# Effect of Paclobutrazol on the Freeze Tolerance of Hybrid Bermudagrass Varieties

**Mujibur Rahman Khan[1], Shuhao Yu[1], Dennis Martin[1], Yanqi Wu[2], Charles Fontanier[1], and Mingying Xiang[1*]**

[1]Department of Horticulture and Landscape Architecture Oklahoma State University, Stillwater, OK [2]Department of Plant and Soil Sciences ,Oklahoma State University, Stillwater, OK

## INTRODUCTION

Winterkill is a significant concern for bermudagrass (*Cynodon* spp.) and other warm-season turfgrasses used in the transitional climatic zone.. Lack of cold tolerance in bermudagrass causes winter mortality at extremely low temperatures, which is a major concern for turf managers during the winter. Research suggests that plant growth regulators (PGR) may improve turfgrass cold tolerance. Paclobutrazol, a widely used PGR, inhibits gibberellin synthesis to reduce vertical growth, minimize mowing, enhance turf density, and increase tolerance to stress and weeds. However, there is inadequate information regarding the effects of paclobutrazol on the freeze tolerance of bermudagrass.

## OBJECTIVE

To evaluate the efficacy of Paclobutrazol on five hybrid bermudagrass (*Cynodon doctonyn x C. transvaalensis*) for freeze tolerance.

## MATERIALS & METHODS

**Figure 1:** Two sets of 5 genotypes including Tahoma 31® ('OKC 1131'), 15x9, OKC1629, OKC2034, and OKC2035 established in a greenhouse using an 80:20 sand and peat mixture.

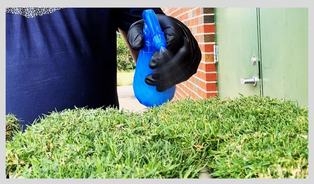


**Figure 2:** Applied paclobutrazol (Trimmit 2SC) biweekly with two applications at a rate of 2.25 kg a.i. ha$^{-1}$.

**Figure 3:** Pre-acclimation: 1 week 24°C/20°C (day/night), 14-hrs photoperiod at 900 µmol

Acclimation: 4 weeks 8°C/2°C (day/night),10-hrs photoperiod at 400 µmol

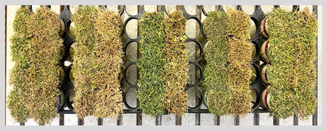
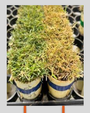
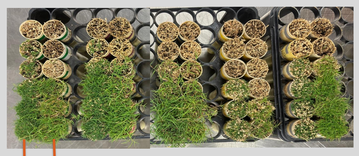


**Figure 4:** After 4 weeks of Acclimation



Treated Control

**Figure 5:** Freeze Test : -6°C to -11°C



Treated Control

**Figure 6:** After 3 weeks of recovery in greenhouse (30/25°C, day/night)

## Experiment 1

## Lethal Temperature

**Table1:** Effect of paclobutrazol on mean lethal temperatures for 50% survival ($LT_{50}$) of five hybrid bermudagrasses (Soil Temp. -6 to -11°C)

| Genotype | $LT_{50}$ (°C) | |
|---|---|---|
| | Control | Treated |
| Tahoma 31® | -11.3 cd | -11.4 cd |
| OKC2034 | -11.4 cd | -11.6 d |
| OKC2035 | -9.4 a | -9.8 ab |
| OKC1629 | -10.2 b | -11.3 cd |
| 15×9 | -11.2 cd | -11.0 c |

## Experiment 2

**Table 2:** $LT_{50}$ value of five hybrid bermudagrasses (Soil Temp. -6 to -11°C)

| Genotype | $LT_{50}$ (°C) |
|---|---|
| Tahoma 31® | -9.7 c |
| OKC2034 | -9.2 b |
| OKC2035 | -8.5 a |
| OKC1629 | -10.4 d |
| 15×9 | -9.8 c |

**Table 3:** Paclobutrazol Effect on $LT_{50}$ value

| Treatment | $LT_{50}$ (°C) |
|---|---|
| Untreated | -9.0 a |
| Paclobutrazol | -9.9 b |

## Percentage of recovery

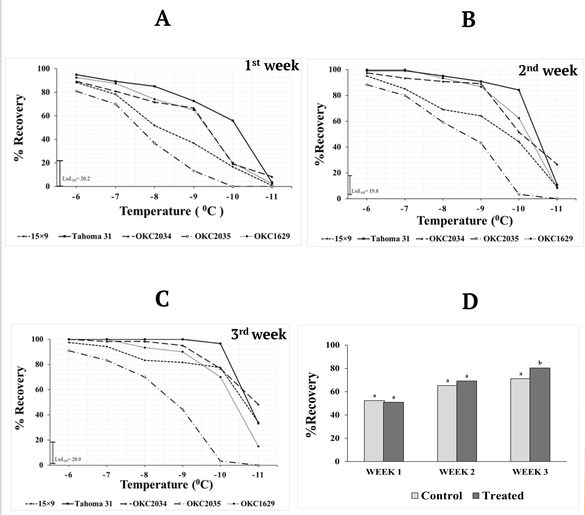



**Figure 7:** Percentage of coverage (regrowth) of five hybrid bermudagrasses over three weeks (A, B, C) following exposure to soil temperatures of -6 to -11 °C for 1 hour, along with the effect of paclobutrazol on recovery (D).

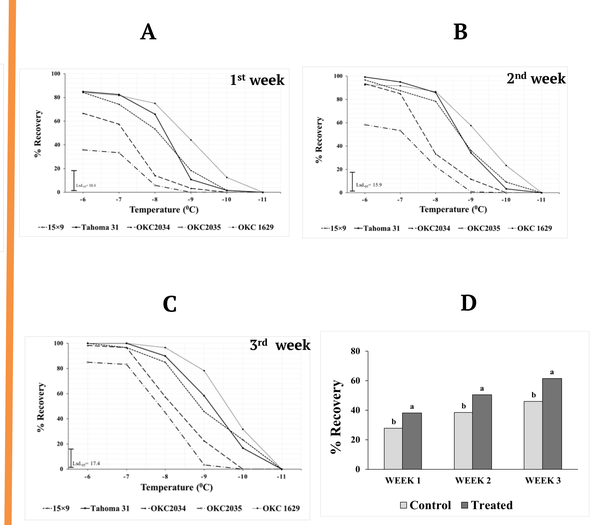



**Figure 8:** Percentage of coverage (regrowth) of five hybrid bermudagrasses over three weeks (A, B, C) following exposure to soil temperatures of -6 to -11 °C for 1 hour, along with the effect of paclobutrazol on recovery (D).

## Rhizome Weight

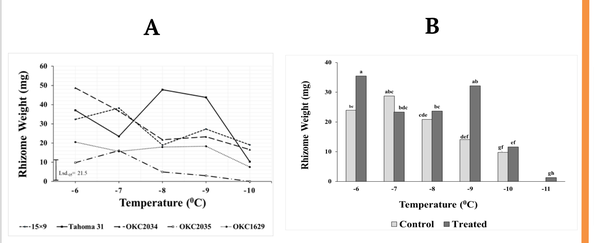



**Figure 9:** After 3 weeks of recovery rhizome dry weight of five hybrid bermudagrasses (A) and effect of paclobutrazol on rhizome dry weight after being exposed to a soil temperature of –6 to -11 °C for 1h (B)

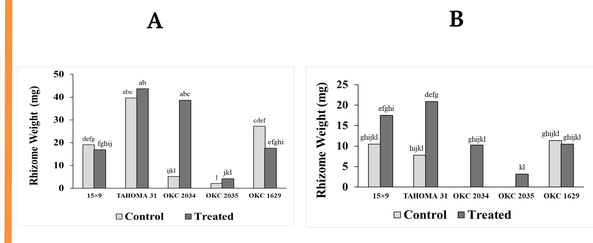
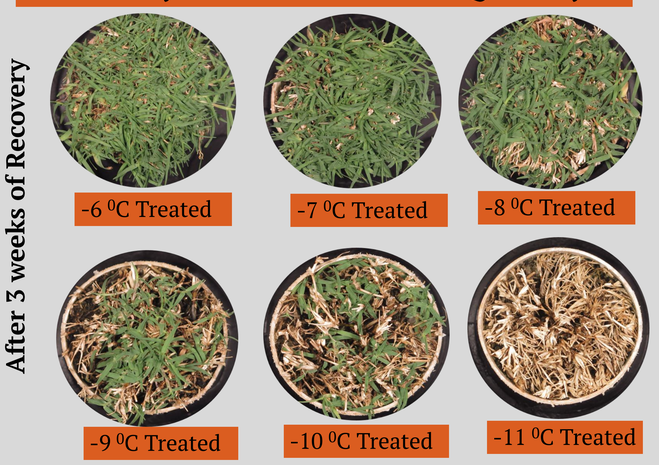



**Figure 10:** Effect of paclobutrazol and freeze exposure at different temperatures (-7 °C (A) and -8 °C (B)) on the dry weight of hybrid bermudagrass rhizomes after three weeks of recovery.

## Recovery Turf Color and Quality





## RESULTS & DISCUSSION

- Paclobutrazol decreased the $LT_{50}$ value and increased freeze tolerance of bermudagrasses in both experiment (Table 1 and Table 2). It also significantly influences the recovery of bermudagrass over a three-week period, demonstrating differences in recovery rates (Figure 7 & 8).
- In the first experiment, OKC2034 exhibited the lowest $LT_{50}$ at -11.6 °C with paclobutrazol application, while OKC2035 had the highest $LT_{50}$ at -9.4 °C with untreated condition (Table 1). In the second experiment, the ranking of freeze tolerance based on $LT_{50}$ across both treatments was as follows: OKC1629 > 15×9 > Tahoma 31® > OKC2034 > OKC2035 (Tables 2 and 3).
- Significant genotype x temperature interactions were observed over three weeks, with Tahoma 31® and OKC1629 showing superior recovery growth after exposure to freezing temperatures (Figure 7 & 8).
- Considerable variation was observed in rhizome dry weight after 3 weeks of recovery among hybrid bermudagrass genotypes, with those treated with paclobutrazol exhibiting increased rhizome weight (Figure 9 & 10).
- Paclobutrazol enhanced turf color and quality after the freeze test, resulting in a darker green color, shorter leaf length, and wider leaf blades, while also increasing overall density.