

GROWTH AND PRODUCTION RESPONSE OF RED CHILI PLANTS (*CAPSICUM ANNUUM* L.) TO APPLICATION OF $\text{Ca}(\text{NO}_3)_2$ + B FERTILIZER AND CA-MG-S FERTILIZER ON INCEPTISOL

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ABSTRACT

This study aimed to evaluate the response of red chili pepper to the application of $\text{Ca}(\text{NO}_3)_2$ + B and Ca-Mg-S fertilizers on Inceptisol soil grown in polybags. The experiment was conducted at the Experimental Field of the Faculty of Agriculture, Universitas Islam Sumatera Utara using a factorial randomized block design consisting of two factors with three replications. The first factor was $\text{Ca}(\text{NO}_3)_2$ + B fertilizer at four dosage levels: 0, 5, 10, and 15 g polybag⁻¹, while the second factor was Ca-Mg-S fertilizer at four dosage levels: 0, 0.75, 1.75, and 2.25 g polybag⁻¹. Parameters observed included plant height, stem diameter, number of branches, flowering age, number of fruits per polybag, fruit weight per polybag, and total soil potassium availability. The results showed that the combined application of $\text{Ca}(\text{NO}_3)_2$ + B and Ca-Mg-S fertilizers significantly affected plant height, stem diameter, flowering age, number of fruits, and fruit weight per polybag, but had no significant effect on the number of branches. The highest plant height and stem diameter were obtained at the highest fertilizer combination rates. The earliest flowering age was observed in treatments K3S2 and K3S3 at 25.17 days after planting, whereas the latest flowering age occurred in the control treatment K0S0 at 32.50 days. The highest number of fruits was produced by treatment K2S3 with 29.50 fruits per polybag. Meanwhile, the highest fruit weight per polybag was recorded in treatments K1S3 and K2S3, each producing 112.00 g per polybag. Overall, the combined application of $\text{Ca}(\text{NO}_3)_2$ + B and Ca-Mg-S fertilizers improved the growth and productivity of red chili pepper cultivated on Inceptisol soil. The K2S3 and K1S3 treatment combinations were considered the most optimal treatments for enhancing yield performance through improved vegetative and generative growth balance.

KEYWORDS: *Capsicum annuum*, calcium nitrate, boron, chili productivity.

INTRODUCTION

Red chili peppers (*Capsicum annuum* L.) are an important horticultural commodity with high economic value and a strategic role in meeting food and industrial processing needs in Indonesia. Demand for red chili peppers continues to increase in line with population growth, the development of the food industry, and the high consumption of fresh spices and vegetables. However, red chili pepper productivity at the farmer level remains relatively fluctuating due to various factors, particularly low soil fertility, nutrient

imbalances, and suboptimal fertilizer management (Ginting et al., 2022; Haryantini et al., 2023; Rahma Dini et al., 2025).

One type of soil widely used for horticultural cultivation in Indonesia is Inceptisol. This soil has considerable potential for agricultural development, but generally suffers from constraints such as low organic matter content, moderate to low cation exchange capacity, and limited availability of certain nutrients. These conditions result in low fertilizer efficiency and impact the growth

and yield of red chili peppers. Several studies have shown that proper amelioration and fertilization management of Inceptisol soils can significantly improve soil chemical properties and red chili productivity (Janah, 2020; Haryantini *et al.*, 2023; Furqoni & Sugiyanta, 2025).

In red chili cultivation, the nutrients calcium (Ca), magnesium (Mg), sulfur (S), and boron (B) play a crucial role in supporting both vegetative and generative plant growth. Calcium strengthens cell walls, promotes root growth, and reduces flower and fruit loss. Magnesium is a key component of chlorophyll, which plays a role in photosynthesis, while sulfur contributes to protein formation and plant enzyme activity. Boron is known to play a role in cell division, photosynthate translocation, flower formation, and improving chili fruit quality. Deficiencies in these elements can lead to stunted plant growth, physiological disorders, decreased fruit formation, and low-quality yields (Kaya *et al.*, 2020; Ropokis *et al.*, 2021; Hossain *et al.*, 2025; Zhang *et al.*, 2026).

The use of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer is an alternative to provide calcium and boron elements quickly available to plants, especially during the active growth and fruit formation phases (Xin *et al.*, 2023; Wang *et al.*, 2024). On the other hand, Ca-Mg-S fertilizer has the potential to improve the balance of secondary nutrients in the soil, thereby increasing the efficiency of nutrient uptake and plant physiological activity (Grzebisz *et al.*, 2022; Sharavdorj *et al.*, 2022; Dölger *et al.*, 2024). The combination of these two types of fertilizer is thought to be able to create more balanced nutritional conditions in Inceptisol soils so that the growth and production of red chilies can be optimally increased. However, scientific information regarding the response of red chili plants to the combination of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and Ca-Mg-S fertilizer in Inceptisol soil media is still relatively limited, especially at the cultivation scale in polybags.

Based on the description, research is needed to evaluate the growth and production response of red chili plants to the application of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and Ca-Mg-S fertilizer on Inceptisol soil. This research is expected to provide scientific information regarding effective fertilizer combinations in increasing the growth and yield of red chilies on suboptimal soil. The purpose of this study was to analyze the effect of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and Ca-Mg-S fertilizer applications on the growth and production of red chili plants on Inceptisol soil.

MATERIALS AND METHODS

Research Location

This research was conducted at the Experimental Field of the Faculty of Agriculture, Islamic University of North Sumatra, located on Jalan Karya Wisata, Gedung Johor, Medan Johor District, Medan City, North Sumatra Province, Indonesia. The research site is at an elevation

of approximately 25 m above sea level with relatively flat topography. The research was conducted from December until all stages were completed.

Tools and materials

The equipment used in this study included a hoe, 10-kg polybags, a watering can, an analytical balance, and various other supporting tools needed during the study.

The materials used included Lado F1 red chili seeds, $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer, Ca-Mg-S fertilizer, Inceptisol soil from Kuala Bekala, and other supporting materials to support the research activities.

Research Design

This study used a factorial randomized block design consisting of two treatment factors. The first factor was the application of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer consisting of four dosage levels, namely 0 g/polybag (K0), 5 g/polybag (K1), 10 g/polybag (K2), and 15 g/polybag (K3), while the second factor was the application of Ca-Mg-S fertilizer which also consisted of four dosage levels, namely 0 g/polybag (S0), 0.75 g/polybag (S1), 1.75 g/polybag (S2), and 2.25 g/polybag (S3). The combination of the two factors resulted in 16 treatment combinations, and each treatment was repeated three times, resulting in a total of 48 experimental units. Each experimental unit consisted of two plants, so the total number of plants used in this study was 96 plants cultivated in 10 kg capacity polybags.

The research began with preparation of the experimental site by clearing the area of weeds, plant debris, and residue from previous experiments using a hoe. After the clearing process was complete, the surface of the land was leveled to facilitate the arrangement and orderly placement of polybags according to the research design.

The growing medium used was Inceptisol soil from Kuala Bekala. The soil was collected at a depth of approximately 0-30 cm from the surface using a hoe. Before use, the soil was first cleared of plant roots, rocks, and other debris to obtain a homogeneous medium that would support optimal plant growth. The soil was then placed in 10 kg polybags, corresponding to the number of experimental units determined.

Red chili seeds of the Lado F1 variety were first sown in the Inceptisol soil-based seedling medium, placed in an area protected from direct exposure to rain and sunlight. Before sowing, the seeds were soaked in warm water for approximately 3 hours to accelerate the imbibition process and increase germination. The seeds were then planted in 8 x 10 cm seedling polybags to a depth of approximately 1 cm and covered lightly with soil. Seedlings were nurtured until they reached 21-24 days after sowing, or had developed 3-4 true leaves. The seedlings used in the study were selected based on uniform growth and plant health. Transplanting was carried out into 10 kg polybags, with one plant per bag,

in the afternoon to reduce stress from high temperatures and minimize the risk of seedling mortality after transplanting.

Fertilizer application was carried out according to the predetermined treatment levels. $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizers were applied according to the treatment. Both types of fertilizer were applied simultaneously with the base fertilizer at the beginning of planting to ensure the availability of essential nutrients from the early stages of plant growth. Follow-up applications were carried out during the generative phase, 40-50 days after planting, to support optimal fruit formation and development.

Fertilizer application was carried out by spreading the fertilizer evenly around the base of the plant stem, then covering it lightly with soil to reduce nutrient loss due to evaporation and leaching. This application method aims to increase fertilizer efficiency and maximize the absorption of nutrients such as potassium, calcium, boron, magnesium, sulfur, and nitrogen, which play a vital role in supporting the vegetative and generative growth of red chili plants.

Seedlings were planted by digging holes 3-4 cm deep in the growing medium. The seedlings were carefully removed by opening the seedling polybag to avoid damaging the root system. Each planting hole was filled with one red chili seedling, then covered with soil around the base of the plant. After transplanting, the plants are immediately watered thoroughly to maintain the moisture of the growing medium and reduce transplant stress. The entire planting process is carried out in the afternoon to avoid high temperature stress, which can hinder the seedlings' adaptation.

Plant care was carried out intensively throughout the study. Watering was done twice daily, in the morning from 7:00 to 9:00 a.m. and in the afternoon from 4:00 to 6:00 p.m. using a watering can. The frequency of watering was adjusted according to weather conditions and was not carried out if it rained. During the initial growth phase, watering was carried out carefully to prevent seedling damage.

Replanting was carried out 1-2 weeks after planting to address dead, abnormally growing, or damaged plants. Abnormal plants were removed and replaced with new seedlings with uniform growth to maintain treatment homogeneity.

Weeding was done manually by removing weeds growing around the plants and inside the polybags. Weed control was necessary to reduce competition for nutrients, water, and light and to prevent the growth of plant-disturbing organisms.

During the study, several pests and diseases were found to affect chili plants, including armyworms, whiteflies,

fruit flies, leaf curl, and Fusarium wilt. Pest control was carried out mechanically and chemically using insecticides containing the active ingredients Prevathon 50 SC, Sagribeat 7/30 WP, and Plethora 97.5 EC. Meanwhile, disease control was carried out using fungicides Antracol 70 WP and Navito. Pesticide applications were carried out in the morning or evening at four-day intervals when the intensity of attacks began to be seen. Fungicide and insecticide use was discontinued when pest and disease attacks were no longer found on the plants.

OBSERVATION PARAMETERS

The parameters observed in this study included plant height, stem diameter, number of productive branches, flowering age, number of fruits per polybag, fruit weight per polybag, and total soil K content.

Plant height was measured using a tape measure, starting from the surface of the growing medium to the highest growing point of the plant. Observations began two weeks after transplanting and were repeated every two weeks until the plants entered the flowering phase.

Stem diameter was measured using a vernier caliper on the main stem just above the surface of the growing medium. Observations were conducted every two weeks, starting two weeks after transplanting until the flowering phase.

The number of productive branches was calculated based on the number of branches producing flowers and potential fruits nine weeks after planting.

Flowering age was determined based on the appearance of the first flower after planting. Observations were conducted when >50% of the plant population in each treatment had flowered. The data were used to evaluate the effect of fertilizer treatment on accelerating the plant's generative phase.

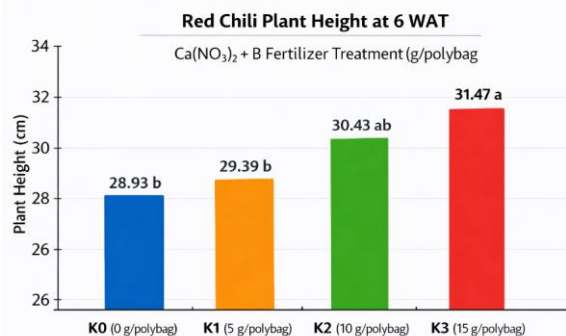
The number of fruits per polybag was calculated based on the total fruit harvested from each plant during three harvests. Fruit weight per polybag was obtained by weighing the entire harvest using an analytical balance to determine total fruit production in each treatment.

Observational data obtained during the study were processed according to the research method used. If significant differences were found, Duncan's test was performed at the 5% level.

RESULTS AND DISCUSSION

Plant Height (cm)

The results of observations on plant height at 6 weeks after planting (WAP) show that the provision of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and Ca-Mg-S fertilizer showed a significant effect on the height of red chili plants, but the interaction between the two treatments did not have a significant effect.



Note: Numbers followed by different letters indicate significant differences at the 5% level based on Duncan's test.

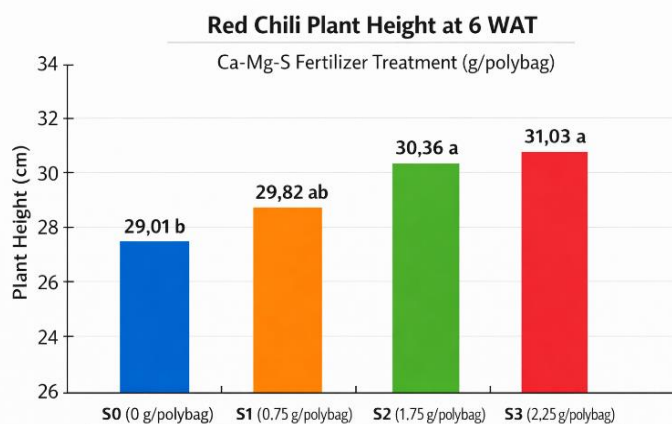
K0: 0 g/polybag, K1: 5 g/polybag, K2: 10 g/polybag, K3: 15 g/polybag

Figure 1: Histogram of the average height of red chili plants (cm) with the application of $\text{Ca}(\text{NO}_3)_2$ + B fertilizer.

Figure 1 shows that the application of $\text{Ca}(\text{NO}_3)_2$ + B fertilizer significantly affected the height of red chili pepper plants at 6 weeks after planting (WAP). In general, increasing the dose of $\text{Ca}(\text{NO}_3)_2$ + B fertilizer tended to increase the height of red chili pepper plants compared to the control treatment. The highest average height was obtained in the K3 treatment (15 g/polybag),

at 31.47 cm, significantly different from the K0 (0 g/polybag) and K1 (5 g/polybag) treatments, but not significantly different from K2 (10 g/polybag).

The increase in red chili pepper plant height in the high-dose $\text{Ca}(\text{NO}_3)_2$ + B fertilizer treatment indicates that calcium, nitrate nitrogen, and boron play an important role in supporting the vegetative growth of red chili pepper plants. Nitrogen in the form of nitrate is known to increase cell division and elongation, thereby accelerating plant growth. On the other hand, calcium functions to strengthen cell wall structure and stimulate meristem tissue development, while boron plays a role in photosynthates translocation, cell wall formation, and plant physiological activity (Ropokis *et al.*, 2021; Arakawa *et al.*, 2021). The combination of these three elements optimizes plant growth, resulting in a significant increase in plant height. The results of this study align with those of Huang *et al.* (2022); Wang *et al.* (2024), who reported that the application of calcium and boron to chili plants increased plant height, branch number, and flower formation compared to the control. This study showed that the combination of calcium and boron increased plant metabolic activity and improved nutrient uptake efficiency, resulting in improved vegetative growth of chili plants.



Note: Numbers followed by different letters indicate significant differences at the 5% level based on Duncan's test.

S0: 0 g/polybag, S1: 0.75 g/polybag, S2: 1.75 g/polybag, S3: 2.25 g/polybag

Figure 2: Histogram of the average height of red chili plants (cm) with the application of Ca-Mg-S fertilizer.

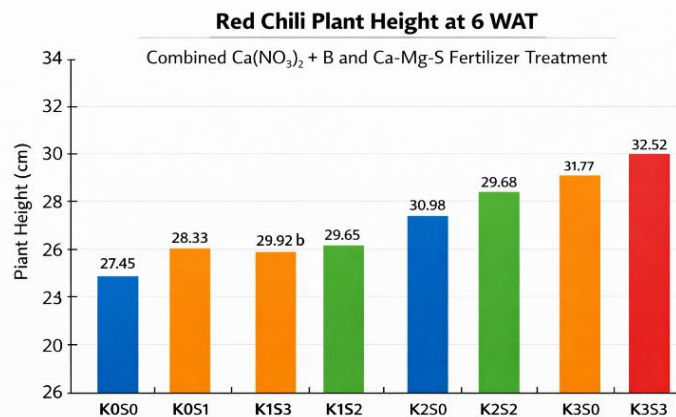
Red chili pepper plant height was also significantly affected by the application of Ca-Mg-S fertilizer (Figure 2). S3 (2.25 g/polybag) produced the highest plant height at 31.03 cm, significantly different from S0 (0 g/polybag), although not significantly different from S1 (0.75 g/polybag) and S2 (1.75 g/polybag).

The increase in plant height in the Ca-Mg-S fertilizer treatment also demonstrates the importance of magnesium and sulfur in supporting plant physiological activity. Magnesium is a major component of chlorophyll molecules, which play a direct role in photosynthesis. Adequate magnesium availability

enhances chlorophyll formation and photosynthates accumulation, resulting in faster plant growth. Sulfur plays a role in the synthesis of amino acids, proteins, and enzymes that support cell division and plant tissue growth (Narayan *et al.*, 2023). The combination of these elements causes plants to have a higher photosynthetic capacity and produces better vegetative growth (Grzebisz *et al.*, 2022; Sharavdorj *et al.*, 2022; Zhang *et al.*, 2023). These findings are supported by research by Setiawati *et al.* (2020) and Swelam & Abd El-Basir (2021), which states that magnesium and boron supplementation can improve the growth and productivity of chili plants by increasing metabolic efficiency and nutrient uptake.

Furthermore, other studies on paprika plants have shown that increasing calcium and magnesium availability

significantly increases shoot growth, chlorophyll content, and plant biomass.



Note: Numbers without letters indicate no significant difference at the 5% level based on Duncan's test.

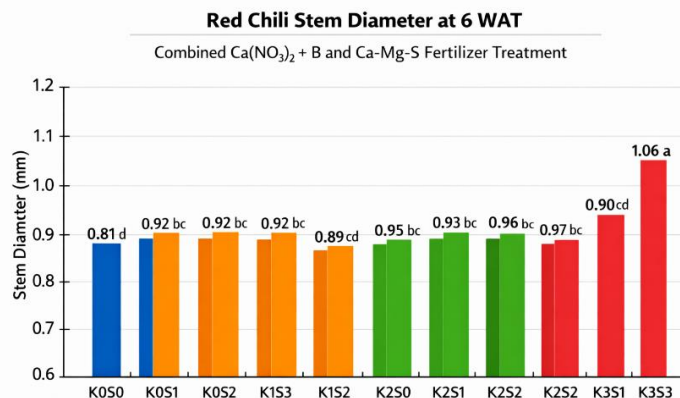
K0: 0 g/polybag, K1: 5 g/polybag, K2: 10 g/polybag, K3: 15 g/polybag; S0: 0 g/polybag, S1: 0.75 g/polybag, S2: 1.75 g/polybag, S3: 2.25 g/polybag

Figure 3: Histogram of average plant height (cm) of red chili peppers with $\text{Ca}(\text{NO}_3)_2$ + B fertilizer and Ca-Mg-S fertilizer applications.

Although the combination between treatments did not show significant differences based on statistical tests (Figure 3), the combination of K3S3 treatment (15 g/polybag of $\text{Ca}(\text{NO}_3)_2$ + B fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) produced the highest red chili plant height, which was 32.52 cm. This indicates that the combination of high doses of $\text{Ca}(\text{NO}_3)_2$ + B and Ca-Mg-

S fertilizers is able to create more balanced nutritional conditions for red chili plants on Inceptisol soil. Inceptisol soil generally has limitations in certain nutrients so that the addition of Ca, Mg, S, and B elements can improve soil nutritional conditions and increase optimal plant growth (Grzebisz *et al.*, 2022; Haryantini *et al.*, 2023; Hossain *et al.*, 2025).

Stem Diameter (mm)



Note: Numbers followed by different letters indicate significant differences at the 5% level based on Duncan's test.

K0: 0 g/polybag, K1: 5 g/polybag, K2: 10 g/polybag, K3: 15 g/polybag; S0: 0 g/polybag, S1: 0.75 g/polybag, S2: 1.75 g/polybag, S3: 2.25 g/polybag

Figure 4: Histogram of average stem diameter (mm) of red chili peppers after application of $\text{Ca}(\text{NO}_3)_2$ + B fertilizer and Ca-Mg-S fertilizer.

Based on Figure 4, the application of $\text{Ca}(\text{NO}_3)_2$ + B and Ca-Mg-S fertilizers showed a significant effect on the stem diameter of red chili peppers at 6 WAP. The highest value was obtained in the K3S3 treatment combination (15 g/polybag of $\text{Ca}(\text{NO}_3)_2$ + B fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) of 1.06 mm, while the lowest value was found in the K0S0 control treatment (0 g/polybag of $\text{Ca}(\text{NO}_3)_2$ + B fertilizer and 0 g/polybag of

Ca-Mg-S fertilizer) of 0.81 mm. In general, increasing the dose of $\text{Ca}(\text{NO}_3)_2$ + B and Ca-Mg-S fertilizers tended to increase the physiological response of plants compared to the control. For the single factor, the K3 treatment (15 g/polybag of $\text{Ca}(\text{NO}_3)_2$ + B fertilizer) produced the highest average red chili stem diameter of 0.96 mm, significantly different from the K0 treatment (0 g/polybag of $\text{Ca}(\text{NO}_3)_2$ + B fertilizer). Meanwhile, for

the Ca-Mg-S fertilizer factor, the S3 treatment (2.25 g/polybag of Ca-Mg-S fertilizer) produced the highest average red chili stem diameter of 0.96 mm, significantly different from the S0 treatment (0 g/polybag of Ca-Mg-S fertilizer).

Physiologically, the increased plant response to the high-dose $\text{Ca}(\text{NO}_3)_2 + \text{B}$ treatment is closely related to the role of calcium, nitrate nitrogen, and boron in supporting metabolic activity and plant tissue development. Calcium functions as a major structural component of cell walls and acts as a secondary messenger in the regulation of various plant physiological processes, including cell division, membrane stability, and enzymatic activity. Adequate Ca availability increases cell membrane integrity and nutrient transport efficiency so that plant growth is more optimal (Wang *et al.*, 2024).

Nitrogen in the form of nitrate from $\text{Ca}(\text{NO}_3)_2$ contributes to protein synthesis, chlorophyll formation, and increased photosynthetic activity. The combination of nitrate and calcium accelerates vegetative tissue formation, thus supporting increased growth and physiological activity of chili plants. Research on red chili plants shows that the application of calcium nitrate-based fertilizer significantly increases plant growth, photosynthetic pigment content, and productivity compared to treatments without calcium (Wang *et al.*, 2024; Hossain *et al.*, 2025).

Furthermore, boron in the $\text{Ca}(\text{NO}_3)_2 + \text{B}$ treatment is thought to play a role in increasing photosynthate translocation, cell wall formation, and carbohydrate and protein metabolism. Boron is also known to have a

synergistic interaction with calcium in the formation of meristem tissue and the development of plant generative organs. Optimal Ca-B interactions can increase the efficiency of other nutrient uptake, improve plant physiological activity, and support better growth (Vera-Maldonado *et al.*, 2024).

The positive response to the Ca-Mg-S treatment indicates that magnesium and sulfur play a significant role in supporting the physiological processes of red chili plants. Magnesium is the central atom in chlorophyll molecules, which significantly determines the efficiency of photosynthesis and the formation of photosynthates. Adequate magnesium availability increases photosynthetic activity, resulting in higher plant biomass accumulation. Meanwhile, sulfur plays a role in the synthesis of amino acids, proteins, and enzymes, which are directly related to plant growth and energy metabolism (Amini *et al.*, 2024).

The combination of K3S3 treatment (15 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) which produced the highest value indicates a synergistic relationship between the elements Ca, Mg, S, and B in supporting plant nutritional balance. In Inceptisol soils which generally have limited available nutrients, supplementation of secondary and micro nutrients is very important to maintain optimal plant physiological activity. A balanced combination of nutrients allows for increased photosynthetic efficiency, assimilate translocation, cell membrane stability, and plant metabolic activity, resulting in better growth and development of red chili plants.

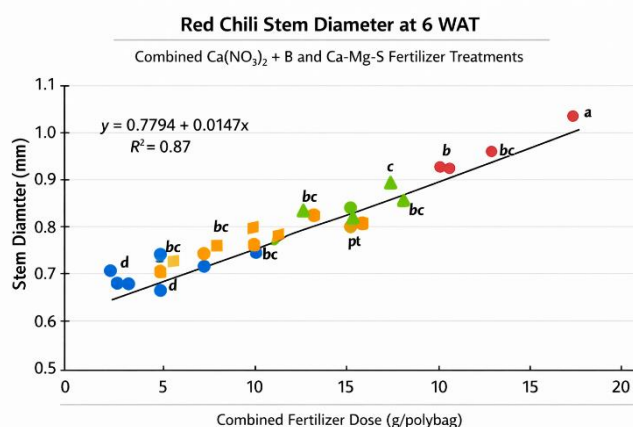


Figure 5: Regression graph of the combination of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizer treatments on the average diameter of red chili stems at 6 weeks post-planting.

The regression graph shows that increasing the dose of the $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizer combination provides a positive linear relationship to the stem diameter of red chili plants at 6 WAP. The regression equation obtained is: $y = 0.7794 + 0.0147x$, with a coefficient of determination (R^2) of 0.87. A positive regression coefficient value of 0.0147 indicates that each increase in one unit of the fertilizer combination dose

causes an increase in stem diameter of 0.0147 mm. Meanwhile, the coefficient of determination (R^2) value of 0.87 indicates that 87% of the variation in stem diameter of red chili plants is influenced by the combination of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizer applications, while the remainder is influenced by other factors such as environmental conditions, physical properties of the planting medium, and plant genetic factors.

Physiologically, the increase in stem diameter due to the application of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizers is closely related to the role of calcium, magnesium, sulfur, nitrogen, and boron in supporting stem cell division and enlargement. Calcium functions to strengthen the structure of the middle lamella and cell walls through the formation of calcium pectate, so that plant stems become stronger and develop optimally. In addition, Ca also plays a role as a secondary messenger in regulating enzyme activity and the growth of plant meristematic tissue. Recent research shows that increasing Ca supply in *Capsicum annuum* plants can increase stem growth, cell membrane stability, and plant nutrient transport efficiency (Wang *et al.*, 2024).

Nitrogen in the form of nitrate from $\text{Ca}(\text{NO}_3)_2$ contributes directly to protein synthesis, protoplasm formation, and photosynthetic activity, thus supporting plant vegetative growth. Adequate nitrogen availability increases cambium activity and vascular tissue formation, ultimately increasing the stem diameter of red chili plants. This is in line with research on horticultural crops that reported that the combination of nitrogen and calcium can significantly increase stem biomass and plant growth rate (Swelam & Abd El-Basir, 2021).

The role of magnesium in Ca-Mg-S fertilizer is also crucial in stem diameter formation because Mg is the central atom of chlorophyll, which determines the efficiency of plant photosynthesis. Increased photosynthetic activity results in higher photosynthate accumulation, thus supporting stem tissue formation and vegetative organ development. Sulfur plays a role in the synthesis of amino acids such as cysteine and methionine, protein formation, and enzymatic activity that supports cell division and plant tissue growth. The combination of Mg and S is known to increase biomass accumulation and plant vigor in various horticultural commodities (Sharavdorj *et al.*, 2022).

Boron in the $\text{Ca}(\text{NO}_3)_2 + \text{B}$ treatment also plays a significant role in stem diameter formation through its role in cell wall synthesis, vascular tissue differentiation, and carbohydrate translocation. The synergistic interaction between Ca and B enhances cell wall stability and improves the growth of plant meristematic tissue. Recent studies reported that the combination of Ca and B increased vegetative growth, stem diameter, and nutrient use efficiency in chili and paprika plants (Xin *et al.*, 2023; Wang *et al.*, 2024).

Based on Figure 5, the treatment with the highest combined dose resulted in the largest stem diameter and was significantly different compared to the low-dose treatment or the control. This indicates that adequate availability of secondary and micronutrients in Inceptisol soil can improve plant physiological conditions, resulting in optimal stem growth. Inceptisol soils generally have relatively low available nutrient content, particularly Ca, Mg, and S, so fertilizer supplementation is a crucial factor in enhancing the vegetative growth of red chili plants (Haryantini *et al.*, 2023).

Number of Branches (branches)

The results showed that the application of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizers did not significantly affect the number of branches in red chili plants (Table 1). This condition indicates that the addition of calcium, magnesium, sulfur, nitrogen, and boron nutrients at the given doses has not been able to significantly modify the plant branching pattern. Physiologically, branch formation in chili plants is not only influenced by nutrient availability, but is also highly controlled by genetic factors, plant hormone balance, light intensity, and apical dominance.

Table 1: Average number of branches (twigs) of red chilies treated with $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizers at 6 WAP.

Treatments	Ca-Mg-S Fertilizer (S: g/polybag)				Average (K)
	0	0.75	1.75	2.25	
Ca(NO ₃) ₂ + B Fertilizer (K: g/polybag)					
0	5.17	5.67	6.00	5.67	5.63
5	6.00	5.83	5.33	7.00	6.04
10	6.33	6.00	6.00	6.33	6.17
15	6.00	6.33	6.83	5.50	6.17
Average (S)	5.88	5.96	6.04	6.13	

Note: Numbers without letters indicate no significant difference at the 5% level based on Duncan's test.

The lack of difference in branch number between treatments indicates that nutrient requirements for branching were likely met even in the control treatment, so additional fertilizer no longer provided a significant response. Furthermore, Ca, Mg, S, and B generally play a more dominant role in enhancing plant physiological activity, cell tissue formation, increasing photosynthesis, photosynthates translocation, and generative organ

quality than directly inducing new branch formation. In chili plants, branch growth is more closely related to the activity of cytokinin and auxin hormones, which regulate the breakdown of shoot dominance. When a plant's hormonal balance is relatively stable, increased nutrient supply does not necessarily lead to increased branching (Gupta *et al.*, 2023; Shen *et al.*, 2023; Han *et al.*, 2024).

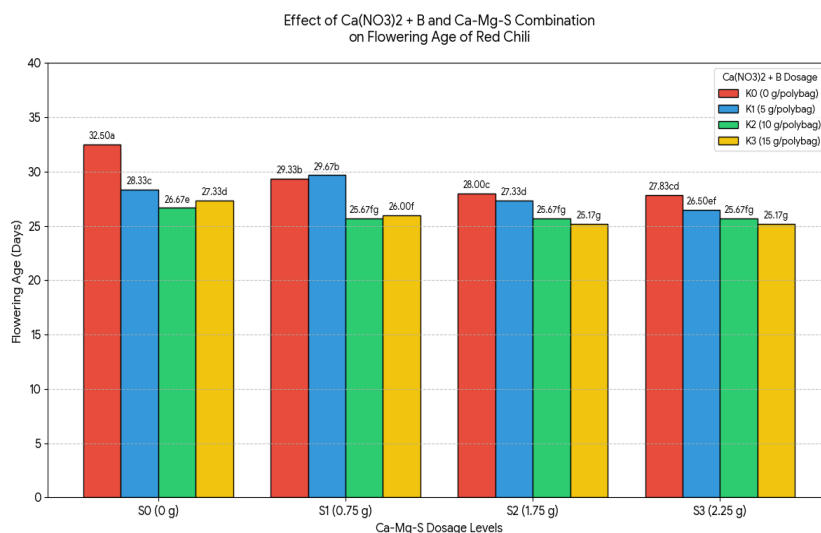
These results align with research by Swelam & Abd El-Basir (2021); Cardoso *et al.* (2022); Bons & Sharma (2023), which reported that calcium and boron application to chili plants significantly impacted plant height, stem diameter, flower formation, and fruit quality compared to the number of vegetative branches. These studies indicate that Ca and B play a greater role in cell membrane stability, cell division, and reproductive organ development. Furthermore, Mayorga-Gómez *et al.*'s (2020) study on red chili peppers also showed that increasing magnesium and sulfur supply tended to increase chlorophyll content, photosynthetic efficiency, and plant biomass, but did not always result in a significant increase in the number of productive branches. This is because branch formation is more influenced by plant morphogenetic factors than by the availability of secondary nutrients.

The insignificant effect of the treatment may also be attributed to the condition of the Inceptisol growing medium, which is still able to provide basic nutrients to

support the initial vegetative growth of the plant. Under these conditions, the plant likely utilizes additional nutrients to increase other physiological activities such as stem enlargement, leaf formation, and reproductive system development rather than the formation of new branches. Although not statistically significant, the tendency for an increase in the number of branches in several high-dose treatments indicates that the combination of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizers still provides a positive physiological response to plant growth. This response is likely more visible in other growth parameters such as stem diameter, leaf area, flowering, and fruit yield than in the number of vegetative branches.

Flowering Age (days)

The results of statistical analysis showed that the combination of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizers had a significant effect on the flowering age of red chilies (Figure 6).



Note: Numbers followed by different letters indicate significant differences at the 5% level based on Duncan's test.

K0: 0 g/polybag, K1: 5 g/polybag, K2: 10 g/polybag, K3: 15 g/polybag; S0: 0 g/polybag, S1: 0.75 g/polybag, S2: 1.75 g/polybag, S3: 2.25 g/polybag

Figure 6: Histogram of flowering time (days) of red chili peppers with $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and Ca-Mg-S fertilizer applications.

The results showed that the combination of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizers significantly affected the flowering time of red chili plants. The longest flowering time was obtained in the control treatment K0S0 (0 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 0 g/polybag of Ca-Mg-S fertilizer), which was 32.50 days after planting, and was significantly different compared to all other treatment combinations. In contrast, the fastest flowering occurred in the treatment combination K3S2 (15 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 1.75 g/polybag of Ca-Mg-S fertilizer) and K3S3 (15 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer), which was 25.17 days after planting. These results indicate that increasing the dosage of $\text{Ca}(\text{NO}_3)_2 +$

B fertilizer combined with Ca-Mg-S fertilizer can accelerate the transition of plants from the vegetative to the generative phase.

Physiologically, accelerated flowering is closely related to improved plant nutrient balance, particularly calcium (Ca), nitrate nitrogen (NO_3^-), magnesium (Mg), sulfur (S), and boron (B). Nitrogen in the form of nitrate plays a role in increasing metabolic activity, protein synthesis, and the formation of healthy vegetative tissue in the early growth phase. When nitrogen requirements are optimally met, plants more quickly reach the physiological phase that supports flower initiation. Furthermore, calcium plays a crucial role in cell membrane stability,

meristematic cell division, and the activation of enzymes involved in the formation of plant reproductive organs. Research on *Capsicum annuum* shows that increasing Ca availability can improve physiological growth and accelerate the generative development of chili plants (Wang *et al.*, 2024).

The accelerated flowering in high-dose treatments is also thought to be influenced by the presence of boron, which plays a crucial role in reproductive tissue differentiation, flower formation, pollen viability, and photosynthates translocation to generative growth points. Boron is known to increase carbohydrate metabolism and accelerate the formation of flower primordia, thus accelerating the flowering phase. The synergistic interaction between Ca and B is crucial for the development of the generative organs of chili plants because both elements contribute to cell wall formation, membrane stability, and reproductive tissue growth (Long & Peng, 2023; Vera-Maldonado *et al.*, 2024).

Furthermore, magnesium in Ca-Mg-S fertilizer functions as the central atom in chlorophyll, increasing

photosynthetic efficiency and photosynthates production. The accumulation of higher photosynthetic yields allows plants to have sufficient energy reserves to accelerate flower formation. Sulfur also plays a role in the synthesis of amino acids and proteins, which are related to enzymatic activity during the plant's reproductive phase. The combination of Mg and S supports increased physiological activity of plants so that the transition to the generative phase occurs more quickly and uniformly (Wickham & Davis, 2024; Sobczak *et al.*, 2024).

The slow flowering in the K0S0 control treatment indicates that the limited secondary and micronutrients in Inceptisol soil can inhibit plant physiological activity, especially the flower formation process. Plants deficient in Ca, Mg, S, and B generally experience delayed generative development due to impaired cell division, photosynthate translocation, and hormonal metabolic activity. Boron and calcium deficiencies in chili plants are known to inhibit meristematic tissue development and reduce the efficiency of flower and fruit formation (da Silva *et al.*, 2019).

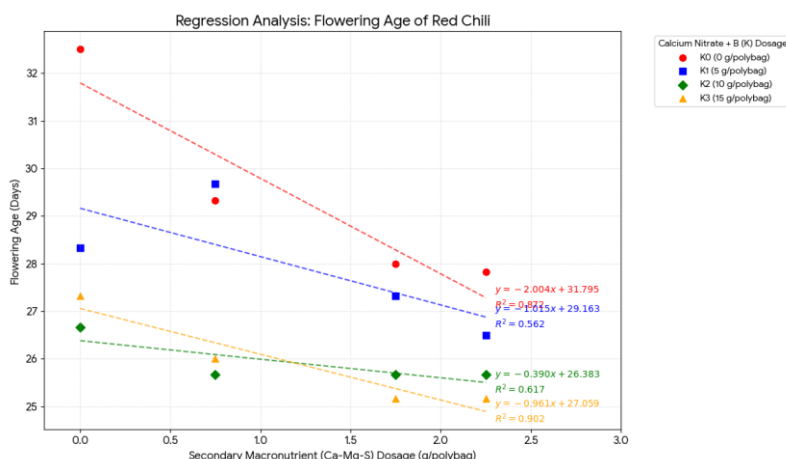


Figure 7: Regression graph of the combination of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizer treatments on the flowering age of red chilies.

The regression graph shows that increasing the dose of Ca-Mg-S fertilizer at each level of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer application tends to reduce the flowering age of red chili plants (Figure 7). The regression relationship formed is a negative linear one, which indicates that the higher the dose of the fertilizer combination given, the faster the plant enters the generative phase. In the treatment without $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer (K0), the regression equation obtained is: $y = -2.004x + 31.795$ with a coefficient of determination value: $R^2 = 0.806$. This equation shows that every 1 g/polybag increase in Ca-Mg-S fertilizer in conditions without $\text{Ca}(\text{NO}_3)_2 + \text{B}$ application can accelerate the flowering age by 2.004 days. The R^2 value of 0.806 indicates that 80.6% of the variation in flowering age is influenced by the application of Ca-Mg-S fertilizer.

In the K1 treatment (5 g/polybag $\text{Ca}(\text{NO}_3)_2 + \text{B}$), the

regression relationship also showed a negative linear pattern: $y = -0.8125x + 29.163$ with a coefficient of determination value: $R^2 = 0.562$. This value indicates that increasing the dose of Ca-Mg-S fertilizer accelerates flowering by 0.8125 days for every 1 g/polybag increase, although the closeness of the relationship is moderate because only 56.2% of the data variation is explained by the regression model. The K2 treatment (10 g/polybag $\text{Ca}(\text{NO}_3)_2 + \text{B}$) obtained the equation: $y = -0.390x + 26.383$ with a coefficient of determination value: $R^2 = 0.617$. This equation shows that the response to accelerated flowering is relatively smaller compared to other treatments, but still shows a tendency that increasing the dose of Ca-Mg-S fertilizer accelerates the generative phase of the plant. Meanwhile, in the K3 treatment (15 g/polybag $\text{Ca}(\text{NO}_3)_2 + \text{B}$) the regression equation was obtained: $y = -0.961x + 27.059$ with a coefficient of determination value: $R^2 = 0.902$. The R^2

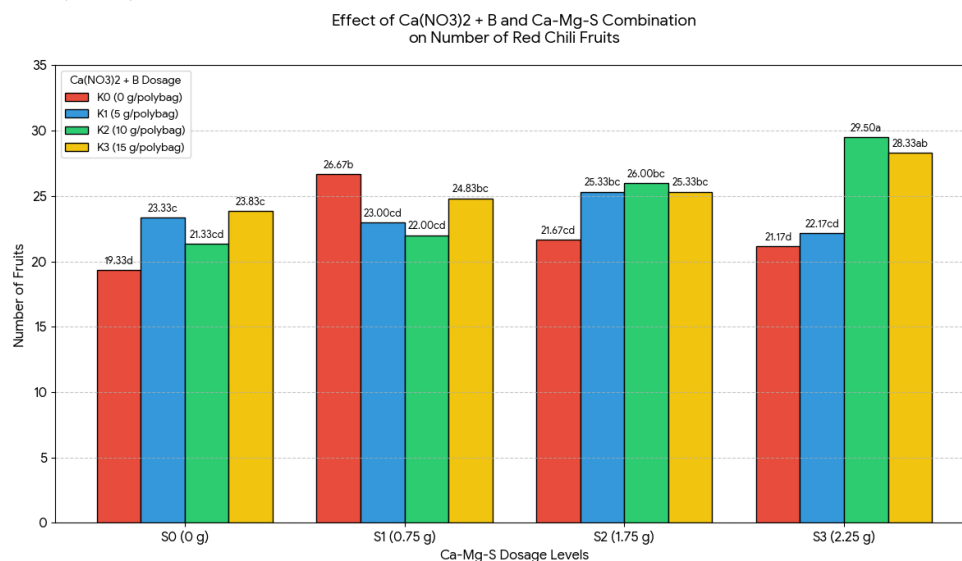
value of 0.902 indicates a very strong relationship between increasing the dose of Ca-Mg-S fertilizer and the acceleration of flowering age. This means that 90.2% of the variation in flowering age can be explained by the increase in fertilizer dose in this treatment. This indicates that the combination of high doses of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ with Ca-Mg-S provides the most optimal physiological response to accelerating red chili flowering.

Physiologically, accelerated flowering occurs because the elements Ca, Mg, S, nitrate nitrogen, and boron play a direct role in supporting metabolic activity and the plant's transition from the vegetative to the generative phase. Nitrate nitrogen increases protein synthesis, chlorophyll formation, and early vegetative growth, allowing plants to more quickly reach the physiologically mature phase for flowering. Calcium functions in cell division, membrane stability, and enzyme activation related to the formation of plant reproductive tissues. Recent research on red chili peppers shows that increasing calcium availability can accelerate flower formation and improve the physiological efficiency of chili plants (Sobczak *et al.*, 2024).

Magnesium in Ca-Mg-S fertilizer acts as the central atom of chlorophyll, increasing the rate of photosynthesis and photosynthate production. High accumulation of photosynthate supports the formation of flower primordia and accelerates flowering. Sulfur also supports amino acid synthesis and enzymatic activity related to the development of plant reproductive organs. Furthermore, boron is known to be crucial for floral tissue differentiation, pollen viability, and carbohydrate translocation to the generative organs. The synergistic interaction between Ca and B accelerates the development of floral meristems, allowing plants to enter the flowering phase earlier (Wang *et al.*, 2024).

The negative slope values in all regression equations indicate that the combination of increasing doses of Ca-Mg-S with $\text{Ca}(\text{NO}_3)_2 + \text{B}$ consistently accelerates the flowering time of red chili plants. This condition indicates that the balance of secondary and micronutrients in Inceptisol soils is crucial for supporting plant physiological efficiency, particularly in accelerating the generative phase and synchronizing flower formation.

Number of Fruits (fruits)



Note: Numbers followed by different letters indicate significant differences at the 5% level based on Duncan's test.

K0: 0 g/polybag, K1: 5 g/polybag, K2: 10 g/polybag, K3: 15 g/polybag; S0: 0 g/polybag, S1: 0.75 g/polybag, S2: 1.75 g/polybag, S3: 2.25 g/polybag

Figure 8: Histogram of the number of red chili fruits (fruits) with $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and Ca-Mg-S fertilizer applications.

The results showed that the combination of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizers significantly affected the number of red chili peppers. Based on the graph, the highest number of fruits was obtained in the K2S3 treatment combination (10 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer), namely 29.50 fruits, which was significantly different from several other treatments. Meanwhile, the lowest number of fruits was obtained in the K0S0 treatment (0 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 0 g/polybag of

Ca-Mg-S fertilizer), namely 19.33 fruits. In general, it can be seen that increasing the dosage of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer combined with Ca-Mg-S tends to increase the number of red chili peppers compared to the control treatment.

The increase in fruit number in the high-dose treatment combination indicates that the balance of secondary and micronutrients plays an important role in supporting the formation of generative organs in red chili peppers. The

nitrate nitrogen element from $\text{Ca}(\text{NO}_3)_2$ plays a role in increasing protein synthesis, chlorophyll formation, and photosynthetic activity, thus increasing photosynthate production. The resulting photosynthate is then translocated to support flower formation and fruit development. Calcium functions to strengthen cell walls and maintain membrane stability, thereby reducing flower and young fruit drop. Recent research on chili plants shows that increasing Ca availability can significantly increase fruit set, fruit weight, and productivity of chili plants (Gupta *et al.*, 2023; Wang *et al.*, 2024). In addition, the boron element in $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer plays an important role in the plant reproduction process, especially in flower formation, pollen viability, pollen tube growth, and fertilization success. Sufficient boron availability increases the success of fruit formation, resulting in a higher number of fruits produced. The synergistic interaction between Ca and B is also known to be able to increase carbohydrate translocation to plant reproductive organs so that fruit development takes place more optimally (Huang *et al.*, 2022; Furqoni & Sugiyanta, 2025).

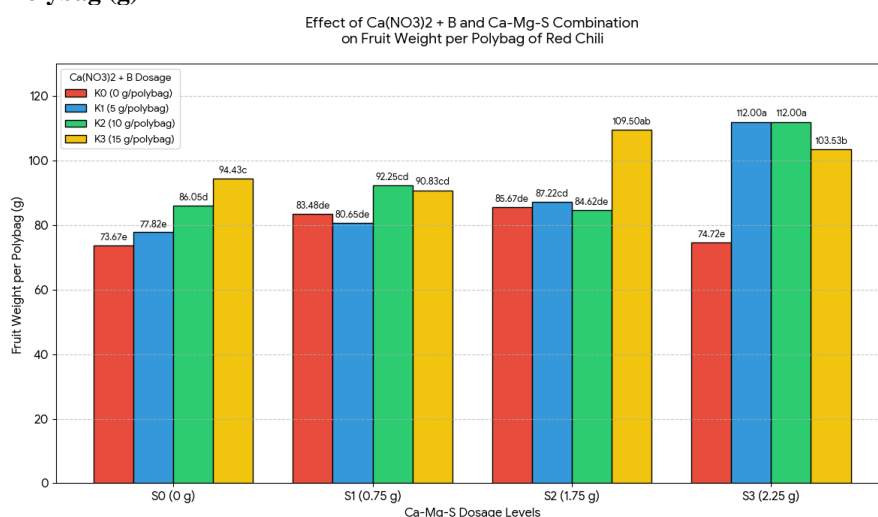
The increase in fruit number in the Ca-Mg-S treatment indicates that magnesium and sulfur contribute to increased red chili productivity. Magnesium, as the central atom in chlorophyll, plays a direct role in increasing photosynthetic efficiency and metabolic energy production in plants. Meanwhile, sulfur functions in the synthesis of amino acids, proteins, and enzymatic activity that supports flower and fruit development. The combination of Mg and S increases plant metabolic efficiency, resulting in higher assimilates accumulation for fruit formation. Research on horticultural crops shows that Mg and S supplementation can increase fruit number and yield quality by increasing photosynthetic

activity and nutrient use efficiency (Setiawati *et al.*, 2020; Sharavdorj *et al.*, 2022).

The control treatment K0S0 (0 g/polybag $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 0 g/polybag Ca-Mg-S fertilizer) produced the lowest fruit number because the plants depend solely on the availability of natural nutrients in Inceptisol soils, which generally have relatively low available nutrient content. These conditions cause plant physiological activity, flower formation, and fruit formation to be less than optimal. In contrast, the combination of K2S3 (10 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) and K3S3 (15 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) treatments is able to provide more balanced nutrients so that it supports plant physiological processes optimally, especially during the flowering and fruit formation phases.

Although the K3S3 treatment (15 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) had the highest fertilizer dose, the highest number of fruits was actually obtained in K2S3 (10 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer). This shows that increasing the fertilizer dose too high does not always result in a proportional increase in the number of fruits. Under certain conditions, plants can experience nutritional imbalances or a tendency to increase vegetative growth so that the efficiency of fruit formation is slightly reduced. Therefore, the combination of K2S3 (10 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) is thought to be a more optimal dose in supporting the balance of vegetative and generative growth of red chili plants.

Fruit Weight per Polybag (g)



Note: Numbers followed by different letters indicate significant differences at the 5% level based on Duncan's test.

K0: 0 g/polybag, K1: 5 g/polybag, K2: 10 g/polybag, K3: 15 g/polybag; S0: 0 g/polybag, S1: 0.75 g/polybag, S2: 1.75 g/polybag, S3: 2.25 g/polybag

Figure 9: Histogram of fruit weight per polybag (g) of red chilies with the provision of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and Ca-Mg-S fertilizer.

The results of the analysis of variance showed that the combination of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizer treatments had a significant effect on the fruit weight per polybag of red chili plants (Figure 9). The combination of K1S3 treatment (5 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) and K2S3 (10 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) produced the highest fruit weight, which was 112.00 g per polybag, respectively, while the lowest fruit weight was obtained in the K0S0 treatment (0 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 0 g/polybag of Ca-Mg-S fertilizer), K0S3 (0 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer), and K1S0 (5 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 0 g/polybag of Ca-Mg-S fertilizer) with values of 73.67 g, 74.72 g, and 77.82 g. These results indicate that the combination of Ca, Mg, S, nitrate nitrogen, and boron in balanced proportions can optimally increase the biomass accumulation of red chili peppers.

The increase in fruit weight in the K1S3 (5 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) and K2S3 (10 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) treatments was closely related to the increased physiological efficiency of the plant during the fruit formation and filling phase. Nitrogen in the form of nitrate from $\text{Ca}(\text{NO}_3)_2$ fertilizer plays an important role in protein synthesis, chlorophyll formation, and increased photosynthetic activity, thus increasing photosynthate production. The resulting photosynthate is then translocated to the sink organs, especially the fruit, thereby increasing the fruit weight of the plant. In addition, calcium functions to maintain the integrity of the cell membrane and strengthen the structure of the fruit cell wall so that fruit development takes place more optimally and fruit loss can be suppressed (Arakawa *et al.*, 2021; Ropokis *et al.*, 2021; Wang *et al.*, 2024).

The role of boron in the treatment combination is also crucial for increasing fruit weight. Boron is known to function in the translocation of sugars and carbohydrates from leaves to fruit, increasing pollen viability, and supporting cell division and differentiation during fruit development. Adequate boron availability results in a more efficient distribution of photosynthates to generative organs, thereby increasing fruit biomass accumulation (Durán-Soria *et al.*, 2020; Matthes *et al.*, 2020; Huang *et al.*, 2022). The synergistic interaction between Ca and B also improves fruit tissue stability and plant metabolic efficiency during the reproductive phase.

The increase in fruit weight at high doses of Ca-Mg-S indicates that magnesium and sulfur also contribute significantly to red chili productivity. Magnesium, as the central atom in chlorophyll, plays a direct role in increasing the rate of photosynthesis and metabolic energy production in plants. Optimal photosynthesis produces higher levels of assimilates, which are then

used for fruit filling (Ahmed *et al.*, 2023; Jiao *et al.*, 2023). Meanwhile, sulfur plays a role in the synthesis of amino acids and proteins, which are essential for fruit tissue formation and plant enzymatic activity (Li *et al.*, 2020; Narayan *et al.*, 2023). Research by Ahmed *et al.* (2023); Qin *et al.* (2024) reported that magnesium and sulfur applications can increase fruit yield and quality in horticultural crops by increasing photosynthetic efficiency and plant nitrogen metabolism.

Interestingly, the highest dose of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ did not always produce the highest fruit weight. This was evident in the K3 treatment (15 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer), which showed no further increase compared to K1 (5 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer) and K2 (10 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer). This condition indicates that at a certain dose, the plant has reached its optimum nutrient requirement. Excessive nutrient administration can cause nutritional imbalances, excessive vegetative growth, or antagonism between nutrients, thus reducing the efficiency of fruit formation. Therefore, the combination of K1S3 (5 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) and K2S3 (10 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) is suspected to be the most optimal dose in creating a balance between vegetative and generative growth of red chili plants on Inceptisol soil.

The low fruit weight in the K0S0 control treatment (0 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 0 g/polybag of Ca-Mg-S fertilizer) indicates that the limitations of secondary and micronutrients in Inceptisol soil can limit plant physiological processes, especially photosynthesis, assimilates translocation, and fruit development. Without adequate nutrient supplementation, plants are unable to form and fill fruit optimally, resulting in low yield weight.

CONCLUSION

The combined application of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizers to Inceptisol soil increased the growth and yield of red chili peppers. Both fertilizers significantly affected plant height, stem diameter, flowering time, fruit number, and fruit weight per polybag, but had no significant effect on the number of plant branches.

Increasing the doses of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ and Ca-Mg-S fertilizers tended to increase vegetative growth, particularly plant height and stem diameter, indicating that the availability of calcium, magnesium, sulfur, nitrate nitrogen, and boron improved plant physiological activity in Inceptisol soil. The combination of the two fertilizers also accelerated the generative phase of the plant, as indicated by the fastest flowering age in the K3S2 treatment (15 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 1.75 g/polybag of Ca-Mg-S fertilizer) and K3S3 (15 g/polybag of $\text{Ca}(\text{NO}_3)_2 + \text{B}$ fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) compared to the control treatment. In terms of production parameters, the K2S3 treatment

combination (10 g/polybag of Ca(NO₃)₂ + B fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) provided the best response to the number of red chilies, while the K1S3 combination (5 g/polybag of Ca(NO₃)₂ + B fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) and K2S3 combination (10 g/polybag of Ca(NO₃)₂ + B fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) produced the highest fruit weight per polybag. These results indicate that the balance of secondary and micronutrients plays an important role in increasing photosynthetic efficiency, photosynthates translocation, flower formation, and red chili fruit development.

Overall, the Ca(NO₃)₂ + B and Ca-Mg-S fertilizer combinations proved effective in increasing red chili productivity on Inceptisol soils. The combination of K2S3 treatment (10 g/polybag of Ca(NO₃)₂ + B fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) and K1S3 (5 g/polybag of Ca(NO₃)₂ + B fertilizer and 2.25 g/polybag of Ca-Mg-S fertilizer) can be recommended as a more optimal dose to support the growth and yield of red chilies because it is able to produce the best balance between vegetative and generative growth of plants.

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