Revista ARACÊ
ISSN: 2358-2472

USE OF PACLOBUTRAZOL IN TOMATO AS AN AUXILIARY STRATEGY IN CULTURAL AND PHYTOSANITARY MANAGEMENT

https://doi.org/10.56238/arev7n3-086

Submitted on: 02/11/2025 **Publication date:** 03/11/2025

Mateus Eduardo do Rio[1], Iasmim de Oliveira do Nascimento[2], Márcio Gabriel da Silva Fantes[3], Adriany da Silva Dias[4], João Pedro Vergilio Bachega[5], Guilherme Victor Redondaro Lourencetti[6], Everaldo José dos Santos Silva[7] and Vagner Amado Belo de Oliveira[8]

ABSTRACT

Being a vegetable crop of high economic value, known for its sweet flavor, attractive shape, and versatility in consumption, the grape tomato (*Solanum lycopersicum* L.) has a growing demand in the market, which is promoting the improvement of agricultural practices, especially in hydroponic systems, which allow greater control over environmental and nutritional conditions. However, the vigorous vegetative growth of indeterminate cultivars requires intense cultural treatments, such as staking and sprouting, increasing operating costs. Paclobutrazol (PBZ), an inhibitor of gibberellin biosynthesis, has been used to control plant growth, reducing the need for labor and facilitating phytosanitary management. This study evaluated the impact of PBZ on the development and yield of grape tomatoes grown in a hydroponic system. The experiment was carried out in the municipality of Parapuã-SP, in protected cultivation, adopting a completely randomized design (DIC), with five treatments (0, 50, 100, 150, and 200 mg L^{-1} of PBZ) and ten replications. The regulator was applied via foliar spraying 30 days after seedling emergence. The following characteristics were evaluated: average plant height at 45 days, average fruit mass, productivity, root development, and estimated yield per hectare. The

[1] Graduating in Agronomic Engineering
Adamantina University Center
E-mail: 54821@fai.com.br
[2] Undergraduate student in Agronomic Engineering
Adamantina University Center
E-mail: 20820@fai.com.br
[3] Graduating in Agronomic Engineering
Adamantina University Center
E-mail: 46520@fai.com.br
[4] Undergraduate student in Agronomic Engineering
Adamantina University Center
E-mail: 67121@fai.com.br
[5] Graduating in Agronomic Engineering
Adamantina University Center
E-mail: 76121@fai.com.br
[6] Graduating in Agronomic Engineering
Adamantina University Center
E-mail: 17921@fai.com.br
[7] Graduating in Agronomic Engineering
Adamantina University Center
E-mail: 15422@fai.com.br
[8] PhD in Agronomic Engineering
Adamantina University Center
E-mail: vagner@fai.com.br

Revista ARACÊ
ISSN: 2358-2472

data were submitted for analysis of variance and the means were compared by Tukey's test at 5% probability. The results showed a significant reduction in plant height with increasing PBZ dose, confirming its vegetative growth inhibitory effect. The dose of 50 mg L^{-1} promoted an increase in average fruit mass and yield, while higher concentrations reduced these parameters. Root development did not present statistically significant differences between treatments, although a small increase in the dosage of 50 mg L^{-1} was observed. The analysis of the yield per hectare indicated a 28% increase in yield for the dose of 50 mg L^{-1} compared to the control. On the other hand, higher doses resulted in a decline in yield, showing that excessive concentrations of PBZ can compromise crop performance. It is concluded that the use of paclobutrazol in grape tomatoes grown in a hydroponic system can be an efficient strategy to reduce vegetative development and optimize crop management. The dosage of 50 mg L^{-1} showed the best agronomic characteristics, providing a balance between vegetative and reproductive development.

Keywords: *Solanum lycopersicum* L. Growth regulator. Hydroponics. Productivity. Phytosanitary management.

Revista ARACÊ
ISSN: 2358-2472

INTRODUCTION

Being a vegetable crop of high economic value, known for its sweet flavor, attractive shape, and versatility in consumption, the grape tomato (*Solanum lycopersicum* L.) has a growing demand in the market, which is promoting the improvement of agricultural practices, especially in hydroponic systems, which allow greater control over environmental and nutritional conditions, contributing to increased productivity and higher quality of cultivation (LOPES; SILVA; GUEDES, 2015).

Most grape tomato cultivars are of indeterminate growth and have vigorous vegetative growth, reaching more than two meters in height. Plants that have an indeterminate growth habit require constant cultural treatments, such as stake, sprouting and spraying (RIO *et al., 2025*). Excessive growth can increase the needs for crop treatments and demand for labor, driving up the operating costs of cultivation.

For good productivity, it is extremely important to control the lateral shoots, which develop together with the leaves of the cultivars. The high number of shoots promotes greater leaf density and hinders air circulation, which creates a favorable environment for the emergence of pests and diseases, increasing the need for sprouting and pesticides, which impacts the operating costs of cultivation (ZAMBOLIN; VALLEY; COSTA, 2000; SANTIAGO; ROSSETTO, 2022).

The use of paclobutrazol can promote a reduction in the need for labor, due to the decrease in size and lateral shoots, as evidenced (SILVA; WOULD; ARAÚJO, 2011). This, in turn, contributes to the reduction of production costs and makes cultivation more sustainable, especially in intensive cultivation systems, such as hydroponics, where labor is one of the main operating costs.

In conventional tomato crops, the mounding process is also carried out, which consists of covering the base of the stem with soil a few days after planting (FILGUEIRA, 2008; HORTICULTURIST'S CHANNEL, 2019). This process aims at better root development, providing better absorption of nutrients and water and better fixation in the soil. On the other hand, the process requires time and labor. Bévora; Zlatev, (2000) found that paclobutrazol reduces plant height and increases the thickness of the stem of the young tomato plant, and accelerates root formation, which becomes an advantage, as it provides an improvement in the quality of seedlings for planting.

Seleguini (2007) reported that the use of paclobutrazol proved to be efficient in reducing the number of lateral shoots and leaf area of the plants, which facilitates air

Revista ARACÊ
ISSN: 2358-2472

circulation and reduces the incidence of foliar diseases, such as brown eye spots, anthracnose, among others (TOFOLI; DOMINGUES; FERRARI, 2015; DOMINGUES *et al.,* 2016). This effect is extremely important, as excessive vegetative development can increase the risk of fungal and bacterial infections

Bévora; Zlatev (2000) observed that the use of paclobutrazol reduced productivity by 9.6%, a result that differs from those observed by Seleguini (2007) and Rio *et al.* (2025), who did not find changes in tomato yield with the spraying of the growth regulator, Rio *et al.* (2025) also emphasizes a small, not significant, increase due to the use of phytoregulator.

The phytoregulator paclobutrazol inhibits the biosynthesis of gibberellins, and may be an efficient tool to control the vegetative growth of tomato, reducing the need for cultural treatments. This study aims to evaluate the impact of paclobutrazol on the management of grape tomatoes in a hydroponic system, to reduce the dependence on cultural treatments, without causing interference on yield.

METHODOLOGY

EXPERIMENTAL AREA

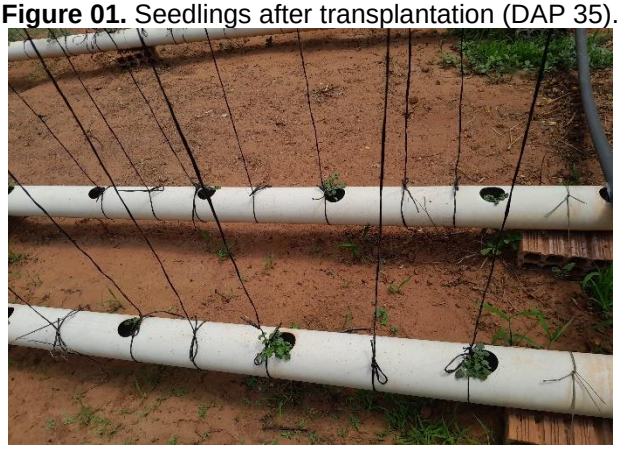
The experiment was carried out in the municipality of Parapuã - SP, in the region of Nova Alta Paulista, in the interior of the state of São Paulo. The climate of the region can be classified as Aw, being a tropical climate, with a dry winter season, average annual temperatures of approximately 24^{oC} and average rainfall totals of 1,000 to 1,400 mm/year according to the Koppen classification (Climatempo, 2025).

INSTALLATION AND CONDUCT OF THE EXPERIMENT

The hydroponic cultivation system was adopted, in which water and nutrients are present in the nutrient solution for the crop, the pH of the solution was adjusted in the range of 5.5 to 6.5 and the electrical conductivity was maintained between 1.5 to 1.8 EC. Each plant was conducted with 2 stems in a double row, with a spacing of 0.40x0.40x1.2 m and a density of 25 thousand plants per hectare (figures 01 and 02). The spraying of pesticides was adjusted according to the needs of the crop. The experiment was carried out in protected cultivation, in a greenhouse with a ceiling height of 3.5 m, covered by an anti-aphid mesh, and covered by a diffuse film with a thickness of 1 micron.

Revista ARACÊ
ISSN: 2358-2472

Figure 01. Seedlings after transplantation (DAP 35).



Source: Authors.

Figure 02. Adult plants, during peak yield.

Source: Authors.

EXPERIMENTAL DESIGN

The experimental design adopted was completely randomized (DIC), with five treatments and ten replications, with one plant per plot. The treatments were: 0; 50; 100; 150; 200 mg $^{L-1}$ of active ingredient per seedling (g a.i./seedling). Paclobutrazol was sprayed 30 days after seedling emergence, using 5 ml of solution per seedling.

The effects of paclobutrazol spraying on indeterminate tomato seedlings were evaluated. For the evaluations, 50 seedlings were selected, observing the greatest possible uniformity, especially regarding size, vigor and plant health. The commercial source of the plant regulator was Cultar 250 with 25% active ingredient.

EVALUATED CHARACTERISTICS

The following characteristics are being evaluated:

a) Average height of plants: distance from the neck to the apical meristem of the plants at 45 days after transplanting;
b) Average fruit mass: average mass of 50 fruits per plot;
c) Productivity: weighing of fruits by plot;
d) Root development: weighing of the root system of plants;
e) Estimated annual production of 1 hectare of tomato under the influence of phytoregulator (figure 07).

Revista ARACÊ
ISSN: 2358-2472

STATISTICAL ANALYSIS

The evaluated characteristics were submitted to analysis of variance by the F test, when their means were significant and compared by Tukey's test at 5% probability (SISVAR, 2000).

RESULTS

The present experiment showed a significant effect for the variables: mean height at 45 days (BF 45d); Average fruit mass (MMF) and average productivity (PM), only the evaluation of root system mass (MSG) did not differ significantly (table 01).

Table 01. Tukey's test at 5% due to the variables: Mean height at 45 days (ROM 45d); Average fruit mass (MMF); Root system mass (SGM) and average yield (PM) under different doses of paclobutrazole.

PBZ Doses (mg)	AM 45d (cm)	MMF (g)	PSR (g)	PM (kg)
0	86.5 A	8.9 A	17.5 A	1.5 AB
50	69 A	9.2 A	21.6 A	1.92 A
100	60 BC	7.7 B	13.4 A	1.21 B
150	57.6 CD	7.7 B	15.4 A	1.37 B
200	49 D	7.7 B	14.5 A	1.32 B

Averages followed by equal letters do not differ from each other, at the level of 5% probability, by the Tukey test.

A significant and linear reduction in plant height was observed with increasing paclobutrazole concentration. The plants treated with the phytoregulator had lower heights than the control group, indicating a growth inhibitory effect (Figure 03).

The dose of 50 mg $^{L-1}$ of active ingredient per PBZ seedling increased the average fruit mass. However, at higher dosages, there was a significant reduction in yield, suggesting that high doses of PBZ can compromise fruit development and mass (Figure 04).

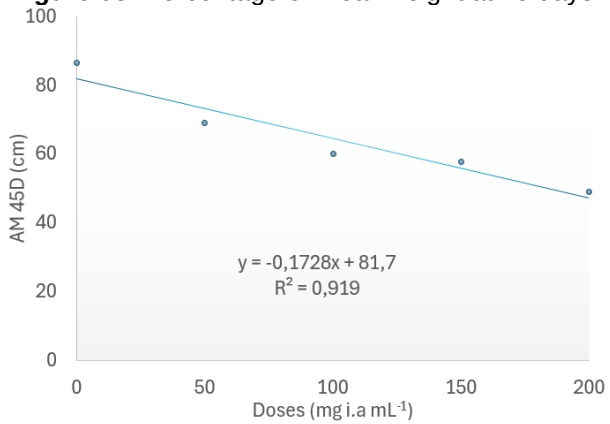
An increase in productivity per plant was observed at the dosage of 50 mg $^{L-1}$ of PBZ. However, at higher dosages, there was a loss of yield, indicating that high doses of paclobutrazol may be harmful to tomato yield (figures 05 and 07).

No significant differences in the weight of the root system were observed between the treatments. However, it is evident that there was an increase in root weight at the dosage of 50 mg $^{L-1}$ of PBZ, suggesting that this concentration can favor root development without compromising vegetative development (Figure 06).

Revista ARACÊ
ISSN: 2358-2472

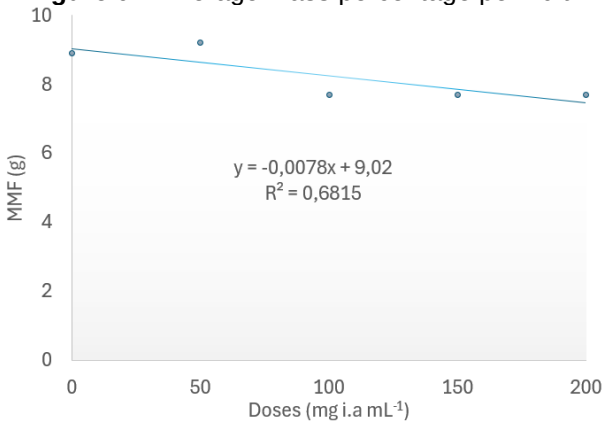
A study of the yield per hectare showed an increase of 28% in yield about the dosage of 50 mg $^{L-1}$ of PBZ and the control treatment. The results obtained, under the conditions studied, show the possible potential of the inhibitor of gibberellin synthesis in tomato crops (Figure 07).

Figure 03. Percentage of mean height at 45 days.



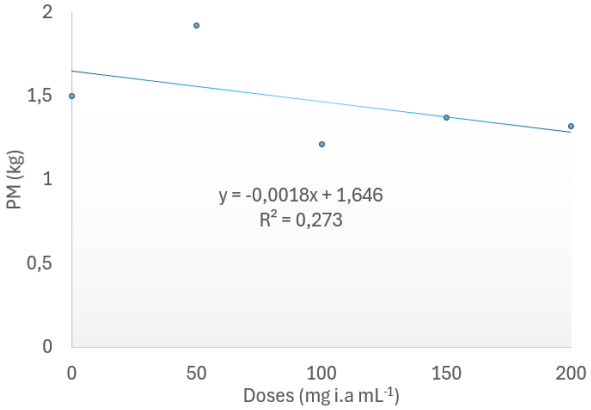
Source: Authors.

Figure 04. Average mass percentage per fruit.



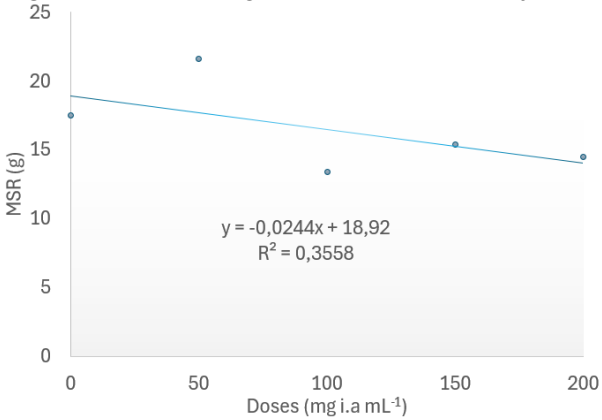
Source: Authors.

Figure 05. Average productivity percentage



Source: Authors.

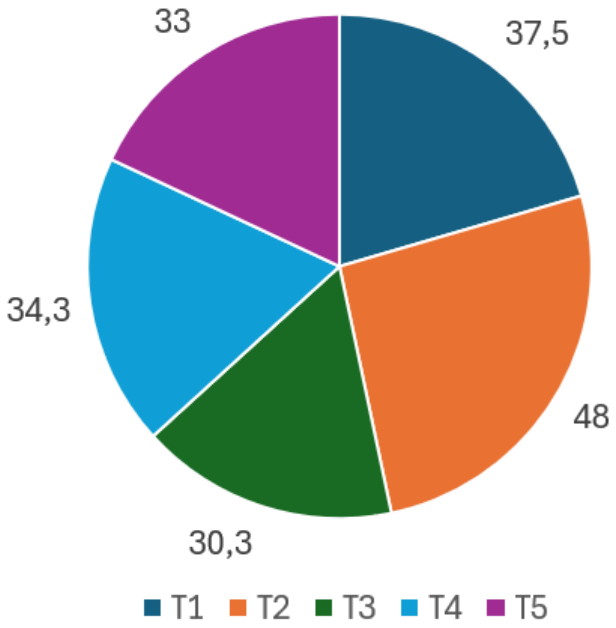
Figure 06. Percentage of mass of the root system.



Source: Authors.

Revista ARACÊ
ISSN: 2358-2472

Figure 07. Estimated yield of grape tomato, as a result of different doses of PBZ in t/ha.



Source: Authors.

DISCUSSION

The results obtained indicate that the use of paclobutrazol in tomato cultivation can influence several aspects of plant development. The reduction in plant height with the increase in PBZ concentration is in line with previous studies that demonstrated the inhibitory effect of paclobutrazol on plant vegetative development (BEVORA; ZLATEV, 2000; SILVA; WOULD; ARAUJO, 2011.). Paclobutrazol blocks the action of the enzyme ent-kaurene oxidase, which is responsible for critical steps in the production of bioactive gibberellins (TAIZ; ZEIGER; MOLLER, 2017). Since gibberellins are responsible for stem elongation, reducing gibberellin levels promotes more compact plants.

Regarding the average weight of the fruits, at the dosage of 50 mg $^{L-1}$ of PBZ there was no significant effect, however, higher doses resulted in a reduction in fruit size, a result close to that observed by Silva; Would; Araujo (2011), who detected losses, both in qualitative and quantitative aspects. This effect can be attributed to the impact of the phytoregulator on the plant's physiology, which in turn can affect the plant's hormonal balance, the main effect of the regulator is the inhibition of the phytohormones gibberellin, and can also increase cytokinin levels, in high dosages PBZ can cause hormonal imbalances, causing damage in vegetative aspects, and reproductive.

The yield per plant increased at the dosage of 50 mg $^{L-1}$ of PBZ, but decreased at higher dosages, this behavior may be related to the balance between the control of

Revista ARACÊ
ISSN: 2358-2472

vegetative development and the reproductive capacity of the plant. Studying the effect of paclobutrazol on different cultivars, Silva (2008) observed a reduction in productivity, together with the increase in the concentration of the regulator in one of the varieties, while in another variety there was no loss on productivity, this result evidences the variety of the cultivar, as another variable. Regardless of the variety, high doses of paclobutrazol can significantly attenuate the vegetative development of plants, compromising fruit production (SILVA; WOULD; ARAUJO, 2011), but certifies that the equilibrium concentration can vary due to the variety.

Regarding the weight of the root system, the absence of significant differences between the treatments suggests that paclobutrazol does not interfere significantly with root development. However, the increase observed in the dosage of 50 mg $^{L-1}$ of PBZ may indicate a positive effect on root formation, in agreement with the present experiment, Silva (2008) also observed an increase in root production as a result of the phytoregulator. This result can contribute to a better absorption of nutrients and water, favoring the general development of the plant (SILVA; WOULD; ARAUJO, 2011).

In summary, the use of paclobutrazol can be an efficient strategy in the cultural and phytosanitary management of tomato plants in a hydroponic system, contributing to the control of vegetative growth and potentially increasing productivity.

CONCLUSION

Under the conditions studied, the use of paclobutrazol in the cultivation of grape tomatoes in a hydroponic system proved to be efficient to reduce vegetative growth, facilitating management and reducing the need for cultural treatments.

The dosage of 50 mg $^{L-1}$ of PBZ promoted the best agronomic characteristics, where a balance was found between vegetative and reproductive development, showing that this dosage promoted larger fruits, high productivity and better root development.

THANKS

The authors would like to thank the National Council for Research and Scientific Development (CNPq) for their financial support, the Office of the Dean of Research and Graduate Studies of the University Center of Adamantina and the technicians, students and collaborators of the University Center of Adamantina (FAI).

Revista ARACÊ
ISSN: 2358-2472

REFERENCES

1. BEROVA, M.; ZLATEV, Z. Physiological response and yield of paclobutrazol treated tomato plants (Lycopersicon esculentum Mill.). Plant Growth Regulation, Dordrecht, v.30, p.117-123, 2000.

2. HORTICULTURIST'S CHANNEL. Find out what are the cultural treatments for table tomatoes. Porto Alegre: Canal do agricultor, 2019. Available at: <https://canaldohorticultor.com.br/saiba-quais-sao-os-tratos-culturais-para-o-tomate-de-mesa/>. Accessed on: 29 Nov 2023.

3. CLIMATEMPO Parapuã. In: CLIMATEMPO: a previsão do tempo. (São Paulo, SP: Climatempo.), 2025. Available at: https://www.climatempo.com.br/climatologia/2436/parapua-sp>. Accessed on: 01 Jan 2025.

4. DOMINGUES, R. J. et al. Fungal diseases with limiting potential for the development of olive growing in the state of São Paulo. 13p. Biological Institute - APTA, São Paulo, 2016

5. FILGUEIRA, F. A. R. New manual of Olericulture: Modern agrotechnology in the production and commercialization of vegetables. Viçosa: UFV, 2008.

6. LOPES, C. A.; SILVA, J. B. C.; GUEDES, I. M. R. Diseases in hydroponic crops and control measures. 12p. Embrapa, Brasília, 2015.

7. RIO, M. E. do. et al. APPLICATION OF PACLOBUTRAZOL IN THE MANAGEMENT OF SWEET GRAPE TOMATOES IN GREENHOUSES. ARACÊ, [S. l.], v. 6, n. 4, p. 19190–19200, 2024. DOI: 10.56238/arev6n4-480. Available at: https://periodicos.newsciencepubl.com/arace/article/view/2631. Accessed on: 2 Feb. 2025.

8. SANTIAGO, A. D.; ROSSETTO, R. Phytosanity. Brasília: Embrapa, 2022. Available at: <https://www.embrapa.br/agencia-de-informacao-tecnologica/cultivos/cana/producao/manejo/fitossanidade. Accessed on: 29 Nov 2023.

9. SELEGUINI, A. Use of paclobutrazol in seedling production, growth, yield and fruit quality of tomato plants in a protected environment. 2007. 100f. Thesis (PhD in Agronomy, Production System) - São Paulo State University, Ilha Solteira, 2007.

10. SILVA, K. S.; FARIA, J.; DE ARAUJO, M. J. Effect of paclobutrazol on plant growth and tomato yield. Brazilian Journal of Agrarian Sciences, v. 6, n. 2, p. 307-312, 2011.

11. SILVA, K. S.; FARIA, J.; DE ARAUJO, M. J. Use of paclobutrazol as a strategy to reduce the size and lateral sprouting of tomato plants. Ciência e Agrotecnologia, v. 35, p. 539-546, 2011.

12. SILVA, K. S.; USE OF 'PACLOBUTRAZOL' IN TOMATO CULTIVATED IN TWO ENVIRONMENTS. 1st ed. Ilha Solteira: Unesp, 2008.

Revista ARACÊ
ISSN: 2358-2472

13. SISVAR: FERREIRA, D.F. Statistical analyses using Sisvar for Windows version 4.0. In fashion... 45th Annual Meeting of the Brazilian Region of the International Society of Biometrics. UFSCar, São Carlos, SP, July 2000.

14. TAIZ, L.; ZEIGER, E.; MOLLER, I. M.; MURPHY, A. Physiology and plant development. 6. ed. Porto Alegre: Artmed, 2017.

15. TOFOLI, J. G.; DOMINGUES, R. J.; FERRARI, J. T. Anthracnose in nightshades: etiology, characteristics and control. 7p. Biological Institute - Apta, São Paulo, 2015.

16. ZAMBOLIM, L.; VALE, F. X. R. DO; COSTA, H. Control of plant diseases: vegetables. Viçosa: UFV, 2000. p. 848-877.