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# Effects of dolomite application and fertilizer types on the growth and yield of Scallion plants (*Allium fistulosum* L.)

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**Abstract** This study demonstrated that the application of dolomite markedly enhanced scallion growth and productivity, with an optimal dosage of 450 kg ha$^{-1}$ yielding the highest fresh economic weight of 12.59 g per plant. Dolomite not only neutralizes soil acidity well, but it also provides calcium and magnesium. However, using it at more than the recommended dose (675 kg ha$^{-1}$) caused a saturation effect that lowered yields. The best yield, 13.30 g, came from NPK fertilizer. This is because it has the right balance of macronutrients to help plants grow and maximize yield. The interaction between dolomite and NPK fertilizer did not significantly impact yield, but the combination increased nutrient uptake. This is due to the increase in soil pH and nutrient availability due to dolomite treatment and fertilizer types (compost and NPK), as well as environmental factors (temperature and rainfall), which significantly affect the yield of scallion. The results showed that applying 450 kg ha$^{-1}$ of dolomite combined with NPK fertilizer was the best way to increase scallion productivity.

**Keywords:** Dolomite, Compost, NPK fertilizer, Nutrient absorption, Scallion plants

## Introduction

Scallions (*Allium fistulosum* L.) are a popular aromatic vegetable that is good for health and can be used in various ways (Kim *et al*., 2024). Scallions are good for health, and their aroma enhances food flavor. The USDA (2019) states that fresh leaves contain protein (1.83%) and carbohydrates (7.34%). Scallions contain essential vitamins and minerals, including vitamin A (997 µg) and vitamin C (18.8 mg). The nutrients in scallions are good for health because they contain vitamins, minerals, and antioxidants. The increasing demand for scallions, driven by domestic consumption and the food industry, particularly instant food products, has had a significant impact on the agricultural sector (Fera *et al*., 2019). Scallion production in Indonesia, particularly in Bali Province, has

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fluctuated over time. The Central Bureau of Statistics (2025) stated that scallion production reached 10.547 quintals in 2021, 7.738 quintals in 2022, 8.179 quintals in 2023, and decreased to 5.106 quintals in 2024. This development in scallion production indicates the need to increase yields to meet growing market demand and encourage farmers to adopt more efficient and sustainable cultivation practices. Fertilization practices are crucial for the success of scallion cultivation. Crop failure in scallion cultivation is often caused by ineffective fertilizer use on agricultural land. Research by Yusdian *et al*. (2016) shows that stable fertilization, including the use of organic and inorganic fertilizers, can improve growth and yield. Ultisols are a type of soil that is generally nutrient-poor, highly acidic, and susceptible to weathering. Under these conditions, plants struggle to grow well. However, Ultisol soil can be improved. One way is to add dolomite to neutralize acidity and implement proper soil management to increase fertility.

Dolomite as a soil amendment is crucial for plants because it can neutralize acidic soil pH, making nutrient absorption easier (Castro and Crusciol, 2015). Several previous studies have shown that applying dolomite can improve soil quality and increase crop yields (Sirait and Siahaan, 2019; Arjana *et al*., 2021). Tanari *et al*. (2018) even found that applying dolomite at the correct dosage of 450 kg per hectare improved soil quality, supported root development, and significantly increased crop productivity.

Compost is known as a solid organic fertilizer derived from the decomposition of organic matter by microorganisms under controlled conditions. It is blackish-brown in color and rich in nutrients needed by plants. Compost, as a soil conditioner, is essential for improving soil fertility. Using compost on acidic soils can reduce soil compaction, increase porosity, facilitate soil aeration and drainage, retain more water, make nutrients more readily available, and increase soil microbial activity (Kononova, 1999). The effectiveness of compost has been shown to improve the performance of several horticultural crops, such as tomatoes, cucumbers, and scallions (Pangaribuan and Pujisiswanto, 2008; Tufaila, 2010; Piras *et al*., 2018). In vegetable cultivation, the use of compost can increase crop yields and maintain soil fertility sustainably.

NPK fertilizer is a manufactured inorganic fertilizer containing nitrogen (N), phosphorus (P), and potassium (K) in specific concentrations and serves to meet the essential nutrient needs of plants in a balanced manner. In NPK fertilizer, nitrogen supports plant growth, phosphorus encourages root development, and potassium makes plants healthier and more resilient to stress. NPK fertilizer provides a balanced and practical nutrient supply for field application, making it very popular among farmers. Studies by Adnan *et al*.

(2015) and Kriswantoro *et al*. (2016) show that NPK fertilizer can help increase scallion yields.

Dolomite combined with compost and NPK fertilizer appears to have significant potential in maintaining soil productivity and crop yields. Dolomite neutralizes soil pH and facilitates nutrient availability. Compost adds organic matter and encourages microbial growth. NPK fertilizer plays a role in providing macronutrients to support plant growth and yield. The combination of dolomite, compost, and NPK fertilizer can work together to help plants absorb more nutrients and grow more effectively. Therefore, it is crucial to investigate how the combination of dolomite, compost, and NPK fertilizer works together to increase scallion yield. This study aimed to evaluate the effect of dolomite and fertilizer types, as well as their interactions, on the growth and yield of scallion plants.

## Materials and methods

The research was conducted in a greenhouse in Luwus Village, Baturiti District, Tabanan Regency, Bali Province, at an altitude of 450-536 meters above sea level. The materials used included Blase F1 scallion seeds, dolomite, compost, and Mutiara 16:16:16 NPK fertilizer.

This study used a factorial randomized complete block design (RCBD) with two factors. The first factor was the dolomite dose (D): D0 (without dolomite), D1 (225 kg $ha^{-1}$), D2 (450 kg $ha^{-1}$), and D3 (675 kg $ha^{-1}$). The second factor was the fertilizer type (P): P0 (without fertilizer), P1 (15 tons $ha^{-1}$ of compost), and P2 (450 kg $ha^{-1}$ of NPK). This design resulted in 12 treatment combinations, each tested three times, for a total of 36 experimental units. Pots were randomly placed in the experimental field, with a spacing of 15 x 10 cm between each polybag. Five kilograms of soil were used in each polybag for planting. The soil was mixed with compost and dolomite according to each treatment.

Dolomite was applied by sprinkling it around the surface of the soil, then mixing it thoroughly and irrigating it until it dissolved into the soil. The dolomite application was done one week before planting. The doses used were 225 kg $ha^{-1}$ (0.0625 g per polybag), 450 kg $ha^{-1}$ (1.125 g per polybag), and 675 kg $ha^{-1}$ (1.1875 g per polybag).

The compost used in this study was cattle manure purchased from an agricultural store and packed in bags. The compost was applied evenly around the surface of each polybag and mixed with the soil. The application rate of compost was 15 tons per ha, equivalent to 37.5 g per polybag. According to the treatment, each polybag was given NPK fertilizer at a dose of 450 kg per hectare,

or 1,125 g per polybag. The NPK fertilizer was mixed with 220 ml of water for each polybag, then poured into the polybags. There were two times when the plants were fertilized: once at 1 week after planting (WAP) and again at 35 WAP. After two weeks, or when the scallion plant seedlings are 14 to 20 cm tall and have two to three leaves, they are carefully transplanted into prepared polybags. The seedlings are carefully selected to ensure they are all the same size before being placed in the polybags.

Watering is crucial during the early stages of plant growth as the scallion plants adapt to their new environment and meet their needs. Once the plants are well established and the roots are strong, water them every other day, in the morning and evening, depending on the soil moisture. A sprayer was used to water the plants before 9:00 AM and after 5:00 PM. During the growth period, there were two times when the plants were fertilized: once a week after planting (WAP) and again 35 WAP. Both preventive and curative methods were used to control pests and diseases. Keeping the experimental area clean and using high-quality seeds were some of the steps taken to keep the plants healthy. Spraying botanical pesticides on all parts of the plants was another step. The plants were harvested 70 days after they were planted (DAP) when some of the lower leaves turned yellow or dried out. The entire plant, including the roots, was uprooted, and any rotten roots and leaves were discarded.

Observed variables include plant height, number of leaves, stem diameter, fresh root weight, and fresh economic weight. All variable data that have been statistically analyzed are presented in a Table format. The data obtained from the experiments were analyzed statistically using the appropriate methods for the experimental design. Treatments that showed significant differences were further analyzed using the Least Significant Difference (LSD) test at the 5% level.

## Results

### *Significance of the influence of dolomite treatment and fertilizer type*

The significance of the effects of dolomite (D), fertilizer type (P), and their interaction (DxP) on scallion plants is shown in Table 1. Based on the statistical analysis results, dolomite application had a very significant effect ($P<0.01$) on plant height and a significant effect ($P<0.05$) on the number of leaves and economic fresh weight. However, dolomite did not significantly affect stem diameter or root fresh weight. The use of different fertilizers had a significant effect ($P<0.05$) on the number of leaves and a very significant effect ($P<0.01$) on the economic fresh weight per plant. However, neither fertilizer type significantly affected plant height, stem diameter, or root fresh weight. The

interaction between dolomite and fertilizer type did not have a significant effect (P>0.05) on any of the observed variables.

**Table 1.** Significance of the influence of dolomite and fertilizer types and their interactions on scallion plants

| Variable | Treatment | | |
|---|---|---|---|
| | D | P | DxP |
| Maximum plant height (cm) | ** | ns | ns |
| Maximum number of leaves (strands) | * | * | ns |
| Stem diameter (mm) | ns | ns | ns |
| Fresh root weight (g) | ns | ns | ns |
| Economic fresh plant weight (g) | * | ** | ns |

Note: ns = no significant (P>0.05), *= significant (P<0.05), ** = very significant (P<0.01)

### *Plant height*

Dolomite treatment had a very significant effect (P<0.01) on the height of scallion plants. However, the type of fertilizer and the interaction between dolomite doses and fertilizer types did not have a significant effect (P>0.05) on plant height (Table 1). The application of a dolomite dose of 225 kg $ha^{-1}$ (D1) resulted in a maximum plant height of 35.52 cm, which was significantly different from other dolomite treatments. The highest plant height was observed with the NPK fertilizer (P2), measuring 33.08 cm, which did not show a significant difference compared to other fertilizer treatments (Table 2).

### *The number of leaves per plant*

The dolomite dose and fertilizer-type treatments had a significant effect (P<0.05) on the number of leaves of scallion plants. However, the interaction between dolomite dose and fertilizer type did not show a significant effect (P>0.05) on the number of leaves (Table 1). A dolomite dose of 675 kg $ha^{-1}$ (D3) resulted in the maximum number of leaves, with an average of 5.17 strands, which was significantly higher than the other dolomite dose treatments. Judging from the type of fertilizer, compost fertilizer (P1) produced the highest number of leaves, namely 4.83 leaves, significantly different from the lowest number of leaves, namely 3.88 leaves, in the treatment without fertilizer (Table 2).

### *Stem diameter per plant*

Based on the analysis of variance, dolomite treatment, fertilizer type, and their interactions had no significant effect (P>0.05) on the stem diameter of scallion plants (Table 1). The application of dolomite fertilizer at a dose of 225

kg ha$^{-1}$ (D1) tended to produce the highest stem diameter of 5.89 mm, although this result was not significantly different from other dolomite treatments. The lowest stem diameter was observed in the treatment without fertilizer (D0), with a value of 5.16 mm. The treatment of fertilizer types showed a tendency for the highest stem diameter value in the NPK fertilizer type (P2) of 6.00 mm, which was not significantly different from the treatment of other fertilizer types (Table 2).

**Table 2.** The effect of dolomite application and fertilizer type on all observed plant variables per plant

| Treatment | Plant height (cm) | Number of leaves (sheet) | Stem diameter (cm) | Root Fresh Weight (g) | Economic Fresh Weight (g) |
|---|---|---|---|---|---|
| Dolomite Dosage (D) | | | | | |
| 0 kg ha$^{-1}$ (D0) | 29.98 b | 4.06 b | 5.16 a | 1.44 a | 9.42 b |
| 225 kg ha$^{-1}$ (D1) | 35.52 a | 4.22 b | 5.89 a | 1.54 a | 12.07 a |
| 450 kg ha$^{-1}$ (D2) | 31.83 b | 4.22 b | 5.75 a | 1.67 a | 12.59 a |
| 675 kg ha$^{-1}$ (D3) | 32.47 b | 5.17 a | 5.77 a | 1.57 a | 11.79 a |
| LSD 5% | 3.98 | 1.05 | - | - | 3.12 |
| Types of Fertilizers (P) | | | | | |
| Without Fertilizer (P0) | 31.67 a | 3.88 b | 5.42 a | 1.46 a | 8.90 b |
| Compost (P1) | 32.60 a | 4.83 a | 5.51 a | 1.58 a | 12.20 a |
| NPK (P2) | 33.08 a | 4.54 ab | 6.00 a | 1.63 a | 13.30 a |
| LSD 5% | - | 0.91 | - | - | 2.70 |

Note: Numbers followed by the same lowercase letters in the same column are not significantly different at 5% LSD.

### *Fresh root weight per plant*

Based on the analysis of variance, dolomite treatment, different types of fertilizers, and their interactions had no significant effect (P>0.05) on the fresh root weight per plant of scallion (Table 1). The dolomite treatment of 450 kg ha$^{-1}$ (D2) produced the highest fresh root weight per plant at 1.67 g, which was not significantly different from other treatments. Among the fertilizer treatments, the NPK fertilizer type (P2) showed the highest fresh root weight per plant at 1.63 g, which was also not significantly different from the other fertilizer treatments. There was a tendency for an increase in fresh root weight with an increase in the dolomite dose, from 0 kg ha$^{-1}$ to 450 kg ha$^{-1}$. The highest fresh root weight of 1.67 g was obtained at a dolomite dose of 450 kg ha$^{-1}$ (D2). The treatment without dolomite (D0) showed the lowest fresh root weight at 1.44 g, while the dolomite treatments of 225 kg ha$^{-1}$ (D1) and 675 kg ha$^{-1}$ (D3) showed results that were not much lower than the 450 kg ha$^{-1}$ (D2) treatment (Table 2).

### *Economic fresh weight per plant*

Based on the analysis of variance, dolomite treatment had a significant effect ($P<0.05$) on the economic fresh weight of scallion plants. The fertilizer type treatment had a very significant effect ($P<0.01$) on the economic fresh weight per plant, while the interaction between dolomite and fertilizer type had no significant effect ($P>0.05$) on the economic fresh weight of scallion plants (Table 1). The application of 450 kg $ha^{-1}$ dolomite (D2) produced the highest economic fresh weight of 12.59 g, which was not significantly different from the treatments of 225 kg $ha^{-1}$ (D1) and 675 kg $ha^{-1}$ (D3). The treatment without dolomite (D0) had the lowest economic fresh weight at 9.42 g. Among the fertilizer types, NPK fertilizer (P2) resulted in the highest economic fresh weight at 13.30 g, which was significantly different from the treatment without fertilizer (P0), but not significantly different compared to the compost fertilizer type (P1) (Table 2).

Unlike fresh root weight, economic fresh weight showed better results at higher dolomite doses. The dose of 450 kg $ha^{-1}$ (D2) produced the best result (12.59 g), followed by D1 (12.07 g). NPK fertilizer (P2) also yielded the highest economic fresh weight (13.30 g), followed by compost (P1) with a value of 12.20 g, and without fertilizer (P0) at 8.90 g.

## Discussion

Research has shown that dolomite can increase soil pH and facilitate nutrient uptake by plants, particularly calcium and magnesium. Plants need this mineral for growth. In general, fresh weight increases with increasing dolomite dosage. After reaching a certain point (450 kg $ha^{-1}$), the dolomite dosage begins to decrease, reaching 675 kg $ha^{-1}$. When plants are given the right amount of dolomite, the scallion plants will grow taller and produce more leaves.

The results of this study are consistent with those of Tanari *et al*. (2018), who found that adding dolomite to acidic soil can neutralize soil pH, improve soil quality, encourage root growth, and increase crop yields. Dolomite is widely known as a soil amendment to improve soil quality and aid nutrient uptake by plant roots.

The addition of dolomite ($CaMg(CO_3)_2$) to the soil triggers a series of chemical reactions. Dolomite reacts with hydrogen ions in the soil to help neutralize soil acidity, as follows:

$$CaMg(CO_3)_2 + 4H^+ \rightarrow Ca^{2+} + Mg^{2+} + 2CO_2 + 2H_2O$$

From the reaction above, plants require calcium ($Ca^{2+}$) and magnesium ($Mg^{2+}$) ions for various physiological processes. Calcium is essential for the formation of cell wall structures and signalling in plant metabolism. Magnesium is an essential component of chlorophyll, which plants use to produce food through photosynthesis.

Dolomite soil amendment has been used by farmers to maintain soil fertility, increase growth, and crop yields (Ilham *et al*., 2019). Adding dolomite to soil can increase nutrient absorption, accelerate the decomposition of organic matter by soil microorganisms, and make nutrients more readily available (Sahari *et al*., 2014). This study found a significant difference between dolomite and non-dolomite applications. In this case, there was an increase in plant fresh weight at doses of 225–450 kg $ha^{-1}$ compared to applications without dolomite treatment.

The combined use of dolomite, compost, and NPK fertilizer in agricultural land can help plants absorb more nutrients and potentially increase scallion yields. The findings of this study are consistent with previous research on the effects of dolomite and fertilizer type on plant growth and yield, although significant variation remains. Dolomite, NPK fertilizer, and compost work together to help plants better absorb nutrients, enhancing plant growth and increasing scallion yields. Using dolomite with NPK fertilizer resulted in more leaves being produced. This was because dolomite made important nutrients more available for plant growth, including the formation of new leaves.

A study of different types of fertilizer showed that NPK (P2) gave the best results, with an economic fresh weight of 13.30 grams. Plants need three macronutrients to grow and develop: nitrogen, phosphorus, and potassium. NPK fertilizer has all three of these. The significant increase in economic fresh weight can be attributed to the ability of NPK fertilizer to promote vegetative and reproductive growth.

The kind of fertilizer also affected the economic fresh weight. Plants that weren't fertilized or were only fertilized with compost weighed the least (13.30 grams) compared to plants that were fertilized with NPK. NPK fertilizers also help plants grow taller and make their stems thicker. In general, new economic weight seems to be positively related to other things, such as new root weight, plant height, leaf number, and stem diameter. Adding more dolomite and using the right fertilizer can help plants grow faster and be worth more.

Composting improves soil health and nutrient density by introducing beneficial microorganisms and micronutrients. Adding compost to the soil improves fertility and soil density. Plants require NPK fertilizer containing nitrogen, phosphorus, and potassium to grow. The nitrogen element in NPK fertilizer encourages vegetative growth, while the phosphorus and potassium

elements increase root development and plant resistance to disease (Lestari and Palobo, 2019).

This study found that the type of fertilizer used (compost and NPK) had no significant effect on plant growth variables such as plant height, stem diameter, and root weight. This is likely due to the low nutrient content of the compost, which does not release nutrients quickly enough to meet plant needs. Compost had only a slight effect on scallion growth.

Compost and NPK fertilizers both provide the nutrients plants need for growth. When dolomite is combined with compost and NPK fertilizer, the efficiency of nutrient absorption in the soil increases, resulting in maximum growth and increased crop yields. Although studies have shown that dolomite can increase soil pH and nutrient availability, its effect on stem diameter is insignificant. While dolomite, compost, and NPK fertilizers all promote plant growth, they do not affect scallion stem diameter. Dolomite helps plants absorb nutrients more efficiently than compost and NPK fertilizers, thus encouraging plant growth and producing more leaves.

This research aligns with the findings of Adi and Musyrif (2021) that the proper application of dolomite and NPK fertilizer can significantly increase scallion yields. Dolomite, which contains calcium and magnesium, increases soil pH and nutrient availability. When soil pH increases, microbes become more active, allowing plants to access nutrients more easily.

The results showed that the interaction between dolomite treatment and fertilizer type had no significant effect on all observed growth and yield variables of scallion plants. The lack of a significant effect of dolomite treatment and fertilizer type on scallion growth and yield may be due to complex interactions among factors. Optimal soil pH can mitigate the additional effects of dolomite application. Furthermore, adequate soil nutrient content can make the difference between dolomite and fertilizer application insignificant.

Increasing the dolomite dose can reach a saturation point, where additional dolomite provides no further benefit. Meanwhile, fertilizer types that already provide all the nutrients plants need may not show any further significant effects. Nutrient antagonism can also occur, where calcium in dolomite can affect the availability of other nutrients such as magnesium or potassium (Wahidah and Achmad, 2020). Plants can also be affected by factors beyond their control, such as rainfall, humidity, and temperature. These conditions make it difficult to determine how dolomite and different types of fertilizer affect plant growth. Under certain conditions, different scallion varieties may require or tolerate different amounts of dolomite and fertilizer (Mansyur *et al*., 2021). Further, more comprehensive research can help understand plant responses to dolomite and fertilizer applications.

The results of this study indicate that the best dolomite dose (450 kg $ha^{-1}$) increased the fresh weight of scallion plants, which is in line with previous research (Tanari *et al*., 2018). A higher dose (675 kg $ha^{-1}$) resulted in a decrease caused by nutrient imbalance (Sahari *et al*., 2014). Plants grew significantly better when using NPK fertilizer. This is supported by the findings of Lestari and Palobo (2019) that NPK is good at providing the nutrients needed by plants. On the other hand, compost does not provide as large an effect as NPK because compost fertilizer releases nutrients more slowly (Iswara and Nuraini, 2022). The absence of interaction between dolomite and fertilizer type is in line with the findings of Wahidah and Achmad (2020), who stated that soil conditions and plant genetics can influence the effectiveness of fertilizer application.

The combined application of dolomite with other fertilizers (compost and NPK) is an excellent way to enhance plant growth. This combination can help plants grow taller, have thicker stems, and be heavier when fresh. Regular soil testing is necessary to ensure that both plants and soil receive the proper amount of nutrients. This study emphasizes the importance of tailoring agricultural practices to specific soil conditions, thereby facilitating increased yields and sustainability. Further research is needed to understand the long-term impacts of specific soil conditions and provide better, more sustainable recommendations.

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## Conflict of interest

The authors declare no conflict of interest.

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