International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(9): 1717-1721
www.biochemjournal.com
Received: 11-06-2025
Accepted: 14-07-2025

Vicky Kumar
M.Sc. (Hort.), Department of Floriculture and Landscaping, MGUVV, Durg, Chhattisgarh, India

Bharti Sao
M.Sc. (Hort.), Department of Floriculture and Landscaping, MGUVV, Durg, Chhattisgarh, India

Neelima Netam
Assistant Professor, Department of Floriculture and Landscaping, MGUVV, Durg, Chhattisgarh, India

Soman Singh Dhruw
Assistant Professor, Department of Soil Science and Agri. Chemistry, MGUVV, Durg, Chhattisgarh, India

Richa Sao
Assistant Professor, Department of Genetics and Plant Breeding, MGUVV, Durg, Chhattisgarh, India

Gagendra Singh Rajput
Guest Faculty, Department of Plant Physiology, MGUVV, Durg, Chhattisgarh, India

Corresponding Author:
Vicky Kumar
M.Sc. (Hort.), Department of Floriculture and Landscaping, MGUVV, Durg, Chhattisgarh, India

Effect of turf growth regulators on morphological traits of carpet grass

Vicky Kumar, Bharti Sao, Neelima Netam, Soman Singh Dhruw, Richa Sao and Gagendra Singh Rajput

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i9Sv.5756

Abstract

A study was conducted during 2024-25 at the Floriculture Research Farm, MGUVV, Sankara, Patan, Durg (Chhattisgarh) to evaluate the effect of Plant Growth Regulators (PGRs) on the morphological traits of Carpet grass (*Axonopus* spp.). Thirteen treatments consisting of different doses of paclobutrazol, Gibberellic Acid (GA_3), ethephon, and trinexapac-ethyl were laid out in a Completely Randomized Design with three replications. Observations were recorded on canopy height, stolon internode length, stolon diameter, leaf length, and leaf width. Significant differences were observed among treatments. GA_3 (0.08–0.16 kg ha^{-1}) promoted vegetative growth by increasing canopy height (up to 6.90 cm), stolon internodal length (2.57 cm), and leaf length (5.05 cm), which facilitated rapid establishment. In contrast, paclobutrazol (0.24 - 0.96 kg ha^{-1}) and trinexapac-ethyl (0.08 - 0.32 kg ha^{-1}) effectively reduced vertical growth (as low as 2.93 cm), minimized internodal elongation, and increased stolon diameter (0.63 mm) and leaf width (1.92 mm), producing compact, dense turf. Ethephon (4.0 - 16.0 kg ha^{-1}) showed moderate suppression of canopy height with increased stolon girth.

Keywords: Carpet grass, turfgrass, plant growth regulators, paclobutrazol, trinexapac-ethyl

Introduction

Turfgrasses are low-growing monocotyledonous plants that form a continuous ground cover maintained at a specific height through mowing. The term "turf," derived from the Sanskrit word *Darabha* (tuft of grasses), refers to the surface vegetation layer along with the dense root–rhizome zone of the soil. Turf is valued not only for its functional role in erosion control, dust suppression, groundwater recharge, and temperature moderation but also for its recreational and aesthetic benefits. It provides a safe and cost-effective surface for sports and leisure activities, while also enhancing landscape beauty, psychological well-being, and urban livability (Beard & Green, 1994; Singh *et al*., 2016) [3, 8]. Additionally, the turf industry generates employment in seed production, sod farming, landscaping, and maintenance.

Warm and cool-season grasses are commonly used depending on climatic adaptability. Warm-season species such as *Cynodon dactylon* and *Zoysia japonica* thrive in tropical climates, whereas cool-season species like *Poa pratensis* and *Lolium perenne* are preferred in temperate zones (Stier *et al*., 2006) [11]. Among warm-season species, *Carpet grass* (*Axonopus* spp.) has gained popularity for its adaptability to shade, tolerance to low inputs, and ability to spread by stolons. It is widely used along roadsides, in parks, and in low-maintenance lawns. Despite these advantages, research on its growth regulation and management remains limited.

One of the major challenges in turfgrass management is excessive shoot growth under favorable conditions, which increases mowing frequency, labor costs, nutrient depletion, and equipment wear. Thus, sustainable strategies to reduce vertical growth while maintaining turf quality are urgently required. In this context, Plant Growth Regulators (PGRs) have proven to be effective management tools. These compounds influence hormonal activity, cell elongation, and division, thereby regulating plant architecture. Ethephon, for instance, promotes ethylene release and horizontal growth while reducing shoot elongation (Arteca, 1997) [2]. Similarly, paclobutrazol and trinexapac-ethyl inhibit gibberellin biosynthesis, resulting in shorter internodes, denser canopy, and improved turf color (Rademacher, 1986) [7]. Conversely, Gibberellic Acid (GA_3) enhances stem elongation, seed germination, and vegetative growth, and is often applied to counteract growth suppression caused by gibberellin inhibitors.

Although several PGRs have been tested on turfgrass species worldwide, their effects on Carpet grass, particularly under the climatic conditions of Chhattisgarh, remain underexplored. Considering the growing demand for sustainable, low-input lawn systems, evaluating the role of growth regulators in improving quantitative and qualitative traits of Carpet grass is both timely and necessary. Therefore, the objective of this study was to assess the influence of different plant growth regulators on the growth behavior, turf quality, and management efficiency of Carpet grass under Chhattisgarh conditions.

Materials and Methods

Experimental site

The present investigation entitled was conducted at the Floriculture Research Farm, College of Horticulture and Research Station, Sankara, Patan, Durg (Chhattisgarh) during 2024 - 25. The site is located at 21.18°N latitude, 81.55°E longitude, and 289.56 m above mean sea level. The region falls under a sub-humid climate with hot summers (42 - 46 °C), mild winters (6-7 °C), and annual rainfall of 1200-1400 mm, 85% of which occurs during June-September.

Planting material and establishment

Stolons of warm-season *Carpet grass* (*Axonopus* spp.) were used. Healthy, disease-free stolons (10-12 cm long) were planted in HDPE grow bags (6 × 24 inches) filled with prepared soil amended with well-rotted Sand, Soil and FYM. Stolons were placed at 5 cm spacing in March 2025, followed by irrigation and light pressing to ensure contact with soil. Fertilizers were applied at 150:100:100 kg N:P:K ha^{-1} yr^{-1}. Nitrogen was split in three doses (April, June, August), while phosphorus and potassium were applied basally.

Experimental design and treatments

The trial was laid out in a Completely Randomized Design (CRD) with 13 treatments replicated thrice, totaling 39 experimental units. Treatments included different doses of paclobutrazol, Gibberellic Acid (GA_3), ethephon, and trinexapac-ethyl, along with a control (water spray). Treatments evaluated in the study included:

Treatment details

Treatment	Treatment details
T_0	Control (Water spray)
T_1	Paclobutrazol @ 0.24 kg ha^{-1}
T_2	Paclobutrazol @ 0.48 kg ha^{-1}
T_3	Paclobutrazol @ 0.96 kg ha^{-1}
T_4	Gibberellic acid @ 0.04 kg ha^{-1}
T_5	Gibberellic acid @ 0.08 kg ha^{-1}
T_6	Gibberellic acid @ 0.16kg ha^{-1}
T_7	Ethephon @ 4.0 kg ha^{-1}
T_8	Ethephon @ 8.0 kg ha^{-1}
T_9	Ethephon @ 16.0 kg ha^{-1}
T_{10}	Trinexapac-ethyl @ 0.08 kg ha^{-1}
T_{11}	Trinexapac-ethyl @ 0.16 kg ha^{-1}
T_{12}	Trinexapac-ethyl @ 0.32kg ha^{-1}

Application of growth regulators

Chemical solutions were prepared by calibrating a hand sprayer. Approximately 20 ml of solution was required per m^2. Active ingredient quantities were calculated based on recommended doses per hectare and adjusted to bag surface area. Treatments were applied uniformly, and observations were recorded periodically.

Cultural practices

Standard practices for turfgrass were followed. Irrigation was provided every second day until establishment and as required thereafter. Manual weeding was done regularly. No pesticides or fungicides were used.

Observations recorded

Quantitative observations were recorded on various morphological traits of carpet grass to assess the influence of different plant growth regulators. These included canopy height (cm), stolon internode length (cm), stolon diameter (mm), leaf length (cm) and leaf width (mm). Together, these parameters provided a comprehensive understanding of turfgrass growth behavior and structural modifications under different treatments.

Statistical analysis

Data on growth and quality parameters were analyzed using ANOVA under CRD (Panse and Sukhatme, 1985) [6]. Standard error of mean (S.Em.±), Critical Difference (CD at 5%), and Coefficient of Variation (CV) were computed. Significance was tested using the F-test.

Result and Discussion

Canopy height (cm)

The canopy height of carpet grass was significantly influenced by the application of plant growth regulators (Table 1). The tallest canopy was recorded in T_6 (GA_3 @ 0.16 kg ha^{-1}) with 6.90 cm, which was significantly superior to all other treatments. This was closely followed by T_5 (GA_3 @ 0.08 kg ha^{-1}) and T_4 (GA_3 @ 0.04 kg ha^{-1}), which produced canopy heights of 6.47 cm and 6.23 cm, respectively. By contrast, the lowest canopy height (2.93 cm) was observed in T_3 (Paclobutrazol @ 0.96 kg ha^{-1}), followed by T_2 (3.37 cm) and T_1 (3.60 cm). Comparable outcomes were observed in earlier studies by Volterrani *et al*. (2015) [13] and Lambert *et al*. (2011) [14].

The reduction in canopy height under paclobutrazol and trinexapac - ethyl treatments may be attributed to their inhibitory effect on gibberellin biosynthesis, which restricts cell elongation and results in compact turf growth. Conversely, GA_3 treatments promoted stem elongation, thereby increasing canopy height, as gibberellins are known to enhance cell elongation and division. Ethephon treatments produced intermediate canopy heights (3.83 - 4.53 cm), likely due to the ethylene-mediated modification of growth processes.

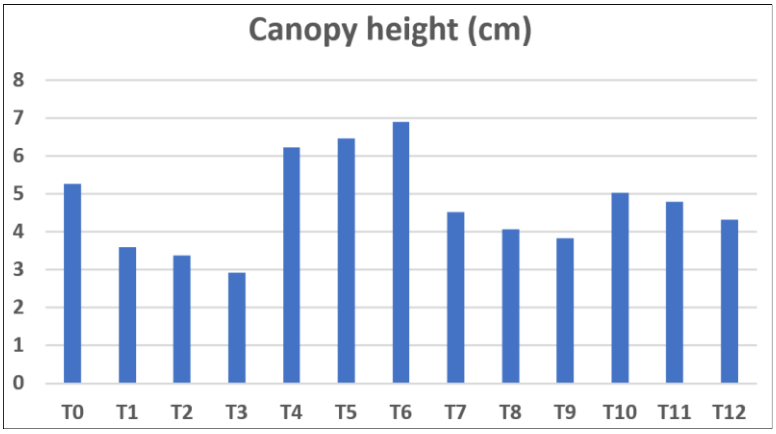

Fig 1: Canopy height (cm)

Stolon internodal length (cm)

Stolon internodal length was significantly affected by PGR application (Table 1). The longest internodes were recorded in T_6 (GA_3 @ 0.16 kg ha^{-1}) with 2.57 cm, which was significantly greater than the control (1.80 cm) and superior to all other treatments. This was followed by T_5 (GA_3 @ 0.08 kg ha^{-1}) and T_4 (GA_3 @ 0.04 kg ha^{-1}), with internode lengths of 2.42 cm and 2.33 cm, respectively. In contrast, the shortest internodes (1.25 cm) were observed in T_3 (Paclobutrazol @ 0.96 kg ha^{-1}), which was significantly lower than the control. These results indicate that GA_3 enhanced internodal elongation by stimulating cell expansion, while paclobutrazol restricted internodal growth by suppressing gibberellin biosynthesis. These observations are consistent with the results of Hudgins *et al*. (2017) [4] and Sidhu *et al*. (2014) [10].

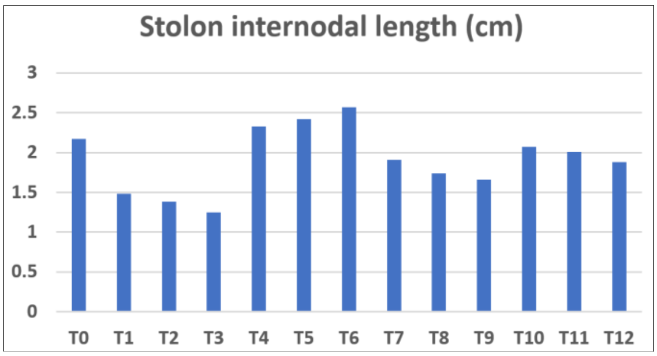

Fig 2: Stolon Internodal length (cm)

Stolon diameter (mm)

Significant differences were observed in stolon diameter of carpet grass under different growth regulator treatments (Table 1). The thickest stolons were obtained in T_3 (Paclobutrazol @ 0.96 kg ha^{-1}) with 0.63 mm, which was significantly higher than the control (0.48 mm) and statistically comparable with T_1 (0.61 mm), T_2 (0.60 mm), and T_9 (0.62 mm). In contrast, the minimum stolon diameter (0.39 mm) was recorded in T_6 (GA_3 @ 0.16 kg ha^{-1}). The increase in stolon thickness under paclobutrazol and ethephon can be attributed to assimilate partitioning towards lateral thickening rather than elongation, while GA_3 stimulated elongation growth at the expense of stolon diameter. Similar findings were reported by Shahzad *et al*. (2023) [9], Hudgins *et al*. (2017) [4], and Sidhu *et al*. (2014) [10].

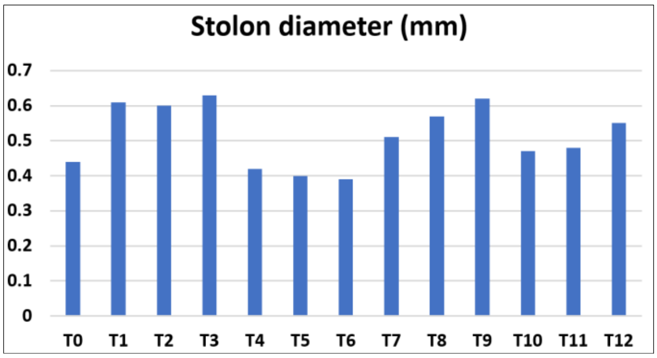

Fig 3: Stolon diameter (mm)

Leaf length (cm)

Leaf length of carpet grass was significantly influenced by growth regulator treatments (Table 1). The longest leaves were recorded in T_6 (GA_3 @ 0.16 kg ha^{-1}) with 5.05 cm, which was significantly greater than the control (3.12 cm). This was followed by T_5 (4.92 cm) and T_4 (4.77 cm). In contrast, the shortest leaves were observed in T_2 (Paclobutrazol @ 0.48 kg ha^{-1}) with 1.54 cm, and T_3 (1.47 cm), both of which were significantly lower than the control. These findings indicate that GA_3 promoted leaf elongation by enhancing cell division and expansion, whereas paclobutrazol restricted leaf growth through inhibition of gibberellin biosynthesis. Similar results have been reported by Lambert *et al*. (2011) [14] and Shahzad *et al*. (2023) [9].

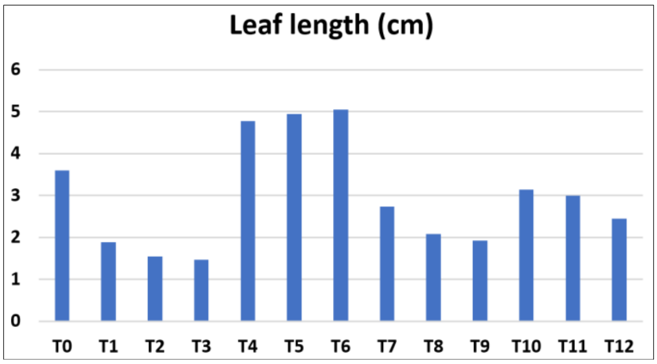

Fig 4: Leaf length (cm)

Leaf width (mm)

Application of growth regulators significantly influenced leaf width (Table 1). The maximum width was observed in T_3 (Paclobutrazol @ 0.96 kg ha⁻¹) with 1.92 mm, which was significantly greater than the control (1.45 mm). This was followed by T_2 (1.87 mm) and T_1 (1.84 mm). The narrowest leaves (1.30 mm) occurred in T_4 (GA_3 @ 0.04 kg ha⁻¹). These results suggest that paclobutrazol promoted leaf thickening, likely due to its growth-retarding effect that enhances assimilate accumulation in leaf tissues. In contrast, GA_3 stimulated elongation growth, producing narrower leaves. Similar trends have been reported by Shahzad *et al.* (2023) [9] and Hudgins *et al.* (2017) [4].

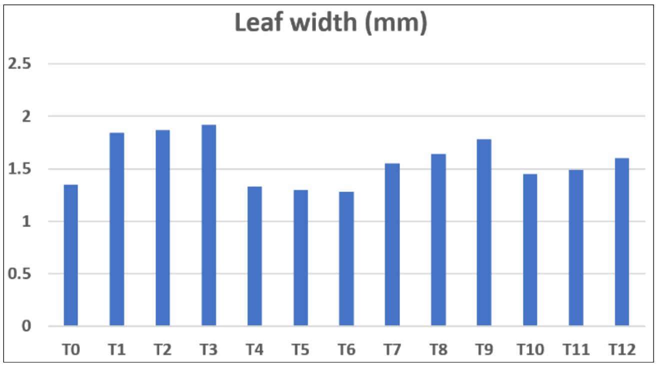

Fig 5: Leaf width (mm)

Table 1: Effect of growth regulators on morphological traits of carpet grass

	Canopy height (cm)	Stolon internodal length (cm)	Stolon diameter (mm)	Leaf length (cm)	Leaf width (mm)
T0	5.27	2.17	0.44	3.60	1.35
T1	3.60	1.48	0.61	1.89	1.84
T2	3.37	1.38	0.60	1.54	1.87
T3	2.93	1.25	0.63	1.47	1.92
T4	6.23	2.33	0.42	4.77	1.33
T5	6.47	2.42	0.40	4.95	1.30
T6	6.90	2.57	0.39	5.05	1.28
T7	4.53	1.91	0.51	2.73	1.55
T8	4.07	1.74	0.57	2.08	1.64
T9	3.83	1.66	0.62	1.92	1.78
T10	5.03	2.07	0.47	3.14	1.45
T11	4.80	2.01	0.48	2.99	1.49
T12	4.33	1.88	0.55	2.45	1.60
SEm±	0.11	0.04	0.01	0.06	0.04
CD at 5%	0.31	0.13	0.04	0.18	0.11

Conclusion

The study revealed that Plant Growth Regulators (PGRs) significantly influenced the growth and turf quality of carpet grass. GA_3 (0.08-0.16 kg ha⁻¹) promoted canopy height, internode elongation, and leaf length, aiding in faster lawn establishment but leading to higher maintenance due to excessive growth. In contrast, paclobutrazol (0.24-0.96 kg ha⁻¹) and trinexapac-ethyl (0.08-0.32 kg ha⁻¹) effectively reduced vertical growth, increased stolon thickness and leaf width, and produced compact, dense lawns with reduced mowing needs. Ethephon (4.0–16.0 kg ha⁻¹) provided moderate suppression of canopy height with improved stolon girth. From a turf management perspective, GA_3 supports faster lawn establishment, whereas paclobutrazol and trinexapac-ethyl provide lasting benefits by promoting compact, high-quality lawns with minimal maintenance needs

References

1. Arghavani M, Kheiry A, Savadkoohi S, Taheri S. Growth and phytochemical content of *Cynodon dactylon* (L.) Pers. as affected by trinexapac-ethyl and paclobutrazol. J Med Plants By-prod. 2016;5(1):7-13.
2. Arteca RN. Plant growth substances: Principles and applications. New Delhi: CBS Publishers & Distributors; 1997.
3. Beard JB, Green RL. The role of turfgrasses in environmental protection and their benefits to humans. J Environ Qual. 1994;23(3):452-460.
4. Hudgins TM, Anderson NP, Chastain TG, Garbacik CJ. Effects of plant growth regulator combinations on turf-type and forage-type tall fescue seed crops; 2017.
5. McCarty LB, Willis TG, Toler JE, Whitwell T. 'TifEagle' bermudagrass response to plant growth regulators and mowing height. Agron J. 2011;103(4):988-994.
6. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. 4th ed. New Delhi: Indian Council of Agricultural Research; 1985.
7. Rademacher W, Fristch H, Graebe JE, Jung J. Tetcyclacis and triazole-type plant growth retardants and their influence on the biosynthesis of gibberellins and other metabolic processes. Pestic Sci. 1986;21(3):241-252.
8. Sangma PM, Singh KP, Kumar N, Pandey R, Singh VP. Comparative performance of warm season turfgrass varieties under Delhi conditions. Indian J Agric Sci. 2016;86(3):362-368.
9. Shahzad MM, Akhtar G, Shehzad MA, Ullah S, Faried HN, Razzaq K, *et al.* Paclobutrazol and maleic hydrazide-induced growth inhibition in warm season turfgrasses through structural and physiological differences. Kuwait J Sci. 2023;50(2):674-680.
10. Sidhu SS, Yu J, McCullough PE. Physiological behavior of ethephon in five turfgrasses. Crop Sci. 2014;54(4):1816-1822.
11. Stier JC. A short history of creeping bentgrass. Grass Roots. 2006;35(1):4-9.
12. Totten FW, Toler JE, McCarty LB. 'Tifway' bermudagrass growth regulation with the use of trinexapac-ethyl and flurprimidol. Weed Technol. 2006;20(3):702-705.
13. Volterrani M, Grossi N, Gaetani M, Caturegli L, Nikolopoulou AE, Lulli F, *et al.* The effect of

increasing application rates of nine plant growth regulators on the turf and stolon characteristics of pot-grown 'Patriot' hybrid bermudagrass. HortTechnology. 2015;25(3):397-404.

14. Lambert ML, Suetens C, Savey A, Palomar M, Hiesmayr M, Morales I, *et al*. Clinical outcomes of health-care-associated infections and antimicrobial resistance in patients admitted to European intensive-care units: a cohort study. The Lancet infectious diseases. 2011 Jan 1;11(1):30-8.