The influence of liquid type with grain size on the soil properties in hybrid corn growth

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Abstract. Liming activity is an effort to raise the soil pH so that the reaction is not acidic. Most of the plants are less tolerant of acidic soil (pH <7). Because acidic soil causes solubility of Aluminum (Al), Manganese (Mn), and Iron (Fe). For example, when Al’s solubility is high, Al does not only poison the plant but causes the essential element phosphorus (P) in the soil to be fixed (bound) by the Al so that it cannot be absorbed by the plant. This study aims to determine the effect of lime types with grain size on soil properties and growth and production of hybrid corn. This study uses nonfaktorial randomized block design (RBD) which consists of two treatment factors, namely the type of agricultural lime which is divided into 2 treatment levels, namely D1: Dolomite and D2: Calcite, each type is divided into 3 sizes namely: D1-1 is passes 60 mesh filter, D1-2 is passes 80 mesh filter, D2-1 is passes 60 mesh filter, D2-2 is passes 80 mesh filter. Thus, 4 treatments will be repeated 3 times, so that there will be 12 experimental units. Each experimental unit consists of 3 polybags, so that 36 polybags will be obtained. And in each experimental unit there were 2 sample plants. The results showed that lime treatment significantly affected plant height, wet weight of straw, ear length, ear diameter and ear weight per plant, but had no significant effect on the number of leaves, leaf area index, and flowering age.

Keywords: dolomite and calcite lime, size of chalk granules, corn

1. Introduction
The quality of lime based on fineness will determine the slow reaction of lime in the soil. Which is very dependent on the level of solubility of the lime. Fineness of lime carbonate gilling needs to get attention because it can be produced in various sizes. The size of the smoothness that is used is usually a mesh. When the size is 100 mesh, it means there are 100 holes per inch of filter (diameter of 100 mesh size = 0.058 inches). Agricultural lime suggested at this time is 100% passed from 20 mesh sieve and 50% must pass from 80-100 mesh sieve [1]. Fine size is expected to be useful in the near future, while a rather rough one will be useful for a long time. The combination of fine chalk with a rather coarse price is cheaper than the fine chalk. The karna will be affordable by farmers' finances. Besides that, the benefits can be enjoyed for longer. Table 1 presents a comparison of the reactions of various fineness of lime
materials. Different gravity not only causes different soil reactions, but also affects plant growth and production [2]. Comparison of various fineness of lime ingredients when given in the same amount, can be seen at Table 1.

Table 1. Comparison of various fineness of lime ingredients when given in the same amount

| Content                  | Various fineness of lime |
|--------------------------|--------------------------|
|                          | 100 mesh      | 60-80 mesh | 20-40 mesh | 8-12 mesh |
| Water solubility         | 100           | 57         | 45         | 28         |
| Contains CO₂ Packaging   | 100           | 57         | 27         | 18         |
| Nitrate formation        | 100           | 94         | 56         | 12         |
| Plant growth             | 100           | 69         | 22         | 5          |

Liming materials are of two types. Those that only contain calcium carbonate (CaCO₃), calcium hydroxide (CaOH₂), or calcium oxide (CaO) are called "calcite lime." Pure calcium carbonate is used as a standard for liming materials and is rated 100 percent [3]. Agricultural lime suggested at this time is 100% escaped from a 20 mesh sieve and 50% must pass from an 80-100 mesh sieve [4,5]. Provide specific examples of the benefits for liming productivity of upland grassland soils using research that began in the 1970: the number of livestock doubled within 4 years of application of lime and clover lasted for more than 20 years [6]. Reviewed the literature and found that, on balance, calcification of the increase in soil C content was largely due to increased yields and therefore residual returns.

Phosphate stones can have a liming value between 450 and 560 kg equivalent to CaCO₃ per ton which is applied because of the presence of several CaCO₃ and dissolution of minerals, which consume H⁺ [7]. If nitrate (NO₃⁻) is taken by plants, there is no clean acidification because NO₃⁻ takes the proton with it [8]. The most important cause of soil acidification on agricultural land is the application of ammonium and urea-based fertilizers, S-element fertilizers and legume growth [9]. Organic matter also has a relatively high CEC, which means a greater amount of lime is needed to increase pH than when dealing with mineral soils. Because organic soils contain fewer micronutrient cations, overliming can cause additional micronutrient deficiencies [10]. According to [11], an increase in soil pH as a consequence of calcification can increase microbial activity, increase the amount of dissolved organic matter and, consequently, increase the solubility of Mn bound to low molecular weight organic compounds. Liming is widely considered to increase the availability of P to plants. However, the benefits of lime on the availability of P land have become a matter of dispute for a long time [12,13].

The same chemical quality from different subtleties will have a different effect. Agricultural lime should meet the requirements of the aforementioned fineness. Lime carbonate is a type of lime whose material comes from limestone which is not through the combustion process, but directly in gilling. There are two kinds of lime carbonate, namely calcite and dolomite. If the raw material contains more calcium carbonate and less magnesium carbonate, this lime is called calcite, if the raw material contains calcium carbonate and magnesium carbonate, this lime is called dolomite [14].

The function of the kitchen in neutralizing acidity is CO₃ has the ability to attract H ions from colloidal soils (trough complexes). Whereas to expel Al from the absorption complex requires OH⁻ ions. After Al ions are compounded with OH ions to form AlOH₃ gibbsite, micelles are occupied by Ca. Through both processes there was neutralization of acidity, both from H ions and from Al ions. In connection with the influence of soil acidity, the problem faced is the high solubility of Al, Fe and Mn where if these three elements are excessive they can be toxic to plants, so that plant growth will decline [16]. Another advantage of the provision of lime (dolomite) is to increase uptake of N elements, other elements increase symbiotic and non-symbiotic N₂ fixation, also increase microbial activity. Increased microbial activity
especially decomposer will increase mineralization [17]. The most commonly used liming material is dolomitic rock that is finely ground, but calcite lime is also widely used. Additional liming materials include fuel lime or hydrated lime, lime pellets, liquid lime, wood ash, and industrial slag [18]. Different fineness not only causes different soil reactions, but also affects plant growth and production [19]. Factors that need to be considered in liming include: the size of the lime particles, the dosage, the method and time of lime administration. Lime particle size affects the speed of reaction of lime in the soil. The finer the size of the lime particles the faster the reaction of lime in the soil [20].

2. Research Methods
This research was carried out in Tanjung Sari Medan, which is located at an altitude of ± 32 meters above sea level. This research is planned for the month (September-November) The materials used in this study are as follows: Hybrid corn seed, pure andosol soil, polybag with a size of 40 x 50 cm, agricultural lime (dolomite and calcite) with a dose of 4 tons/ha (6.7 g) Urea, KCL, NPK as basic fertilizer. The tools used in this study are as follows: hoes, meters, knives, saws, sieves (80 mesh, and 60mesh). The stages of the research implementation are: preparation of planting area (filling of andosol soil, provision of seeds, separation of lime based on grain size (size of 60 mesh and 80 mesh), application of lime (lime sown on the ground in polybags), planting of seeds (corn seedlings are planted after 2 weeks of lime sowing, plant maintenance (weeding, watering, fertilizer and spraying), yield (plant height (cm), number of leaves (strands), leaf area index, wet weight of corn straw (g), length of cropping cob (cm), diameter of cropping cobs (mm), weight of cobs per plant (g).

3. Result and Discussion
The results showed that lime treatment significantly affected plant height, wet weight of straw, ear length, ear diameter and ear weight per plant, but no significant effect on leaf number, leaf area index, and flowering age. Based on the results of the different mean test, dolomite lime treatment results in better plant growth and production compared to calcite lime. The difference in grain size results in different production (ear length, ear diameter and wet weight of cob), where the grain size of 80 mesh produces higher production than 60 mesh size. But the difference in grain size produces plant height and straw wet weight which is not significantly different. In terms of fineness of lime, for sizes 60 and 80 mesh does not give a difference in plant growth, this is due to observation of 6 lime MST size of 60 and 80 mest has been dissolved in the soil. The type of dolomite fertilizer provides higher growth and production than calcite because in addition to increasing the availability of nutrients from the soil, it also contributes the element Mg in the lime. Mg plays a role in increasing the rate of photosynthesis because it can increase leaf chlorophyll. While calcite only contains lime and calcium.

The fine grain size of 80 mesh caused real production to be higher than 60 mesh. This means that the finer the grain size, the more rapid the decomposition in the soil, causing the P element to increase the weight of corn, the faster it is available to plants. High data of maize plants at the ages of 2, 3, 4, 5 and 6 weeks after planting (MST) due to the treatment of lime type with grain size are presented in Appendices 1, 3, 5, 7 and 9, while the variance is in appendix 2, 4, 6, 8, and 10. From the variance it can be seen that the lime treatment has no significant effect on the height of plants aged 2 and 3 MST, and has a significant effect at the ages of 4, 5 and 6 MST. The treatment of dolomite lime causes plants to be higher than using calcite. This is allegedly caused by dolomite lime, in addition to increasing the availability of nutrients from the soil, also contributing elements of Mg in the lime. Mg plays a role in increasing the rate of photosynthesis because it can increase leaf chlorophyll. Photosynthesis results are then channeled to the leaf buds, so that the plants grow taller. In terms of fineness of lime, for sizes 60 and 80 mesh does not give a difference in plant height, this is due to observation 6 MST the lime has dissolved in the soil. This unreal effect is due until the 6th week MST in the types of dolomite and calcite has dissolved in the soil and both can improve soil acidity. Table 2 shows that at the age of 6 MST, plant height in the dolomite
treatment group was significantly higher than the plant height in the calcite treatment group. But the height of plants treated with 60 mesh was not significantly different from those treated with 80 mesh, both on dolomite and in calcite. The level of plant height (cm) of corn due to the treatment of lime species with size its granules are 6 MST, can be seen at Table 2.

**Table 2.** The level of plant height (cm) of corn due to the treatment of lime species with size its granules are 6 MST

| Treatment | Plant height (cm) |
|-----------|------------------|
| D₁ – 1    | 94.85            |
| D₁ – 2    | 96.68            |
| D₂ – 1    | 80.27            |
| D₂ – 2    | 77.87            |
| BNJ       | 13.98            |

Remarks: The numbers followed by the same letter in the same column are not significant at the level of test \( \alpha = 0.05 \) based on the BNJ

Data on the number of leaves of corn plants at the ages of 2, 3, 4, 5 and 6 MST due to the treatment of lime types with grain size are presented in Appendices 11, 13, 15, 17 and 19, while the variance is in Appendices 12, 14, 16, 18 and 20. From variance, it can be seen that lime treatment has no significant effect on the number of leaves of corn plants at all ages of observation. The effect of the type of chalk with the size of the granules in the number of leaves of corn plants at the age of 6 MST can be seen in Table 2. High histogram of corn plants in the age of 6 mst in different types of lime with granular size, can be seen at Figure 1.

**Figure 1.** High histogram of corn plants in the age of 6 mst in different types of lime with granular size
The number of leaves in the dolomite lime treatment group was not significantly different from that of calcite lime treatment group, as well as the treatment of lime size 60 mesh with 80 mesh different from each other was not significant. Data of corn plant leaf area index due to the treatment of lime type with grain size is presented in Appendix 21, while the variance is in Appendix 22. From variance, it can be seen that lime treatment has no significant effect on leaf area index of corn plants. The effect of lime type with grain size on leaf area index of corn plants can be seen in Table 3.

Table 3. Average index of corn plant leaf area due to treatment of lime type with granular size

| Treatment | Leaf Area Index |
|-----------|----------------|
| D₁ – 1    | 552.55         |
| D₁ – 2    | 564.97         |
| D₂ – 1    | 542.24         |
| D₂ – 2    | 540.69         |
| BNJ₀.05   | 49.98          |

Remarks: The numbers followed by the same letter in the same column are not significant at the level of α = 0.05 based on the BNJ test

Table 3 shows that the leaf area index in the dolomite lime treatment group was not significantly different from the calcite lime treatment group, as well as the treatment of limestone size 60 mesh with 80 mesh not different each other. Appendix 23, while the variance is in Appendix 24. From variance, it can be seen that lime treatment has no significant effect on the age of flowering of corn plants. The effect of lime type with grain size on the flowering age of corn plants can be seen in Table 4.

Table 4. Average flowering age (days) of corn plants due to treatment of lime types with granular size

| Treatment | Flowering Age (days) |
|-----------|----------------------|
| D₁ – 1    | 53.92                |
| D₁ – 2    | 53.33                |
| D₂ – 1    | 55.92                |
| D₂ – 2    | 54.33                |
| BNJ₀.05   | 2.79                 |

Remarks: The numbers followed by the same letter in the same column are not significant at the level of test α = 0.05 based on the BNJ
Table 4 shows that the flowering age in the dolomite lime treatment group was not significantly different from that of calcite lime treatment group, as well as the treatment of limestone size 60 mesh with 80 mesh different from each other was not significant. Data of wet weight of corn crop due to the treatment of lime type with grain size is presented in appendix 25, while the variance is in appendix 26. From variance, it can be seen that the lime treatment has a significant effect on the wet weight of straw. The effect of lime type with grain size on straw wet weight can be seen in Table 5.

| Treatment | Wet Straw Weight (g) |
|-----------|----------------------|
| D₁ – 1    | 408.23               |
| D₁ – 2    | 414.74               |
| D₂ – 1    | 341.26               |
| D₂ – 2    | 344.35               |
| BNJ       | 61.33                |

Remarks: The numbers followed by the same letter in the same column are not significant at the level of test \( \alpha = 0.05 \) based on the BNJ.

Table 5 shows that at the age of 6 MST, the wet weight of straw in the dolomite treatment group was significantly higher than the wet weight of straw in the calcite treatment group. But the wet weight of straw which was treated with 60 mesh was not significantly different from those treated with 80 mesh, both on dolomite and on calcite. Histogram of wet weight of straw in lime type treatment with grain size can be seen in Figure 2.

Figure 2. Histogram of wet weight of corn plant straw in various types of lime with the size of granules

Wet straw weights are higher using dolomite. This means that the use of dolomite can cause fibers that are formed in more plant organs to produce heavier biomass than using calcite. The presence of dolomite which contains Mg elements while in calcite there is no Mg causes there is an excess in the use of dolomite, in addition to the higher available nutrients by using dolomite. The length of corncob in the dolomite treatment group was significantly longer than the length of the cob in the calcite treatment group. The length of cobs of plants treated with 80 mesh dolomite lime were significantly higher than dolomite.
60 mesh, while the length of cob given calcite lime 60 mesh was not significant with 80 mesh. The long cob histogram in lime type treatment with grain size can be seen in Figure 3.

**Figure 3.** Histogram of corn plant length in different types of lime with the size of granules

The length of the cob is longer by using dolomite lime than calcite. The use of lime aims to improve soil fertility due to the presence of elements that are absorbed in acid soils. In this case P elements can become available, and plants can be used for the development of corn cobs. The process of forming cob and corn kernels is influenced by the availability of phosphorus. The element of phosphorus is often found in seeds and fruit organs. In terms of the size of the chalk granules, the size of the 80 mesh is longer than the cob size of 60 mesh. This means that the finer the grain size, the more rapid the decomposition of the soil, causing the P element to become more readily available to plants. Corn diameter data of corn plants due to the treatment of lime type with grain size are presented in Appendix 29, while the variance is in appendix 30. From the variance, it can be seen that the lime treatment has a significant effect on the diameter of corn cob.

4. Conclusion

Based on the results of the different mean test, dolomite lime treatment results in better plant growth and production compared to calcite lime. The difference in grain size results in different production (ear length, ear diameter and wet weight of cob), where the grain size of 80 mesh produces higher production than 60 mesh size. But the difference in grain size produces plant height and straw wet weight which is not significantly different. In terms of fineness of lime, for sizes 60 and 80 mesh does not give a difference in plant growth, this is due to observation of 6 lime MST size of 60 and 80 mest has been dissolved in the soil. The type of dolomite fertilizer provides higher growth and production than calcite because in addition to increasing the availability of nutrients from the soil, it also contributes the element Mg in the lime. Mg plays a role in increasing the rate of photosynthesis because it can increase leaf chlorophyll. While calcite only contains lime and calcium. The fine grain size of 80 mesh caused real production to be higher than 60 mesh. This means that the finer the grain size, the more rapid the decomposition in the soil, causing the P element to increase the weight of corn, the faster it is available to plants.

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