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The Effect of NPK Fertilizer and Gobest ZPT on the Growth of Chili Plants (Capsicum frutescens L.)

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Abstract. Abstract. This study aims to determine the effect of NPK and ZPT Gobest fertilizers on the growth of cayenne pepper plants (Capsicum frutescens L.). The experiment was carried out using a Group Random Design (RAK) with two factors, namely the dose of NPK fertilizer (100 kg/ha, 150 kg/ha, and 200 kg/ha) and the concentration of ZPT Gobest (1 ml/liter, 2 ml/liter, and 3 ml/liter) which was repeated for three replicates. The parameters observed included plant height, number of leaves, leaf area, and number of branches. The results showed that the application of 200 kg/ha NPK fertilizer and 2 ml/liter ZPT Gobest had the best influence on plant vegetative growth, such as plant height and number of leaves, leaf area, and number of branches.

Keywords: NPK, ZPT gobest, pepper

1 Introduction

Chili (Capsicum frutescens L.) is one of the horticultural commodities that has high economic value in Indonesia [1]. The increasing demand for chili, both for household and industrial needs, encourages farmers to optimize production [2]. However, in the cultivation process, chili peppers are susceptible to various environmental factors that can affect their growth and yield, such as soil conditions, nutrient availability, and pest attacks [3].

To achieve optimal growth and high yields, the use of fertilizers and plant growth regulators (PGRs) is an important practice in chili cultivation. NPK fertilizer, which consists of Nitrogen (N), Phosphorus (P), and Potassium (K), is a type of inorganic fertilizer that plays an important role in providing essential macro nutrients for plants. Nitrogen plays a role in the formation of leaves and stems, Phosphorus helps root development and photosynthesis, while Potassium functions to increase plant resistance to disease and improve fruit quality.

NPK fertilizer (Nitrogen, Phosphorus, Potassium) has a significant effect on chili plant growth. Nitrogen (N) plays a role in stimulating vegetative growth, such as the formation of more and larger leaves and stems, which are important for photosynthesis. Phosphorus (P) aids in root development, allowing plants to absorb nutrients more efficiently from the soil. In addition, phosphorus is also involved in energy formation through photosynthesis, thereby supporting overall plant growth. Potassium (K) increases the strength of plant tissue, helping plants to be more resistant to environmental stress and disease [4].

The use of NPK fertilizer in the right dosage also has a direct effect on chili crop yields. Potassium, in particular, plays an important role in improving fruit quality, such as size, color, and taste, as well as increasing the shelf life of chili peppers. Phosphorus, by supporting flower and fruit formation, contributes to an increase in the number of fruits per plant. Adequate nitrogen ensures that plants have good vegetative growth, which will support optimal flower and fruit formation. Thus, NPK fertilizer is one of the key components in improving chili pepper yield and quality [5].

The dosage of NPK fertilizer for chili plants varies depending on soil conditions, plant age, and growth phase. In general, the recommended dosage is around 200-300 kg per hectare for NPK combinations with a ratio of 16-16-16 or 15-15-15. In the early growth phase (1-4 weeks after planting), NPK fertilizer is applied to support root and leaf growth. Subsequently, when the plants begin to flower and bear fruit, the fertilizer dosage can be increased to 300-400 kg per hectare with a higher potassium (K) composition, for example, using NPK with a ratio of 12-12-17 or 15-9-20. Fertilizer is applied gradually every 2-3 weeks through a drip irrigation system or by spreading it around the base of the plant [6].

This study compared the effectiveness of NPK fertilizer and organic fertilizer in improving the growth and yield of chili plants. The results showed that a combination of NPK fertilizer and organic fertilizer produced better results than using either fertilizer alone, as well as improving the quality of the harvest [7]. The effect of NPK fertilizer dosage on the growth and yield of chili plants grown in sandy soil. The results show that proper NPK

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fertilization can improve the quality and quantity of chili yields, and provide appropriate dosage recommendations for these soil conditions [8]. This study explores the effects of various NPK fertilizer doses on the growth and yield of red chili peppers. The results show that the optimal NPK dose can significantly increase plant height, number of leaves, and chili yield [9].

In addition to fertilizers, the use of plant growth regulators (PGRs) such as Gobest is also increasingly popular. Gobest is a PGR that contains various plant hormones, such as auxin, cytokinin, and gibberellin, which aim to stimulate vegetative and generative plant growth. Auxin plays a role in cell enlargement and root growth, cytokinin regulates cell division and bud formation, while gibberellin affects stem growth and cell elongation [10].

Plant growth regulators (PGRs) play an important role in optimizing chili plant growth. PGRs such as auxin, cytokinin, and gibberellin work synergistically to influence various physiological processes in plants. Auxin, for example, stimulates cell elongation that supports root and stem growth, so that chili plants can grow stronger and absorb nutrients better. Cytokinin helps cell division that accelerates new shoot growth, while gibberellin plays a role in elongating stems and increasing overall vegetative growth [11].

In addition to influencing growth, PGRs also play an important role in increasing chili crop yields. Auxin and gibberellin can accelerate the flowering and fruit formation processes, while cytokinin helps maintain the quality and quantity of yields. PGRs help regulate the balance between vegetative and generative growth, which has an impact on increasing the number and size of chili fruits. With the right application of PGRs, chili yields can increase in terms of both productivity and fruit quality, such as color and shelf life [12].

Gobest PGR is a plant growth regulator that contains various important plant hormones, such as auxin , cytokinin, and gibberellin. Auxin plays a role in stimulating cell elongation, accelerating root growth, and supporting bud formation. Cytokinin functions in cell division and the regulation of bud and leaf growth, thereby accelerating plant tissue regeneration. Giberellin, on the other hand, helps stem elongation, stimulates flowering, and enhances fruit growth. The combination of these hormones makes Gobest PGR effective in enhancing the vegetative and generative growth of plants, including chili peppers, thereby potentially increasing yield and crop quality [8].

The appropriate ZPT dosage depends heavily on the type of plant, growth stage, and environmental conditions. For chili plants, ZPTs such as Gobest are generally used at a dosage of about 1-2 ml per liter of water, which is then applied through foliar spraying or irrigation systems. Applications are usually carried out once every 1-2 weeks, depending on the needs of the plant, especially in the early growth phase until fruit formation. It is important not to use PGRs excessively, as too high a dose can cause unbalanced growth or damage to plants. Small-scale dose trials are recommended before widespread application [13].

This study examined the effect of various types of PGRs on the quality of chili peppers. The results showed that the application of certain PGRs can improve the size, color, and taste of chili peppers, as well as extend the shelf life of the harvest [14]. In this study, the authors investigated the effect of auxin and [15] application on the growth and yield of red chili plants. The results showed that the application of these PGRs can accelerate flowering and increase crop yields, especially at the right dosage. This study explored the effect of Gobest PGR application on the vegetative and generative growth of chili plants. The results showed that Gobest PGR application significantly increased plant height, number of leaves, and number of chili fruits compared to the control treatment [16].

With a combination of NPK fertilization and Gobest PGR application, it is expected to improve the vegetative and generative growth of chili plants more optimally, thereby increasing crop yield in terms of both quantity and fruit quality. Research on the effect of these two components on chili plants is important to determine the most effective dosage and application method, thereby providing appropriate cultivation practice recommendations for farmers.

The objective of this study is to determine the optimal dosage of the combination of NPK fertilizer and Gobest PGR to maximize chili pepper yield, both in terms of quantity and quality. The research question is: What is the optimal combination of NPK fertilizer and Gobest PGR to enhance chili pepper plant growth and yield?

2 Method

2.1 Research Time and Location

This research will be conducted at the experimental field of Muhammadiyah University Sidoarjo, which is suitable for chili cultivation, with controlled environmental conditions. The research will take place over one growing season, from November 2024 to January 2025, starting from seedling planting to harvest, lasting approximately 3 months.

2.2 Research Procedures

Materials: High-quality chili pepper seeds, NPK fertilizer (with adjusted ratios), Gobest ZPT, water, and

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growing medium (soil, compost, manure). Tools: Scale, sprayer, bucket, measuring tape, writing tools, thermometer, and soil pH and moisture meters.

This study used a Randomized Block Design (RBD) with two factors, namely NPK fertilizer dosage and ZPT gibest dosage, with 3 replicates. The treatments applied were as follows: Factor 1: NPK fertilizer (N) dosage with 3 treatment levels: N1: 100 kg/ha, N2: 150 kg/ha, N3: 200 kg/ha. Factor 2: Gobest ZPT concentration (Z) with 3 treatment levels: Z1: 1 ml/liter, Z2: 2 ml/liter, Z3: 3 ml/liter.

The research procedure was carried out by preparing the land: the land was cleared and beds of uniform size were prepared for each plot. Seedling planting: chili seeds were planted in the designated plots after the seedlings reached an age of about 3-4 weeks. Treatment Application: NPK fertilizer was applied to the plants according to the specified dosage by drenching or sprinkling around the base of the plants. ZPT Gobest was applied by spraying the leaves with a solution at a specified dosage. Plant Maintenance: Watering, weeding, and pest control were carried out regularly during the research period.

Observation Parameters Observations were made on the following parameters: Plant Growth: Including plant height, number of leaves, leaf area, and number of branches measured weekly. The research data were analyzed using analysis of variance (ANOVA) to determine the effect of treatment on plant growth and yield variables. If there were significant differences, the BNJ test was used to determine the differences between treatments.

3 Results and Discussion

3.1 Plant Height

The results of the variance analysis showed that there was no interaction between the NPK and ZPT gobest treatments. The NPK treatment had an effect on all observation periods, while the ZPT treatment had an effect on plant growth at 28, 35, 42, and 49 days after planting. Further tests can be seen in Table 1.

Table 1. Average Treatment of NPK and ZPT Gobest on Plant Height (cm)

Treatment	Age (HST)													
	7		14		21		28		35		42		49	
c	12.24	a	14.22	a	19.39	a	25.83	a	34.33	a	35.06	a	36.00	a
NPK 150 kg/ha	10.99	ab	14.00	ab	21.72	ab	31.50	ab	36.44	ab	37.94	ab	39.83	ab
NPK 200 kg/ha	13.51	b	18.28	b	25.39	b	37.67	b	45.61	b	46.67	b	50.72	b
BNJ 5%	2.04		3.41		3.87		5.78		8.10		9.33		8.08	
ZPT Gobest 1 ml/liter	12.61		15.00		20.22		28.44	a	33.06	a	33.17	a	36.28	a
ZPT Gobest 2 ml/liter	12.63		17.22		23.61		34.78	b	44.00	b	45.22	b	47.33	b
ZPT Gobest 3 ml/liter	11.50		14.28		22.67		31.78	ab	39.33	ab	41.28	ab	42.94	ab
BNJ 5%	**tn**		**tn**		**tn**		**5.78**		**8.10**		**9.33**		**8.08**	

Note: Identical numbers in the same column indicate no significant difference, n.s. = not significant.

From Table 1, it can be explained that the NPK 200 kg/ha treatment is significantly higher than the NPK 100 kg/ha treatment at all observation ages. The ZPT Gobest 2 ml/liter treatment is significantly higher than the ZPT Gobest 1 ml/liter treatment.

3.2 Number of Leaves

The analysis of variance shows that there is no interaction between the NPK and ZPT Gobest treatments. The NPK treatment affects growth at 7, 14, and 28 days, while the ZPT treatment affects growth at 49 days after planting. Further tests can be seen in Table 2.

Table 2. Average of NPK and ZPT Gobest treatments on Number of Leaves (pieces)

Treatment	Age (HST)								
	7		14		21	28	35		42	49
NPK 100 kg/ha	3.67	a	7.33	a	11.33	13.22	18.78	a	17.78	22.11

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NPK 150 kg/ha	3.89	ab	9.00	ab	13.44	13.67	19.33	ab	16.56	21.56	
NPK 200 kg/ha	4.33	b	9.33	b	13.33	15.89	25.33	b	20.56	28.33	
BNJ 5%	0.59		1.97		tn	tn	5.71		tn	tn	
ZPT Gobest 1 ml/liter	3.67		7.67		11.78	12.67	17.22	a	14.22	17.44	a
ZPT Gobest 2 ml/liter	4.22		9.56		13.33	15.22	25.00	b	20.89	27.78	b
ZPT Gobest 3 ml/liter	4.00		8.44		13.00	14.89	21.22	ab	19.78	26.78	ab
BNJ 5%	tn		tn		tn	tn	5.71		tn	9.46	

Note: Identical numbers in the same column indicate no significant difference, tn = not significant.

From Table 2, it can be explained that the NPK 200 kg/ha treatment is significantly higher than the NPK 100 kg/ha treatment at all observation ages. The ZPT Gobest 2 ml/liter treatment is significantly higher than the ZPT Gobest 1 ml/liter treatment.

3.3 Leaf Area

The analysis of variance shows that there is no interaction between the NPK and ZPT Gobest treatments. The NPK treatment affects growth at 7, 14, and 49 days, while the ZPT treatment affects growth at 49 days after planting. Further tests can be seen in Table 3.

Table 3. Average of NPK and ZPT Gobest treatments on Leaf Area (cm³)

Treatment	Age (HST)									
	7		**14**		**21**	**28**	**35**	**42**	**49**	
NPK 100 kg/ha	19.31	a	122.01	a	345.48	701.73	1146.44	1032.67	1114.37	a
NPK 150 kg/ha	21.33	a	199.72	ab	605.50	883.33	2048.38	1176.66	1596.49	ab
NPK 200 kg/ha	31.82	b	239.27	b	649.85	1133.05	2170.01	1610.18	2556.62	b
BNJ 5%	7.30		108.17						1111.36	
ZPT Gobest 1 ml/liter	20.87		153.81		424.69	740.73	1125.13	961.75	1,211.21	a
ZPT Gobest 2 ml/liter	28.06		248.14		683.30	1044.99	2071.58	1,596.61	2,519.60	b
ZPT Gobest 3 ml/liter	23.53		159.05		492.84	932.40	2168.12	1,261.15	1,536.67	ab
BNJ 5%									1111.36	

Note: Identical numbers in the same column indicate no significant difference, tn = not significant.

From Table 3, it can be explained that the NPK 200 kg/ha treatment is significantly higher than the NPK 100 kg/ha treatment at 7, 14, and 49 days after planting. The ZPT Gobest 2 ml/liter treatment is significantly higher than the ZPT Gobest 1 ml/liter treatment at 49 days after planting.

3.4 Number of Branches

The analysis of variance results indicate that there is no interaction between the NPK and ZPT Gobest treatments. The NPK treatment affects growth at 49 HST, while the ZPT treatment affects growth at 49 HST on chili plant growth. Further tests can be seen in Table 4.

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Table 4. Average of NPK and ZPT Gobest treatments on Number of Branches (fruits)

Treatment	49 HST	
NPK 100 kg/ha	3.22	a
NPK 150 kg/ha	4.56	ab
NPK 200 kg/ha	7.22	b
BNJ 5%	3.28	
ZPT Gobest 1 ml/liter	3.00	a
ZPT Gobest 2 ml/liter	6.78	b
ZPT Gobest 3 ml/liter	5.22	ab
BNJ 5%	**3.28**	

Note: Identical numbers in the same column indicate no significant difference.

From Table 4, it can be explained that the NPK 200 kg/ha treatment was significantly higher than the NPK 100 kg/ha treatment at all ages of 49 HST. The ZPT Gobest 2 ml/liter treatment was significantly higher than the ZPT Gobest 1 ml/liter treatment.

3.5 Discussion

The application of different NPK doses had a significant effect on plant height at various observation ages (7-49 HST) ( ). At the NPK dose of 200 kg/ha, plant height, number of leaves, leaf area, and number of branches showed the highest values compared to the NPK doses of 100 kg/ha and 150 kg/ha. This is in line with research conducted by Rosi et al. (2018), which states that increasing the NPK fertilizer dose can enhance vegetative growth, including plant height, due to the more optimal availability of macro nutrients (N, P, K). Nitrogen (N) plays an important role in protein and chlorophyll formation, phosphorus (P) supports root development and flowering, while potassium (K) increases plant resistance to environmental stress. However, increasing the NPK dose must be adjusted to the needs of the plant because excess fertilizer can cause nutrient imbalance and decreased productivity.

On the other hand, the application of Gobest PGR also showed a significant effect on plant height, number of leaves, leaf area, and number of branches, especially at a dose of 2 ml/liter. Gobest PGR contains active compounds that can stimulate plant growth by increasing cell division and elongation. These results are in line with the research by Ernita et al. (2023), which states that the application of natural or synthetic PGRs can increase the activity of growth hormones such as auxin and gibberellin, thereby supporting plant height growth. At a dose of 1 ml/liter, the effect of Gobest PGR was lower than at a dose of 2 ml/liter, while a dose of 3 ml/liter showed results that were not much different from the 2 ml/liter dose.

Gobest PGR contains active compounds that can stimulate cell division and enlargement, thereby supporting leaf growth. Plant growth regulators (PGRs) such as auxin and gibberellin can increase leaf growth by stimulating new cell formation and prolonging leaf life [19]. At a dose of 1 ml/liter, the effect of Gobest PGR was lower than that of 2 ml/liter, while 3 ml/liter showed results that were not much different from 2 ml/liter. This indicates that there is an optimal dose of PGR that is effective in supporting leaf growth.

Overall, the results of this study indicate that the application of 200 kg/ha of NPK and 2 ml/liter of Gobest PGR has the best effect on the number of leaves. However, further analysis is needed to determine the long-term impact of this treatment on the generative phase of plants, such as flowering and fruiting. In addition, the efficiency of fertilizer and PGR use needs to be considered to reduce production costs and negative impacts on the environment. This study can serve as a reference for farmers in determining the optimal fertilizer and ZPT dosage to increase crop productivity, particularly in terms of vegetative growth such as leaf number.

4 Conclusion

Based on the results of this study, it can be concluded that the application of NPK fertilizer and Gobest PGR has a significant effect on the growth of cayenne pepper (Capsicum frutescens L.). A NPK fertilizer dosage of 200 kg/ha and a Gobest PGR concentration of 2 ml/liter provide the best results in improving vegetative growth parameters, such as plant height and number of leaves, leaf area, and number of branches. This combination of treatments increases nutrient availability for plants and stimulates growth hormone activity, thereby supporting optimal plant development. The results of this study can serve as a recommendation for farmers to increase chili pepper productivity through proper NPK fertilization and ZPT application.

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DEMETER: Journal of Farming and Agriculture
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