

Introduction

Paclobutrazol (PBZ) belongs to the triazole group of fungicides and acts as a plant growth regulator by inhibiting the biosynthesis of gibberellin. As a fungicide, PBZ inhibits biosynthesis of ergosterol, which compromises cell wall development. It is commonly used as a plant growth regulator in horticultural and arboricultural industries on ornamentals and shade trees.

PBZ has been shown to manage other fungal infections including *Botrytis cinerea* on cut roses¹, *Verticillium dahliae* on cotton², and fungal infections on other economically important crops. Jacobs and Berg (2000)³ previously examined PBZ sensitivity on *Ophiostoma novo-ulmi* on fewer and lower concentrations of PBZ, and on amended water cultures. They also reported reduced growth rates.

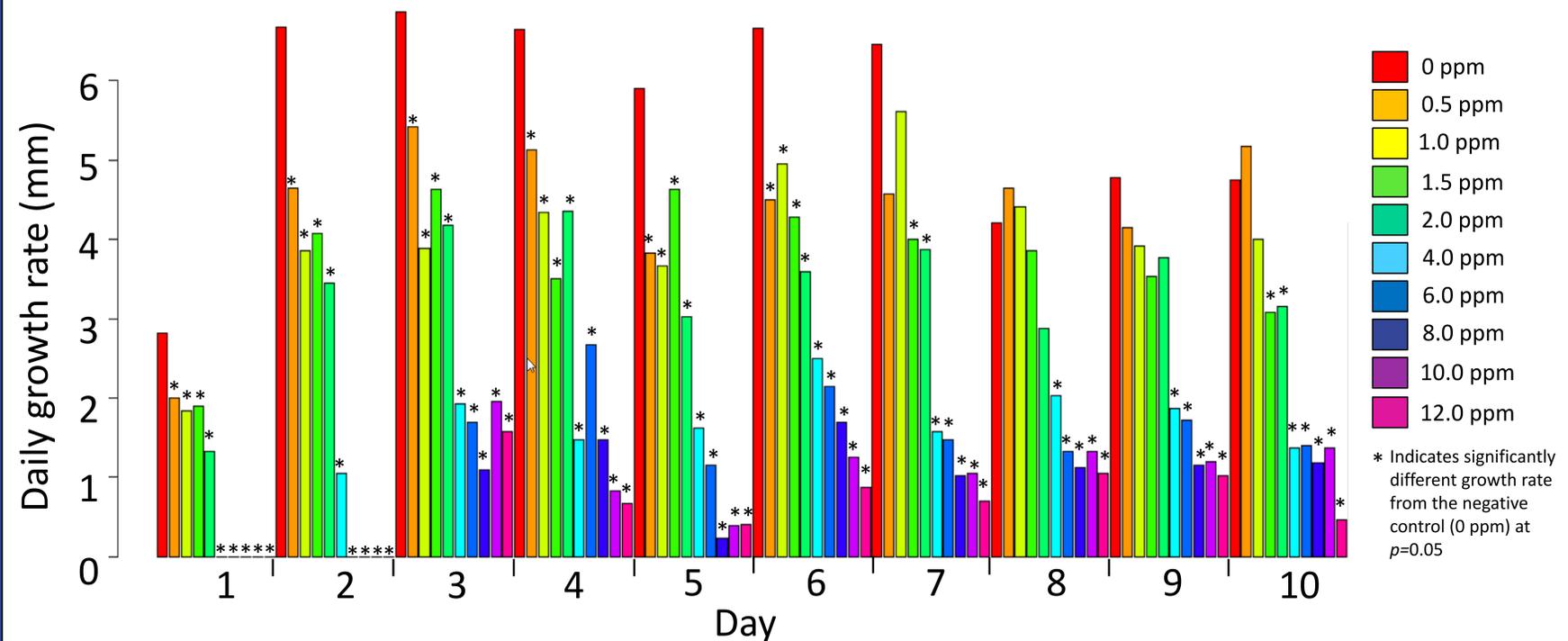
The goal of this project is a more in-depth daily growth analysis of *Ophiostoma novo-ulmi* on an array of PBZ concentrations (parts per million (mg/L); ppm), and whether those concentrations are found in commercially available products.

Materials and Methods

Fifteen PBZ concentrations were tested *in vitro* for their effects on *O. novo-ulmi* daily growth rates. Concentrations (ppm) used were 0, 0.5, 1, 1.5, 2, 4, 6, 8, 10, 12, 20, 40, 50, 100, 400. Cultures were grown at 25°C in the dark. Isolates were measured every 23-25 hours for 10 days. Plates were marked so that isolates were measured along the same two perpendicular planes each time (images 1 & 2).

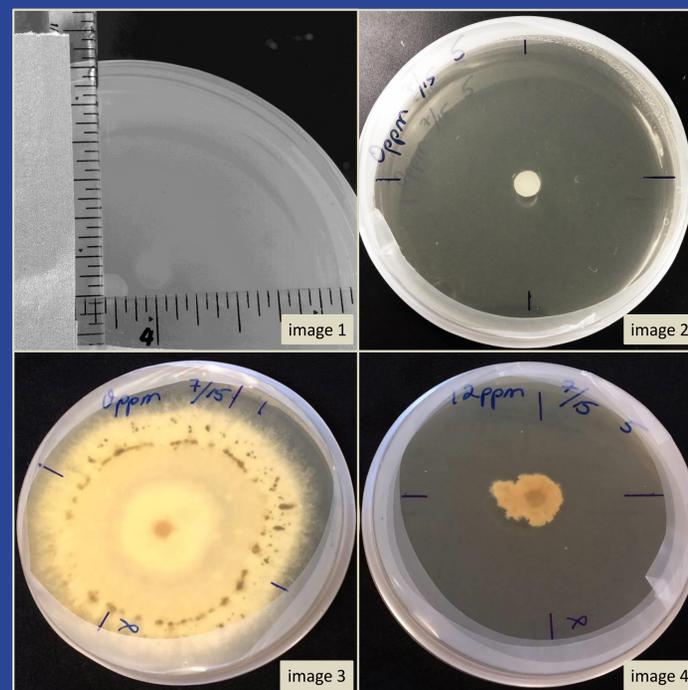
Daily growth rates were calculated as the difference in average diameter between each day. Due to the sample size and daily growth rates of approximately 1 mm unit of resolution of the diameter measurements, the data did not reliably meet the assumptions of normality and homogeneity of variance required for a standard ANOVA. Data was evaluated in R utilizing the ANOVA permutation test aovp of the Imperm library. Tukey's HSD test was applied to the resulting data to determine the concentrations which were statistically significant at the $p=0.05$ from the control.

Daily growth rate of *Ophiostoma novo-ulmi* on paclobutrazol-amended PDA (fig 1)



Results

- Colonies did not grow on PDA media with 20 ppm or higher concentrations (data not shown)
- Growth rates were statistically different for 0.5, 1, 1.5, 2, 4, 6, 8, 10, 12 ppm for the first seven days compared to the growth rate of the negative control (figure 1)
- Colonies growing on paclobutrazol-amended media appeared to have more dense and less fibrous hyphal (image 4) growth than colonies grown on unamended PDA (image 3)



1. Shaul, O., Elad, Y. & Zieslin, N. 1996. Suppression of *Botrytis* blight in cut rose flowers with gibberellic acid. Effects of exogenous application of abscisic acid and paclobutrazol. *Postharvest Biology and Technology*, 7: 145–150.
 2. Cimen, I., Basbag, S., Temiz, M. & Sagir, A. 2004. The effect of paclobutrazol, growth retardant, on cotton growth and *Verticillium* wilt (*Verticillium dahliae* Kleb.). *Plant Pathology Journal*, 3: 35–39.
 3. Jacobs, K. A. & Berg, L. C. 2000. Inhibition of fungal pathogens of woody plants by the plant growth regulator paclobutrazol. *Pest Management Science*, 56: 407–412.

Discussion

- Paclobutrazol (PBZ) did affect the growth rate of *Ophiostoma novo-ulmi*, especially at concentrations of 2.0 ppm and higher after seven days.
- Arboricultural and horticultural PBZ products, Cambistat (Rainbow Treecare Scientific Advancements) and Bonzi (Syngenta) (223,000 ppm and 4000 ppm, respectively), are labeled for applications at concentration rates much higher than what is necessary to halt *O. novo-ulmi* growth *in vitro* seen in this study.
- Jacobs & Berg showed that PBZ-exposed isolates, in all concentrations, had growth rates approximately half of the rate of their control.
- If high concentrations are able to reach the outer canopy of American elms (*Ulmus americana*) with Dutch elm disease (DED) related-flagging, before the tree blocks the vascular tissue, paclobutrazol may slow fungal growth and advancement.
- In the future, paclobutrazol may be used as a curative product to manage symptomatic American elms. No curative products are currently available for Dutch elm disease.
- An experiment treating DED-affected American elms is underway in DuPage County, Illinois and will be reported on at a future time.
- Future work needs to focus on quantifying how much paclobutrazol actually reaches the upper canopy in mature trees.