

Effect of cow manure and dolomite on the growth and production of mung beans (*Vigna radiata* L.)

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Abstract

This study aims to analyze the effect of dolomite fertilizer and cow pen application on the growth and production of mung beans (*Vigna radiata* L.). The study was conducted using a quantitative method with a Group Randomized Design (RAK), including three dolomite dose treatments: no dolomite (d0), 1 kg/plot (d1), and 2 kg/plot (d2). The research was carried out in the experimental land of the Faculty of Agriculture UPMI in May-August 2021. The results showed that the application of dolomite had a significant effect on plant height at 4 weeks after planting (MST), with d2 treatment producing the highest height. However, no significant influence was found on other parameters such as the number of leaves, the number of pods, the weight of seeds per plot, the weight of 100 grains, and the length of the roots. This suggests that dolomite is more effective in supporting plant early growth through increased soil pH and nutrient availability, but does not directly increase crop yields. Therefore, the use of dolomite needs to be combined with other agronomic strategies to optimize mung bean production in acidic land.

Keywords: Dolomite fertilizer, green beans (*Vigna radiata* L.), plant growth

Introduction

Indonesia is known as a fertile agrarian country and rich in agricultural products and plantations (Marlina & Isnaini, 2011; Tanjung *et al.*, 2023) [10, 17]. The agricultural sector is one of the backbones of the Indonesian people's economy, making a great contribution to the income of the community and the state. In addition to being a source of livelihood, this sector also provides raw materials for industry and generates foreign exchange for national development (Kusuma *et al.*, 2022; Setya *et al.*, 2019; Widian & Subono, 2019) [9, 15, 19].

One of the important legume crop commodities is mung beans (*Vigna radiata* L.). Mung beans have a high nutritional content, such as amyllum, protein, iron, calcium, fat, and various vitamins (Harianti *et al.*, 2022; Irwanda *et al.*, 2022; Sianipar *et al.*, 2020) [6, 8, 16]. This makes it one of the important food ingredients for the world community. In North Sumatra Province, mung bean production has fluctuated in recent years. In 2015, production reached 306.0 tons, increased in 2016 to 2171.1 tons, and continued to increase in 2017 to 2874.2 tons. However, in 2018 and 2019 there was a decrease in production by 1766.59 tons and 449.4 tons, respectively (Duadja & Fitriyani, 2022; Vanhuri & Lubis, 2019) [3, 19]. These production fluctuations indicate that there are challenges in optimizing the growth and yield of mung beans in the region.

Soil fertility is one of the main factors that determine the success of plant growth (Hasibuan *et al.*, 2022; Banana *et al.*, 2022; Saragih, 2016) [7, 14]. To improve soil fertility, cow manure is often used because of its ability to improve the physical, chemical, and biological properties of soil (Azhari *et al.*, 2022; Ernanda *et al.*, 2022) [1, 4]. This fertilizer can also increase soil water resistance, improve soil structure, and reduce the risk of environmental pollution (Hasibuan *et al.*, 2022; Purnomo *et al.*, 2020) [7, 13].

In addition to cow manure, dolomite fertilizer also has an important role in soil fertility management. Dolomite is a primary mineral containing calcium (Ca) and magnesium (Mg), which serves as a liming agent for acidic soils, thus helping to increase soil pH (Dalimunthe *et al.*, 2020;

Nasution & Yoman, 2021) [2, 11]. Dolomite is also able to increase the availability of nutrients such as phosphorus, which is usually low in acidic soils, which is only about 0.01–0.2 mg/kg (Harahap *et al.*, 2020; Yuzairi U.S *et al.*, 2022) [5, 20]. The application of dolomite is known to increase soil pH, and the availability of nutrients such as Ca and Mg, and reduce harmful aluminum levels.

The characteristics of dolomite can be more specifically identified based on the following main characteristics:

1. It has a chemical classification of carbonates.
2. The color varies, such as white, pink, green, gray, brown, to black.
3. It has white stripes.
4. It has a pearl-like texture, is translucent, and has a perfect three-way slit in three directions.
5. It has a hardness level between 3.5 to 4 on the Mohs scale.
6. Its specific gravity ranges from 2.8 to 2.9.
7. The chemical composition of dolomite is $\text{CaMg}(\text{CO}_3)_2$.
8. It is commonly utilized in various sectors, such as construction aggregates, cement manufacturing, dimensional stones, lime producers through calcination processes, oil and gas reservoirs, magnesium sources in the chemical industry, agricultural soil treatment, and as a metallurgical flux.

The complementary use of dolomite and cow manure offers substantial potential to optimize plant growth, particularly in challenging agricultural environments characterized by acidic and nutrient-poor soils. Dolomite, known for its ability to neutralize soil acidity, enhances soil pH levels and provides essential nutrients such as magnesium and calcium. This amendment is particularly effective in improving the availability of nutrients in acidic soils, which often limit plant productivity. On the other hand, cow manure acts as a natural organic fertilizer, supplying the soil with organic matter that significantly improves its structure, aeration, and water retention capacity. When used together, dolomite and cow manure can synergistically create a conducive

environment for plant growth, fostering improved nutrient uptake and sustainable soil health.

This research focuses on analyzing the impact of combining dolomite and cow manure on the growth and production of mung beans (*Vigna radiata* L.). Mung beans, a leguminous crop with significant nutritional and economic value, often face productivity challenges on marginal or less fertile lands. By examining the interactions between these two fertilizers, the study seeks to uncover practical strategies to maximize crop yields while improving soil quality. Specifically, the research aims to determine the optimal ratios and application methods of dolomite and cow manure to enhance the growth rate, biomass accumulation, and seed production of mung beans.

The findings from this study are expected to provide actionable insights into sustainable agricultural practices for improving mung bean cultivation on low-fertility soils. This approach not only promotes environmental sustainability through the use of organic and mineral soil amendments but also supports smallholder farmers in achieving better productivity and income. By bridging the gap between soil

science and practical farming techniques, the research contributes to a more resilient agricultural system tailored to the needs of resource-constrained areas.

Research methods

This study used a quantitative method with an experimental approach to evaluate the effect of dolomite administration on the growth and production of mung beans (*Vigna radiata* L.). The research design used was a Group Random Design (RAK) with two treatment factors. The first factor is the administration of dolomite (D) with the following three levels of treatment:

- d0 : without Dolomite fertilizer (d0)
- d1 : Dolomite concentration 1 kg/crop
- d2 : Dolomite concentration 2 kg/crop

After the data from the research results are obtained, data analysis will be carried out using a Factorial group random design (RAK) with the formula:

$$Y_{ijk} = \mu_0 + \rho_i + \alpha_j + \beta_k + (\alpha\beta)_{jk} + \epsilon_{ijk}$$

Table 1: Information

Y_{ijk}	=	Observation results from the experimental plot that received the first treatment of the j level and the second factor of the k level and placed in the i repeat
M0	=	Effect of middle value (NT) / general average
PI	=	Influence of the i group
α_j	=	influence of factor I of the jth level
β_k	=	influence of factor II k-level
(ab) jk	=	the effect of the combination of treatment between factor I of the j-level and factor II of the k-level
Eijk	=	the effect of error due to factor I of the j level and factor II of the k level placed in the i group.

This study uses the main ingredients in the form of green bean seeds of the Vima-1 variety, cow manure, dolomite fertilizer, and urea fertilizer. The tools used include padlocks for watering, hoes for tillage, rulers for measuring plant growth, office stationery (ATK) for data recording, cameras for documentation, and other supporting equipment.

Results and discussion

The effect of the dolomite application on the growth and production of mung bean plants (*Vigna radiata* L) has a very obvious effect. Meanwhile, the effect was not obvious on the plant height of 2 mst, 6 mst, seed weight per plot (gr), root length per sample (cm), weight of 100 sample grains (gr), number of leaves (strands), and number of pods. The amount that has a real effect on the height of the plant is 4 ms per sample (cm).

Plant Height

The application of dolomite had a significant effect on plant height at 4 weeks after planting (WAP) but showed no significant effect at 2 and 6 WAP.

Effect of dolomite on plant height at 2 WAP (cm):

- D0 (0 kg dolomite/plot): 10.26 cm
- D1 (1 kg dolomite/plot): 10.26 cm
- D2 (2 kg dolomite/plot): 11.04 cm

As shown in Table 1, the D2 treatment (2 kg dolomite/plot) produced the highest plant height at 2 WAP, reaching 11.04 cm, while both D0 (0 kg dolomite/plot) and D1 (1 kg dolomite/plot) recorded the same value of 10.26 cm. Although D2 showed a higher plant height, the differences between treatments were not statistically significant at this growth stage.

Overall, while dolomite application demonstrated potential benefits on plant height, its impact may vary depending on the growth stage, with more pronounced effects observed during later development stages. This highlights the importance of timing and appropriate application rates for optimizing plant growth.

Effect of Dolomite on Plant Height at 4 WAP (cm):

- D0 (0 kg dolomite/plot): 13.44 cm (a)
- D1 (1 kg dolomite/plot): 12.33 cm (ab)
- D2 (2 kg dolomite/plot): 16.74 cm (ab)

Explanation: The data in Table 2 indicates that the application of dolomite significantly affected plant height at 4 weeks after planting (WAP). The highest plant height was observed in the D2 treatment (16.74 cm), while the lowest height was recorded in the D1 treatment (12.33 cm). The D0 treatment (13.44 cm) did not show a statistically significant difference when compared to either D1 or D2.

Notation: Values followed by different lowercase letters (a or ab) within the same column indicate significant differences based on the DMRT test at a 5% significance level.

Additionally, the effect of the dolomite application on seed weight per plot (grams) showed a highly significant impact, which can be visualized through a corresponding graph for detailed interpretation.

Effect of Dolomite on Plant Height at 4 MST (cm):

- D0 (0 kg dolomite/plot): 13.44 cm (a)
- D1 (1 kg dolomite/plot): 12.33 cm (ab)
- D2 (2 kg dolomite/plot): 16.74 cm (ab)

Explanation: demonstrates the impact of dolomite application on plant height at 4 weeks after planting (WAP). The D2 treatment (2 kg dolomite/plot) resulted in the tallest plants at 16.74 cm, while the D1 treatment (1 kg dolomite/plot) had the shortest plants at 12.33 cm. The D0 treatment (control, 0 kg dolomite/plot) showed an intermediate height of 13.44 cm. However, statistical analysis using the DMRT test at a 5% significance level indicates no significant difference between the D0, D1, and D2 treatments, as evidenced by the shared letters (a and ab).

Notation: Different lowercase letters in the column indicate significant differences between treatments. Identical letters suggest no significant variation in plant height among the respective treatments.

This finding highlights the potential influence of dolomite on early plant growth but suggests the need for further study to confirm its effects at varying application rates and growth stages.

The effect of cow manure application on seed weight per plot (gram) has a very obvious effect can be seen in the graph Figure 1

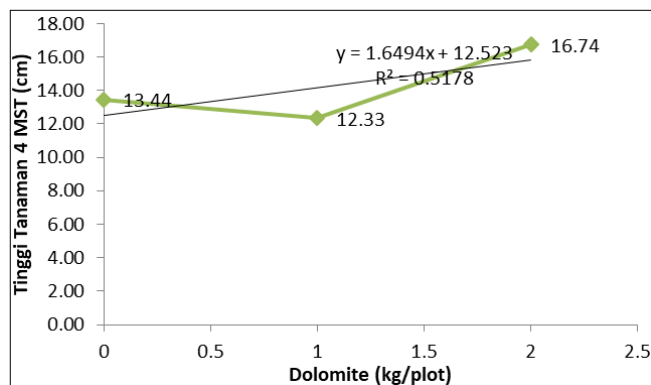


Fig 1: Plant height (cm) due to dolomite administration with various treatment doses.

Figure 1. It can be seen that the application of dolomite responds to plant height (cm) showing a linear relationship with the regression equation:

$$\hat{y} = 1.6494x + 12.523; R^2 = 0.5178$$

Table 4. Effect of Dolomite on Plant Height at 6 MST (cm):

- D0 (0 kg dolomite/plot): 24.33 cm
- D1 (1 kg dolomite/plot): 25.00 cm
- D2 (2 kg dolomite/plot): 25.85 cm

Explanation: Table 4 illustrates the effect of dolomite application on plant height at 6 weeks after planting (WAP). The highest plant height was observed in the D2 treatment (2 kg dolomite/plot), reaching 25.85 cm, while the lowest height was recorded in the D0 treatment (0 kg dolomite/plot) at 24.33 cm. The D1 treatment (1 kg dolomite/plot) resulted in an intermediate height of 25.00 cm.

Although the results suggest a positive trend in plant height with increasing dolomite application rates, the differences among treatments are relatively small, indicating that the effect may not be statistically significant. Further analysis or replication is needed to confirm the consistency of these findings and their potential implications for optimizing dolomite usage.

Number of Leaves

From the results of statistical tests, the effect of dolomite application has no real effect on the number of leaves (strands) at the age of 2 mst, 4 mst.

Table 5. Effect of Dolomite on Leaf Count at 2 MST (Strands):

- D0 (0 kg dolomite/plot): 5.00 strands
- D1 (1 kg dolomite/plot): 4.93 strands
- D2 (2 kg dolomite/plot): 5.19 strands

Explanation: The effect of dolomite application on the number of leaves at 2 weeks after planting (WAP). The highest leaf count was observed in the D2 treatment (2 kg dolomite/plot), which produced 5.19 strands. The lowest leaf count was recorded in the D1 treatment (1 kg dolomite/plot) at 4.93 strands, while the D0 treatment (0 kg dolomite/plot) yielded an intermediate leaf count of 5.00 strands.

The data suggests a slight increase in the number of leaves with higher dolomite application, although the differences between treatments are minimal. This indicates that dolomite may have a limited impact on leaf development at this early growth stage. Further studies could help clarify its influence on other plant parameters and later stages of development.

Effect of Dolomite on Leaf Count at 4 MST (Strands):

- D0 (0 kg dolomite/plot): 17.67 strands
- D1 (1 kg dolomite/plot): 17.82 strands
- D2 (2 kg dolomite/plot): 18.19 strands

Explanation: The effect of dolomite application on leaf count at 4 weeks after planting (WAP). The highest leaf count was recorded in the D2 treatment (2 kg dolomite/plot), producing 18.19 strands, while the lowest was in the D0 treatment (0 kg dolomite/plot) at 17.67 strands. The D1 treatment (1 kg dolomite/plot) resulted in an intermediate leaf count of 17.82 strands.

The data indicates a slight positive trend in leaf count with increasing dolomite application rates, suggesting that dolomite may contribute to improved vegetative growth. However, the differences between treatments are relatively minor, highlighting the need for further analysis to determine the statistical significance and practical implications of these findings.

Number of Pods per Plot (pods)

Effect of Dolomite on the Number of Pods (per sample) at 45 HST:

- D0 (0 kg dolomite/plot): 2.63 pods
- D1 (1 kg dolomite/plot): 3.63 pods
- D2 (2 kg dolomite/plot): 4.52 pods

Explanation: the effect of dolomite application on the number of pods per sample at 45 days after sowing (HST). The highest number of pods was observed in the D2 treatment (2 kg dolomite/plot), with 4.52 pods per sample, while the lowest was found in the D0 treatment (0 kg dolomite/plot) at 2.63 pods. The D1 treatment (1 kg dolomite/plot) resulted in 3.63 pods per sample, showing a positive trend with increased dolomite application.

Despite these differences, statistical tests suggest that dolomite application had no significant effect on pod number at both 45 and 60 HST. This may indicate that while dolomite appears to influence pod count, other factors like

soil fertility or environmental conditions could play a more dominant role. Further analysis could be conducted to examine these influences in greater detail.

Effect of Dolomite on Pod Count (per sample) at 60 HST:

- D0 (0 kg dolomite/plot): 4.89 pods
- D1 (1 kg dolomite/plot): 6.74 pods
- D2 (2 kg dolomite/plot): 5.85 pods

Explanation: the effect of dolomite application on pod count per sample at 60 days after sowing (HST). The highest number of pods was observed in the D1 treatment (1 kg dolomite/plot) with 6.74 pods per sample, while the lowest was found in the D0 treatment (0 kg dolomite/plot) at 4.89 pods. The D2 treatment (2 kg dolomite/plot) resulted in 5.85 pods per sample, indicating an intermediate outcome between D0 and D1.

These results suggest that dolomite application may have an influence on pod production, with the D1 treatment showing the highest pod count. However, the lack of statistical significance across treatments suggests that other factors, such as soil fertility or plant genetics, might be contributing to the observed differences. Further research could be conducted to confirm these findings and better understand the role of dolomite in pod development.

Seed Weight per Plot

Single Effect of Dolomite on Seed Weight Per Plot in Harvests 1, 2, and 3 (gr):

- D0 (0 kg dolomite/plot): 22.89 gr
- D1 (1 kg dolomite/plot): 22.85 gr
- D2 (2 kg dolomite/plot): 22.04 gr

Explanation: The statistical analysis shows that the application of dolomite had no significant effect on seed weight per plot across the 1st, 2nd, and 3rd harvests. As presented in Table 9, the D0 treatment (0 kg dolomite/plot) produced the highest seed weight at 22.89 grams, followed by D1 (1 kg dolomite/plot) at 22.85 grams. The D2 treatment (2 kg dolomite/plot) resulted in the lowest seed weight of 22.04 grams.

These findings suggest that while dolomite is beneficial for increasing soil pH, it does not directly impact seed yield in this study. The lack of a significant effect could be attributed to the relatively fertile soil conditions, which may have already provided sufficient nutrients for optimal crop growth, diminishing the additional benefits of dolomite. Further investigation into different soil types or varying crop varieties might offer insights into the specific conditions under which dolomite application could positively influence seed yield.

Weight 100 grains per sample

Single Effect of Dolomite on the Weight of 100 Grains in the 1st, 2nd, and 3rd Harvest (gr):

- D0 (0 kg dolomite/plot): 3.34 gr
- D1 (1 kg dolomite/plot): 3.27 gr
- D2 (2 kg dolomite/plot): 3.37 gr

Explanation: The statistical analysis revealed that dolomite application had no significant effect on the weight of 100 grains during the 1st, 2nd, and 3rd harvests. As shown in Table 10, the D2 treatment (2 kg dolomite/plot) produced the highest 100-grain weight of 3.37 grams, whereas the lowest was observed in the D1 treatment (1 kg

dolomite/plot) at 3.27 grams. The D0 treatment (control) resulted in an intermediate grain weight of 3.34 grams.

The lack of significant differences among treatments suggests that genetic factors may play a more dominant role in determining seed size and weight than the application of dolomite. This finding indicates that while dolomite might influence other growth parameters, its effect on grain weight is minimal under the conditions tested. Further research could explore interactions between dolomite and other factors, such as soil fertility or plant variety.

Root Length per plot

Single Effect of Dolomite on Root Length at 65 HST (cm):

- D0 (0 kg dolomite/plot): 23.59 cm
- D1 (1 kg dolomite/plot): 24.59 cm
- D2 (2 kg dolomite/plot): 23.70 cm

Explanation: The results of statistical tests show that the application of dolomite had no significant effect on root length at 65 days after planting (HST). As presented in Table 11, the D1 treatment (1 kg dolomite/plot) resulted in the longest root length at 24.59 cm, followed by D2 (2 kg dolomite/plot) at 23.70 cm and D0 (0 kg dolomite/plot) at 23.59 cm.

The minimal differences in root length among the treatments suggest that dolomite application does not play a critical role in influencing root growth at this stage. These findings highlight the need for further research to explore other factors that might affect root development and evaluate dolomite's impact under varying soil and environmental conditions.

On the root length parameter, dolomite application did not have a noticeable effect on the age of 65 HST (Table 10). The D1 treatment produced the highest root length of 24.59 cm, while the D0 treatment produced the shortest root length, which was 23.59 cm. Although not significant, the use of dolomite still shows an increasing trend in root length, which favors the development of root volume for wider nutrient uptake.

Dolomite fertilizer is classified as a primary mineral that contains calcium and magnesium elements and is used as a liming agent in acidic soils to raise pH. Dolomite fertilizer is also another alternative in improving soil properties to increase plant growth and mung bean yield, cow manure is an organic fertilizer that functions as a water binder, improves soil structure, loosens soil, improves soil physical, chemical, and biological properties, reduces environmental pollution, increases land production and prevents land degradation.

The effect of the dolomite application on the growth and production of mung bean plants (*Vigna radiata* L) has a very obvious effect non-existent. While the ones that did not have a real effect on the plant height were 2 mst, 6 mst, seed weight per plot (gr), root length per sample (cm), weight 100 sample grains (gr), number of leaves (strands), number of pods. The amount that had a real effect on the height of plants aged 4 ms per sample (cm). and develop well. Neutral pH (6.5-7) results in soil organic matter reversing microorganisms and N anchors can work optimally.

The application of Dolomite had a real effect on the height of plants aged 4 ms (cm). Nutrients N, P and K can stimulate the growth and development of plant roots so that plants can reach a wider scope of nutrient absorption so that the volume of roots is wider.

Dolomite lime contains calcium (CaO) and Magnesium (MgO). The main use of this lime is to increase the pH of the soil as well as neutralize its acidity level. The acidity level of the soil needs to be adjusted to the natural habitat of the plants to be maintained so that it can adapt well.

Overall, the application of dolomite has a positive effect on several aspects of mung bean plant growth, especially in the vegetative phase such as plant height. However, the effect on crop yields such as seed weight and number of pods is not significant. This suggests that dolomite is more effective in improving soil conditions for early growth, but does not directly increase crop yields. Increased soil pH and the availability of nutrients such as Ca and Mg, phosphorus, and magnesium are important in supporting the process of metabolism and protein synthesis in plants.

Conclusion

The application of dolomite has a significant effect on the height of mung bean plants (*Vigna radiata L.*) at the age of 4 weeks after planting (MST), showing increased growth in the early vegetative phase. However, the application of dolomite did not exert a significant influence on other parameters such as plant height at 2 and 6 MST years, number of leaves, number of pods, weight of seeds per plot, weight of 100 grains, and root length. This indicates that although dolomite can improve soil conditions and support the early growth of plants, its use does not directly increase crop yields. Therefore, dolomite is effectively used to promote the early growth of mung beans, but it needs to be combined with other agronomic efforts to maximize crop production and overall yield.

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