to these challenges, the West Sumatran government is actively promoting the expansion of shallot cultivation into marginal land areas that are typically less productive. This initiative aims to create optimal conditions for shallot farming, improve overall production, and provide economic benefits to local farmers (Bappeda, 2021).

The primary challenges in lowland areas are associated with Ultisol soil. This soil is typically infertile due to its high clay content, low concentrations of organic matter and essential nutrients such as calcium and magnesium, increased aluminum solubility, and inadequate drainage and aeration (Pratamaningsih *et al*., 2023). However, the soil properties will be slightly different if it has been used in the long term. Ultisol Limau Manis has been cultivated for a long time, resulting in improved chemical properties, although physical properties, such as soil structure, remain below optimal levels (Table 1).

One solution to these issues is the use of organic materials, such as goat manure, as a base fertilizer. Goat manure has a high soil organic carbon content and a carbon-to-nitrogen (C/N) ratio of 20-25, which helps to loosen the soil and makes the nutrients in the manure available during the decomposition process. A study by Peni *et al*., (2023) showed that applying 15 tons per hectare of organic goat manure significantly increased lettuce production. Similarly, another study by Walida *et al*., (2020) found that applying 2 tons per hectare of goat manure in combination with 100 kilograms per hectare of urea fertilizer enhanced soil organic carbon, total nitrogen, the C/N ratio, and the fresh weight yield of mustard greens.

Moreover, shallots require an increased level of calcium (Ca) to form robust bulbs (Coolong & Randle, 2008). The firmer the bulbs, the better they can fend off rotting and damage from microbial activity, as microbes struggle to penetrate the cell walls of shallots with higher hardness index values compared to other varieties. To enhance bulb hardness, we can utilize calcium-rich materials such as guano and dolomite. Granular guano, sourced from bat manure, is abundant in phosphorus and potassium, while dolomite is a rich source of magnesium. (Anugrah, 2016) observed that applying four tons of dolomite per hectare improved the chemical properties of inceptisol soils, increasing calcium concentrations by 5.65 meq/100 g and magnesium by 0.60 meq/100 g. Additionally, (Septiawan *et al*., 2025) found that applying two tons of dolomite per hectare could boost shallot yield by 25.97%. In terms of guano, it has been shown to achieve a dry bulb yield of 10.54 t/ha without the use of ZA (Kristina *et al*., 2023). In our cultivation practices, we incorporate goat manure, granular guano, and dolomite.

Excessive lime ($CaCO_3$) in the soil can lead to an overabundance of bases, resulting in nutrient deficiencies for plants. Specifically, high levels of $CaCO_3$ toxicity can adversely affect the availability of essential micronutrients such as zinc (Zn), copper (Cu), boron (B), and molybdenum (Mo) (Anggoro & Sugandi, 2024). Unfortunately, shallot farmers often apply excessive amounts of dolomite, sometimes exceeding six tons per hectare each planting season.

To promote optimal shallot growth, it is essential to determine the ideal dosages of both guano and dolomite, which provide crucial elements such as calcium (Ca), phosphorus (P), potassium (K), and magnesium (Mg). Incorporating goat manure may also help to reduce reliance on other inputs, including dolomite. Currently, combination treatments involving specific dosages of guano and dolomite have not been explored for the Peking shallot variety cultivated in Ultisol soil.

The Peking shallot variety, introduced from China, shows considerable potential for cultivation in lowland areas, as it requires fewer pesticides than local varieties and yields higher-quality bulbs. This study aims to assess the growth and yield response of the Peking shallot to the application of dolomite and granulated guano in Ultisol soil that has been enhanced with goat manure.

2. Methodology

2.1 Description of Experimental Area and Time Experiment

This research was conducted at the Experimental Garden of the Faculty of Agriculture at Andalas University in Limau Manis, Padang City, situated at an altitude of 250 meters above sea level. The study occurred during the rainy season over a four-month period, from October 2022 to January 2023. The region experiences an annual rainfall of approximately 5,000 mm.

2.2 Experimental Design

This study was designed as a two-factor factorial within a Complete Randomized Design (CRD), featuring three replications. The first factor assessed was the dosage of dolomite (CaMg(CO3)2), evaluated at three levels: 0 tons per hectare (ha), 2 tons per hectare, and 4 tons per hectare. The second factor examined was the dosage of guano fertilizer, tested at four levels: 0 kg per hectare, 100 kg per hectare, 200 kg per hectare, and 300 kg per hectare. This design led to 12 unique treatment combinations, each replicated three times, resulting in a total of 36 experimental units. Each unit contained 45 plants, arranged with a spacing of 20 cm by 20 cm.

Data collected from the observations were analyzed using analysis of variance (ANOVA) at a significance level of $\alpha = 5\%$. Means were separated by least significant difference (DNMRT) when Fisher's exact test was significant ($P < 0.05$)

2.3 Planting Preparation and Application of Treatments

This study utilized Peking shallot bulbs obtained from farmers in Alahan Panjang. The bulbs were chosen based on specific criteria: they had to be healthy, free from rot, uniform in size, and consist of a single bulb. These bulbs were stored for a duration of two months prior to their application.

Before implementing any treatments, a comprehensive analysis of the experimental soil was conducted. Soil samples were collected from five distinct locations within the plot: four from the corners and one from the center, each taken at a depth of 1 to 20 cm. The samples

were thoroughly mixed and cleaned of debris. The composite soil sample was subsequently analyzed at the Environmental Engineering Laboratory of Universitas Andalas.
Land preparation was conducted two weeks following the herbicide application. This process involved hoeing the soil to a depth of 30 cm and forming beds measuring 100 cm by 200 cm. Two days before installing the silver-black plastic mulch, dolomite lime was applied to the soil. The shallot bulbs were then planted over a week after the dolomite lime treatment. A total of 10 tons of goat manure per hectare was incorporated into the planting holes one week after planting. Guano fertilizer was applied two weeks later, once the plants had established uniform growth, in accordance with the prescribed treatment dosages. Three weeks after the guano application, 200 kilograms per hectare of NPK Ponska fertilizer (15% N, 15% P_2O_5, 15% K_2O, 10% S) and 200 kilograms per hectare of SS Ammophos fertilizer (16% N, 20% P_2O_5, 12% S) were added. Periodic control measures were implemented to effectively manage weeds, pests, and diseases. Harvesting began when the plants displayed yellowing leaves and the necks of the bulbs began to soften.

The observations encompassed several parameters, including plant height (in centimeters), the number of leaves, the number of tillers, the number of bulbs, and the fresh weight per plant (in grams). Vegetative growth parameters were recorded on a weekly basis until 7 weeks after planting (WAP), while yield parameters specifically the count of bulbs and their fresh weight were assessed at harvest. A ruler was utilized to measure the height of the shallots, and a digital weighing scale was used to determine the weight of the bulbs.

3. Results and Discussion

3.1 Initial Soil Properties

The analysis of soil properties includes pH, total nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), and organic matter (OM) as shown in Table 1.

Table 1. Properties of Ultisol

No.	Parameter	Unit	Analysis Result	Criteria*
1	pH	-	6.2	Slightly acid
2	Organic Matter Content	%	0.32	Very low
3	Nitrogen (N)	%	0.72	High
4	P_2O_5 Bray 2	ppm	14.97	High
5	K^+	me100 g tanah $^{-1}$	0.692	High
6	Ca^{2+}	me100 g tanah $^{-1}$	0.613	Very low
7	Mg^{2+}	me 100 g tanah $^{-1}$	0,41	Low
8	SO_4^{2-}	%	0,024	Very low

Source: *Soil Research Institute. Indonesia (2005)

Table 1 shows that the soil pH stands at 6.2, categorizing it as slightly acidic. This condition has arisen due to the extended usage of the planting area, which has involved the application of both manure and dolomite. However, the region's high rainfall intensity has led to a notable decline in organic matter content through leaching. According to (Khaled & Sayed, 2023), the ideal soil pH for crops such as shallots falls within the slightly acidic to neutral range, typically between 6.0 and 7.0. Maintaining this pH range is vital for ensuring nutrient availability, thereby enabling plants to effectively absorb the essential nutrients they require.

The initial nutrient analysis reveals that nitrogen, phosphorus, and potassium levels in the soil are high due to the long-term application of inorganic fertilizers such as urea, TSP, potassium, or NPK fertilizers. These elevated levels of macronutrients indicate that the soil is fertile and well-suited for shallot cultivation. However, the levels of calcium, magnesium, and sulfur in the soil are quite low, suggesting a need for their supplementation.

Calcium can be obtained from sources like goat manure, dolomite, or guano, while magnesium can also be sourced from dolomite and goat manure. Additionally, sulfur can be supplied through goat manure. Therefore, the application of dolomite, granular guano, and goat manure in this study may not primarily have served as a liming agent to correct the soil's pH but rather as a source of essential nutrients, including micronutrients. These baseline soil conditions provide a crucial context for interpreting the observed effects, or lack thereof, of the treatments applied.

3.2 Nutrient Content of Goat Manure, Guano, and Dolomite

Table 2 highlights that both goat manure and granular guano deliver essential nutrients, including nitrogen (N), phosphorus (P), calcium (Ca), and potassium (K). While goat manure contains a modest amount of magnesium, dolomite is particularly abundant in this mineral. Moreover, both granular guano and dolomite demonstrate elevated levels of calcium (CaO), with granular guano being especially recognized for its high phosphorus content.

Nitrogen is essential for maintaining the freshness and greenness of plants, as it is a key component of chlorophyll, which plays a vital role in photosynthesis. It not only promotes plant growth but also enhances the protein content of crops. Phosphorus is another crucial nutrient that supports a range of metabolic and physiological processes, including energy metabolism, cell division, DNA synthesis, and phospholipid production. It primarily exists in soil as phosphate (Pi) or Pi esters (Isidra-Arellano *et al*., 2021). A deficiency in Pi can adversely affect fruit production and the quality of plants during their vegetative growth and root development, ultimately leading to a decline in crop yields (Abobatta & Abd Alla, 2023; Jezek *et al*., 2023; Lopez *et al*., 2023). Furthermore, phosphorus is fundamental in regulating physiological responses and improving plants' resilience to abiotic stresses, such as heat, salinity, drought, waterlogging, elevated CO2 levels, and heavy metal toxicity (Hawkesford *et al*., 2012; Lambers, 2025).

Table 2. Analysis Nutrient Content of Goat Manure, Guano and Dolomite

Elements	Goat Manure	Granular Guano	Dolomit
C/N	29 *		
N	0.63 % *	3%	
P_2O_5	1.25 % *	15%	
CaO	1.64 % **	12%	30%
K_2O	1.06 % *	5%	
MgO	0.60 %**		20%

Source: *(Hartati & Rachman, 2022) ** Semakto (2006)

During photosynthesis, potassium plays a vital role in regulating the opening and closing of stomata, which directly impacts carbon dioxide (CO2) absorption. In addition to this function, potassium supports carbohydrate production in plants and enhances the quality of fruit (Farooq *et al*., 2018; Surucu *et al*., 2020).

Calcium from the organic matter is essential for the plant. The signal transduction pathways of many environmental and developmental stimuli in plants are affected by the changes in cytosolic Ca2+ levels (Tuteja & Mahajan, 2007). Furthermore, calcium serves as a counter-cation for both inorganic and organic anions within the vacuole. Magnesium is also crucial; it not only facilitates the photosynthesis process but is integral to the subsequent transfer of photoassimilates throughout the plant (Tränkner *et al*., 2016).

3.3 Effect on The Growth Parameters

Means were separated by least significant difference (DNMRT) when Fisher's exact test was significant ($P < 0.05$). Table 3 was created with IBM SPSS Statistics 28.0. The ANOVA results for the plant height, number of leaves and number of tillers showed no statistically significant effects from dolomite application, guano application, or their interaction (Table 3.).

Table 3. Result for ANOVA Regarding The Effect Of Dolomite, Granular Guano Dosage, and Dolomite Granular Guano Interaction on The Mean Growth Parameters

Experimental factors	Means Plant Height		Mean Number of Leaves		Mean Number of Tillers	
	F-Value	p	F-Value	p	F-Value	p
Dolomite Dosages	2.47	0.11	0.11	0.90	0.41	0.67
Granular Guano Dosages	0.65	0.59	1.25	0.32	3.18	0.04
Dolomite Dosages x Granular Guano Dosages	0.49	0.81	1.13	0.37	1.23	0.33

3.3.1 *Plant Height and Number of Leaves at & WAP*

The results of the data analysis showed that there was no interaction between various kinds of Dolomite and Granular Guano dosage against the plant height and number of leaves of shallots at 7 WAP (Table 4).

Rahayu & Berlian V.A (2007) described shallots as annual plants that grow upright in a grass-like form, typically reaching heights of 15-20 cm while forming clumps. In contrast, Sinaga *et al*. (2023) reported that some varieties can attain greater heights. For example, the Maja Cipanas variety can reach up to 36.14 cm, Violetta 1 Agrihorti can grow to 37.83 cm, Violetta 2 Agrihorti to 37.8 cm, and Violetta 3 Agrihorti to 36.14 cm, with the Sembrani variety achieving an impressive 39.28 cm. In this experiment, the Peking variety exhibited heights ranging from 33.42 cm to 38.18 cm, whereas Gultom *et al*. (2015) noted a maximum height of only 25.67 cm for the Peking variety. This suggests that the Peking shallot plants in this study are relatively tall.

Table 4 presents the number of leaves produced by Peking shallots, which ranges from 27.67 to 32.13. This figure is significantly higher compared to the results of Gultom *et al*. (2015) study, which recorded an average of just 11.98 leaves. The Bima Brebes variety is known to yield between 14 and 50 leaves (Menteri Pertanian, 1984). Furthermore, Kristina *et al*. (2023) reported that when Bima Brebes was cultivated in Ultisol Limau Manis, it produced between 25.68 and 33.75 leaves. In comparison, the SS Sakato variety from Solok city generated 22 to 46 leaves (Menteri Pertanian, 2017). Putri (2024) emphasized that the appearance of a plant is affected by the specific variety and growth type of shallots. Additionally, vegetative growth is affected by the plant's capacity to synthesize various necessary components (Abdissa *et al*., 2011).

Table 4. The Plant Height and Number of Leaves Peking Shallot on Different Dosages of Dolomite and Granular Guano

Treatment		Plant Height	Number of Leaves
Dolomite Dosages	Granular Guano Dosages	(cm)	
0 ton/ha	0 kg/ha	38.19 a	32.06 a
	100 kg/ha	35.68 a	30.22 a
	200 kg/ha	33.93 a	30.11 a
	300 kg/ha	37.22 a	28.83 a
2 ton/ha	0 kg/ha	37.31 a	32.13 a
	100 kg/ha	36.53 a	31.28 a
	200 kg/ha	37.17 a	29.93 a
	300 kg/ha	35.89 a	27.67 a
4 ton/ha	0 kg/ha	34.13 a	30.56 a
	100 kg/ha	33.49 a	28.93 a
	200 kg/ha	33.42 a	27.78 a
	300 kg/ha	35.60 a	32.06 a
	KK	8.41 %	9.23 %

Notes: The same lowercase letters indicate not significant difference (at p< 0.05) , while the difference lowercase letters indicate significant difference (at p< 0.05) according to Duncan's test)

The experimental soil exhibited high levels of nitrogen (N), phosphorus (P), and potassium (K). When enhanced with organic sources of N, P, and K, along with goat manure as a base fertilizer, this combination resulted in optimal growth and leaf count for Peking plants. However, the addition of calcium oxide (CaO) and magnesium oxide (MgO) from dolomite, as well as various nutrients from Granular Guano, did not significantly affect leaf height or quantity. This indicates that the Ultisol growing medium was well-prepared to support plant growth effectively.

3.3.2 *Number of Tillers*

The data analysis results indicated that the single treatment of granular guano had a significant effect on the number of shallot tillers (Table 5).

Table 5. Number of Tillers of Peking Shallots at 7 WAP

Granular Guano	Dolomite Dosage			Mean
Dosage	0 ton/ha	2 ton/ha	4 ton/ha	
0 kg/ha	6.22	6.00	5.78	6.00 a
100 kg/ha	6.00	5.61	6.00	5.87 a
200 kg/ha	5.89	5.94	5.44	5.76 ab
300 kg/ha	5.28	5.22	5.72	5.41 b
Mean	5.85 a	5.69 a	5.74 a	
KK = 7.43%				

Notes: The same lowercase letters indicate not significant difference (at p< 0.05), while the difference lowercase letters indicate significant difference (at p< 0.05) according to Duncan's test)

Table 5 indicates that the number of tillers for Peking shallots is approximately between 5.41 and 6.00, with the treatment utilizing 300 kg/ha of NPK resulting in a lower number of tillers compared to other treatments. This reduction could be attributed to the high availability of P_2O_5 in the soil. Granular Guano contains 15% P_2O_5, NPK Phonsca also has 15% P_2O_5, and SS contains 20% P_2O_5, all contributing to elevated levels of P_2O_5 in the soil, which may suppress tiller formation.

P. Marschner (2012) report that elevated phosphorus concentrations can impede the absorption of iron (Fe) and zinc (Zn). Iron is essential for many biological processes; as a redox-active metal, it is involved in photosynthesis, mitochondrial respiration, nitrogen assimilation, and the biosynthesis of hormones such as ethylene, gibberellic acid, and jasmonic acid. Additionally, iron plays a critical role in the production and scavenging of reactive oxygen species, osmoprotection, and defense against pathogens. Fe–S clusters are fundamental for electron transfer and form integral components of substrate binding sites in enzymes (Hänsch & Mendel, 2009).

Furthermore, zinc deficiency can adversely affect net photosynthesis in plants by disrupting the activity of carbonic anhydrase, a key enzyme for CO_2 fixation in C4 plants. This deficiency also impacts Cu–Zn superoxide dismutase and D-ribulose-5-phosphate 3-epimerase, both of which are critical in the Calvin cycle and oxidative pentose phosphate pathway (Jelakovic *et al*., 2003).

3.4 Effect on Yield Parameters

Means were separated by least significant difference (DNMRT) when Fisher's exact test was significant (P <0.05). Table 6 was constructed using IBM SPSS Statistics 28.0.

Table 6. Result For ANOVA Regarding The Effect of Dolomite, Granular Guano Dosage, and Dolomite*Granular Guano InteractionoOn The Mean Yield Parameters

Experimental factors	Number of Bulbs		Fresh Weight of Bulb per Plant		Fresh Weight per Clove	
	F-Value	p	F-Value	p	F-Value	p
Dolomite Dosages	0.31	0.74	1.64	0.22	2.10	0.14
Granular Guano Dosages	1.95	0.15	1.05	0.39	0.71	0.56
Dolomite Dosages x Granular Guano Dosages	1.33	0.28	0.96	0.47	0.44	0.85

The ANOVA results for the number of bulbs, fresh weight of cloves and fresh weight of bulb per plant showed no statistically significant effects from dolomite application, guano application, or their interaction (6).

Table 7 below presents the production rates of bulbs from Peking shallots, showing a range between 5.61 and 6.44 bulbs per plant. The Bima Brebes variety is known to yield between 7 and 12 bulbs (Menteri Pertanian, 1984). According to Kristina *et al*. (2023), when Bima Brebes is cultivated in Ultisol Limau Manis soil, it can produce yields of 5.80 to 9.03 bulbs per plant. In contrast, the SS Sakato variety from Solok City can generate between 9 and 25 bulbs per plant (Menteri Pertanian, 2017). Sinaga *et al*. (2023) found that the number of bulbs across five different varieties ranged from 7.30 to 11.00. Notably, the yield of Peking bulbs in this experiment was relatively lower. Nonetheless, the size of the Peking cloves is regarded as good. The SS Sakato variety from Solok City features clove sizes ranging from 11.67 to 23.33 grams, whereas Bima Brebes cloves weigh approximately 1.66 grams (Kristina *et al*., 2023). Comparatively, the Sumbu Merapi variety has clove weights between 8.92 and 13.47 grams (Menteri Pertanian, 2022), which are smaller than those of the Peking variety.

Table 7. The Number of Bulbs, Fresh Weight Of Bulb Per Plant, Fresh Weight Per Cloves and Yield on Different Dosage Dolomite and Granular Guano

Dolomit Dossage	Granular Guano Dossage	Number of Bulbs	Fresh Weight of Bulb per Plant (g)	Fresh Weight per Cloves (g)	Yield (tons ha^{-1})
0 ton/ha	0 kg/ha	6.44 a	84.31 a	13.25 a	21.08
	100 kg/ha	6.17 a	89.27 a	14.76 a	22.32
	200 kg/ha	6.33 a	80.01 a	12.87 a	20.00
	300 kg/ha	5.61 a	104.78 a	19.50 a	26.19
2 ton/ha	0 kg/ha	6.37 a	96.14 a	15.19 a	24.04
	100 kg/ha	5.83 a	100.54 a	19.22 a	25.14
	200 kg/ha	6.22 a	90.99 a	15.82 a	22.75
	300 kg/ha	5.61 a	95.26 a	17.76 a	23.81
4 ton/ha	0 kg/ha	5.89 a	82.42 a	14.48 a	20.61
	100 kg/ha	6.39 a	72.96 a	11.58 a	18.24
	200 kg/ha	5.78 a	80.77 a	15.51 a	20.19
	300 kg/ha	6.00 a	87.29 a	14.84 a	21.82
	KK	7.64 %	20.11 %		

Notes: The same lowercase letters indicate not significant difference (at $p < 0.05$) according to Duncan's test)

Table 7 indicates that the weight per clove produced by Peking shallots ranged from 72.96 grams to 104.78 grams. The yield for this variety was between 18.24 and 26.19 tons per hectare, which is higher than that of other varieties. In contrast, research conducted by Gultom *et al*. (2015) found that Peking shallots produced fresh bulb weights of only 21.34 to 23.45 grams, with a potential yield of just 14.23 tons per hectare. Additionally, Sinaga *et al*. (2023) reported that the yields of five different shallot varieties ranged from 8.51 to 12.89 tons per hectare. The Bima Brebes variety grown on Ultisol soil at Limau Manis yielded only around 9 tons per hectare (Kristina *et al*., 2023). Some things that differentiate one variety of shallots from another are usually based on the shape, size, color, firmness, aroma of the bulb, age of the plant, resistance to disease and rain and others (Saptorini *et al*., 2020).

Dolomite and granular guano have no significant effect on the generative components of shallots. This finding stands in contrast to the research conducted by (Gusmiatun *et al*., 2021), which indicated that applying 5 tons of dolomite per hectare led to optimal plant height and increased weight in the Manjung variety of shallots. Similarly, Kristina *et al*. (2023) found a significant positive effect of guano on the dry weight of shallot bulbs compared to chicken manure and oil palm empty bunches (OPEB). The low initial organic matter content (0.327%) in the experimental soil likely contributed to the pronounced effects of organic matter additions on shallot growth. To achieve meaningful improvements in soil properties and nutrient availability for optimal bulb development, larger quantities of organic matter may be needed. Consequently, the inclusion of goat manure, which has a high carbon-to-nitrogen (C/N) ratio, provides limited nutrition but releases it slowly, resulting in optimal growth for Peking shallots. Furthermore, the nutrients from NPK and SS Ammophos fertilizers enhance the overall yield. This suggests that cultivating shallots on recovered Ultisol, characterized by favorable chemical properties, primarily requires organic matter in this instance, goat manure.

These results have significant practical implications for farmers. They indicate that applying dolomite and other fertilizers, such as guano, to near-neutral pH soil may not be a cost-effective strategy for increasing shallot yields. This insight can assist farmers in optimizing their resource allocation by avoiding unnecessary expenditures on inputs that do not provide substantial returns on investment. Ultimately, these findings contribute to the improvement of agricultural practices and the promotion of sustainability by discouraging the excessive use of fertilizers when their benefits are not evidenced.

4. Conclusion

Based on the findings of this study, we conclude that the application of dolomite and guano did not significantly influence the growth and yield parameters of Peking shallots cultivated in recovered Ultisol. This lack of effect is likely due to the soil properties already being within the optimal range following the application of goat manure, NPK Phonsca, and SS Ammophos. Additionally, it was noted that even high doses of granular guano can reduce the number of tillers because of excess phosphorus.

In light of these findings, it is advisable for farmers to conduct a soil pH analysis prior to applying dolomite. Further research is also needed to assess the long-term effects of dolomite and guano fertilizers on soil fertility and crop yield, as well as to explore plant responses in genuinely acidic Ultisol.

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