JALF — Journal of Agriculture, Livestock and Fisheries
Volume 1, Number 1 (2026) · November 2026
Research Center Progresif · jalf@researchcenterprogresif.org

Influence of Plant Growth Regulator (PGR) Dosage on the Growth and Yield of Various Chili (Capsicum annuum L.) Varieties

Hilda Pratiwi[1], Nur Halimatuz Zuhra[2*], Naziratil Husna[1], Vinny Pratiwi[1], Sri Novayanti[3]

[1]*Department of Agricultural Science, Faculty of Agricultural and Animal Sciences, Universitas Islam Kebangsaan Indonesia, Aceh, Indonesia*

[2]*Agrotechnology Study Program, Faculty of Agriculture, Universitas Samudra, Aceh, Indonesia*

[3]*Faculty of Teacher Training and Education, Universitas Islam Kebangsaan Indonesia, Aceh, Indonesia*

*Corresponding author: nhzuhra21@gmail.com

Article History — Received: 10-11-2026 · Accepted: 16-11-2026

Abstract

Red chili pepper (Capsicum annuum L.) is an economically valuable horticultural commodity that is widely cultivated. To increase its productivity, plant growth regulators (PGRs), such as auxins, are used to influence various physiological processes in plants. This study aimed to assess the effects of PGR application and variety on the growth and yield of red chili and the interaction between the two. The research was conducted in Meunasah Raya Village, Pidie Jaya Regency, and at the Universitas Syiah Kuala Laboratory from June to October 2025, using a factorial randomized block design (RBD) with 16 samples. The observed variables were plant height, stem diameter and number of leaves, with the PGR paclobutrazol applied at doses of 10, 15 and 20 ml/L. The results indicate that PGR dose affected plant growth: the control gave the best results at 15 days after planting (DAP), while the 20 ml/L dose gave the lowest. The 20 ml/L dose also produced the best stem diameter at 15 DAP, although the effect was not significant at 30 and 45 DAP. Chili variety also influenced growth: the AKAR variety had the best plant height at 15 and 30 DAP, while the PERINTIS variety performed best at 45 DAP. The interaction between PGR dose and variety significantly affected all observed parameters, namely plant height, stem diameter and number of leaves.

Keywords: red chili (Capsicum annuum L.); plant growth regulator (PGR); chili varieties; productivity

Abstrak

Cabai merah (Capsicum annuum L.) merupakan komoditas hortikultura bernilai ekonomis tinggi yang banyak dibudidayakan. Untuk meningkatkan produktivitasnya, digunakan zat pengatur tumbuh (ZPT), seperti auksin, yang berpengaruh terhadap berbagai proses fisiologis tanaman. Penelitian ini bertujuan untuk mengkaji pengaruh aplikasi ZPT dan varietas terhadap pertumbuhan dan hasil cabai merah, serta interaksi keduanya. Penelitian dilaksanakan di Desa Meunasah Raya, Kabupaten Pidie Jaya, dan Laboratorium Universitas Syiah Kuala pada Juni hingga Oktober 2025, dengan menggunakan Rancangan Acak Kelompok Pola Faktorial (RAK) 16 sampel. Variabel yang diamati: tinggi tanaman, diameter batang, dan jumlah daun, dengan aplikasi ZPT Paclobutrazol: 10 ml/L, 15 ml/L, dan 20 ml/L. Hasil penelitian menunjukkan bahwa dosis ZPT berpengaruh terhadap pertumbuhan cabai, dengan dosis kontrol memberikan hasil terbaik pada umur 15 HST, sedangkan dosis 20 ml/L menunjukkan hasil terendah. Dosis ZPT 20 ml/L juga memberikan diameter batang terbaik pada umur 15 HST, meskipun tidak signifikan pada umur 30 dan 45 HST. Varietas cabai juga mempengaruhi pertumbuhan, dengan varietas AKAR menunjukkan tinggi tanaman terbaik pada umur 15 HST dan 30

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HST, sementara varietas PERINTIS menunjukkan hasil terbaik pada umur 45 HST. Interaksi antara dosis ZPT dan varietas berpengaruh signifikan terhadap semua parameter yang diamati, termasuk tinggi tanaman, diameter batang dan jumlah daun.

Kata kunci: cabai merah (Capsicum annuum L.); zat pengatur tumbuh (ZPT); varietas cabai; produktivitas

Introduction

Red chili (Capsicum annuum L.) is a horticultural crop of high economic value and in great demand. Indonesia, including Aceh Besar, is a major red chili-producing area, and national and Acehnese production underline the importance of developing this crop. Plant growth is influenced by plant growth regulators (PGRs), both natural and synthetic. Synthetic PGRs are costly and difficult to obtain, so natural PGRs such as shallot extract are an alternative. Plant hormones such as auxins play an important role in physiological processes (root growth, cell enlargement and others). Improved varieties are important because they have a high yield potential and tolerate environmental conditions. This research was conducted to examine the effect of PGR application and chili variety on growth and yield, and the interaction between the two.

PGRs are non-nutrient organic compounds that influence growth at low concentrations (Putri et al., 2013; Asra et al., 2020; Aisyah, 2020; Pujiasmanto, 2020). Paclobutrazol (C15H20ClN3O) suppresses gibberellin, inhibits internode elongation and enhances flowering (Kusumiyati, 2015). Improved varieties have a high yield potential, pest resistance and adaptability (Ellya, 2018; Andayani, 2016). The AKAR variety (West Sumatra) is resistant to gemini virus and suited to a range of altitudes. The PERINTIS variety (Pidie Jaya) is resistant to aphids and gemini virus and matures early, at 75–150 days after planting (Munawar, 2017).

This study aimed to determine the effect of PGR application and variety, and the interaction between these two factors, on the growth and yield of chili. It was hypothesised that PGR application and its interaction with variety significantly affect chili growth and yield.

Methods

Location and Time

The study was carried out in Meunasah Raya Village, Meurah Dua District, Pidie Jaya Regency, and at the Laboratory of Universitas Syiah Kuala from June to October 2025.

Procedures

Preparation of the growing medium

Soil, rice husk and compost were mixed at a ratio of 2:1:1 and placed in polybags.

Preparation of planting material

The planting material consisted of the AKAR and PERINTIS chili varieties. Paclobutrazol was applied by spraying at the treatment doses (10, 15 and 20 ml/L), starting 7 days after transplanting. Healthy seeds were selected, sown and placed in polybags. The seedlings were raised for 4 weeks and maintained to protect them from disease.

Paclobutrazol application and transplanting

Paclobutrazol was sprayed onto the plants once every 7 days at doses of 10, 15 and 20 ml/L. After 4 weeks, healthy seedlings were transplanted to beds at a spacing of 60 cm and watered daily.

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Crop maintenance

Maintenance included watering, replanting, weeding and pest control. Plants were watered twice a day, in the morning and in the afternoon. Replanting was carried out where plants failed to grow or died.

Harvest

Fruits were harvested at 90, 95, 100, 105 and 110 days after planting, when they had turned red, by picking the fruit together with its stalk.

Observed variables

1. Plant height (cm). Plant height was measured every 15 days from the base to the tip of the highest leaf on the sample plants in each bed. The measurements of the sample plants were averaged in an observation table.

2. Stem diameter (cm). Stem diameter was measured at 15, 30 and 45 days after planting (DAP) with a measuring instrument graduated in centimetres.

3. Number of leaves per plant. Leaves were counted on each chili plant at 15, 30 and 45 DAP.

Results and Discussion

Effect of PGR Dose on the Growth and Yield of Chili Varieties

The effect of PGR dose and variety on chili production was assessed by observing several parameters, namely plant height, stem diameter, number of leaves, number of fruits per plant, fruit weight per plant, fresh shoot weight per plant, fresh root weight per plant and root percentage, as follows.

1. Plant height (cm)

Mean chili plant height at 15, 30 and 45 DAP under the PGR dose treatments is shown in Table 1.

Table 1. Mean plant height at 15, 30 and 45 DAP under PGR dose treatments.

PGR dose (ml/L)	Plant height (cm)		
	15 DAP	30 DAP	45 DAP
Control	26 d	42.5 b	47.75 b
10	24.5 b	41.75 b	48.75 b
15	24.75 bc	40.5 b	48 b
20	22 a	28.75 a	31.25 a
HSD 0.05	0.31	11.79	6.34

Note: values followed by letters were compared using the honestly significant difference (HSD) test at the 0.05 level.

Table 1 shows that PGR dose had a highly significant effect on plant height at 15 DAP. The best result was in the control (26), and the lowest mean plant height was at the 20 ml/L dose (22), which differed significantly from the 15 ml/L and 10 ml/L doses.

Table 1 also shows that PGR dose had a highly significant effect on plant height at 30 and 45 DAP. At 30 DAP the best treatment was the control (42.5), and at 45 DAP the 10 ml/L dose (48.75), which differed significantly from the other treatments. Hormones produce a range of growth and morphogenetic responses that are pleiotropic in their effects. This can be seen in auxin, which is involved in many growth responses, such as apical dominance, cell division and growth, organ responses, fruit regulation and stimulatory responses. In addition, several hormones can produce similar responses, for example cell elongation caused by auxin, brassinosteroids and gibberellins (Cokrowati & Diniarti, 2019).

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2. Stem diameter

Mean stem diameter at 15, 30 and 45 DAP under the PGR dose treatments is shown in Table 2.

Table 2. Mean stem diameter at 15, 30 and 45 DAP under PGR dose treatments.

PGR dose (ml/L)	Stem diameter per plant		
	15 DAP	30 DAP	45 DAP
Control	11.05 a	11.175 a	11.225 a
10	10.55 a	10.7 a	10.75 a
15	11.3 a	11.4 a	11.45 a
20	15.025 a	15.075 a	15.1 a
HSD 0.05	11.75	7.98	8.01

Note: values followed by letters were compared using the honestly significant difference (HSD) test at the 0.05 level.

Table 2 shows that PGR dose had a significant effect on stem diameter at 15 DAP, with the best result at the 20 ml/L dose (15.025) and the lowest mean at the 10 ml/L dose.

PGR dose had no significant effect on stem diameter at 30 DAP and a significant effect at 45 DAP. The best treatment at 30 DAP was the 20 ml/L dose, as it was at 45 DAP (15.075). A key characteristic of plant growth regulators is, first, that each hormone produces a range of growth and morphogenetic responses that are pleiotropic in their effects, as seen in auxin, which is involved in apical dominance, cell division and growth, organ responses, fruit regulation and stimulatory responses. Second, several hormones can produce similar responses, for example cell elongation caused by auxin, brassinosteroids and gibberellins (Cokrowati & Diniarti, 2019).

3. Number of leaves

The mean number of leaves at 15, 30 and 45 DAP under the PGR dose treatments is shown in Table 3.

Table 3. Mean number of leaves at 15, 30 and 45 DAP under PGR dose treatments.

PGR dose (ml/L)	Number of leaves per plant		
	15 DAP	30 DAP	45 DAP
Control	20 a	59 a	81 d
10	18.25 a	51 a	74.75 c
15	19.5 a	38 a	68.5 b
20	21.75 a	48.25 a	57.5 a
HSD 0.05	11.58	26.30	1.98

Note: values followed by letters were compared using the honestly significant difference (HSD) test at the 0.05 level.

Table 3 shows that PGR dose had a significant effect on the number of leaves per plant at 15 DAP, with the best result at the 20 ml/L dose (21.75) and the lowest at the 10 ml/L dose.

PGR dose had a highly significant effect at 30 and 45 DAP. The best treatment at 30 DAP was the control (59), and at 45 DAP also the control (81), which differed significantly from the other treatments. This indicates that the PGR dose affects plant growth. It is consistent with Nazibah, Karno and Lukiwati (2018), who found that paclobutrazol application in tomato reduced the number of leaves by 8% compared with the control.

Effect of Variety on the Growth and Yield of Chili

1. Plant height (cm)

Mean plant height at 15, 30 and 45 DAP by variety is shown in Table 4.

Table 4. Mean plant height by variety at 15, 30 and 45 DAP.

Variety	Plant height (cm)

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	15 DAP	30 DAP	45 DAP
AKAR	98.5 b	41.25 a	95.5 a
PERINTIS	96 a	35.5 a	97.5 a
HSD 0.05	0.22	8.33	4.48

Note: values followed by letters were compared using the honestly significant difference (HSD) test at the 0.05 level.

Table 4 shows a highly significant effect of variety on plant height at 15 DAP, with AKAR the tallest (98.5). At 30 DAP the tallest plants were again AKAR (41.25), while at 45 DAP the tallest were PERINTIS (97.5), which differed significantly from AKAR.

2. Stem diameter

Mean stem diameter at 15, 30 and 45 DAP by variety is shown in Table 5.

Table 5. Mean stem diameter by variety at 15, 30 and 45 DAP.

Variety	Stem diameter		
	15 DAP	30 DAP	45 DAP
AKAR	10.05 a	10.15 a	10.2 a
PERINTIS	22.1 b	20 b	20 b
HSD 0.05	8.3	5.64	5.66

Note: values followed by letters were compared using the honestly significant difference (HSD) test at the 0.05 level.

Table 5 shows a significant effect of variety on stem diameter at 15 DAP, with PERINTIS highest (22.1). At 30 and 45 DAP the effect on stem diameter per plant was not significant; the best value at both ages was in PERINTIS (20), although it differed from AKAR. This agrees with Setyowati et al. (2018), who reported that different varieties grow differently even when planted in soil under the same conditions.

3. Number of leaves

The mean number of leaves at 15, 30 and 45 DAP by variety is shown in Table 6.

Table 6. Mean number of leaves by variety at 15, 30 and 45 DAP.

Variety	Number of leaves		
	15 DAP	30 DAP	45 DAP
AKAR	23.5 a	76.5 b	162 a
PERINTIS	20 a	20 a	187 b
HSD 0.05	8.19	18.60	1.40

Note: values followed by letters were compared using the honestly significant difference (HSD) test at the 0.05 level.

Table 6 shows no significant effect of variety on the number of leaves at 15 DAP (PERINTIS, 20). At 30 DAP the effect on the number of leaves per plant was significant, with the highest value in AKAR (76.5). At 45 DAP the highest value was in PERINTIS (187), which differed significantly from AKAR (162).

Interaction between PGR Dose and Variety on the Growth and Yield of Chili

The HSD post-hoc test showed a highly significant interaction between PGR dose and variety for all observed parameters, namely plant height, stem diameter and number of leaves.

Conclusion

This study concludes that PGR dose had a highly significant effect on plant height at 15, 30 and 45 DAP and a significant effect on the number of leaves at 15, 30 and 45 DAP. The best chili growth and yield were obtained at a dose of 20 ml per plant. The interaction between PGR dose and variety had a highly significant effect on plant height and stem diameter at 15, 30 and 45 DAP, with an interaction for plant height and stem diameter at 15 DAP in the AKAR variety.

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Declarations

Translation. This article was submitted in Indonesian and translated into English by the editorial office of Research Center Progresif with the assistance of a generative AI tool. The data, tables and references are unchanged from the authors' manuscript, and the authors have been invited to check the translation.

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