Efficacy of Fungal Laccase to Facilitate Biodethatching in Bermudagrass and Zoysiagrass

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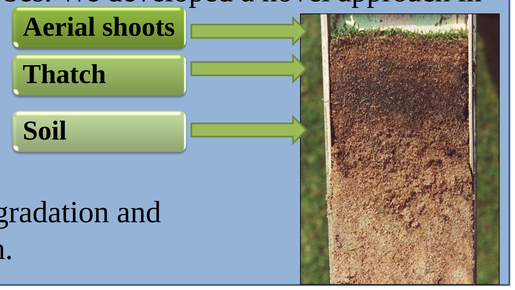
INTRODUCTION

Accumulation of high organic matter content in the form of thatch layer is one of the major problems in turfgrass greens. Thatch is a layer of tightly intermingled living and dead organic matter present below the green grass and above the soil. The rate of thatch degradation is limited by lignin, a plant cell wall constituent that is resistant to microbial degradation and limits the availability of easily degradable cellulose and hemi-cellulose to the microbes. We developed a novel approach in which we used fungal laccase, a lignolytic enzyme from *Trametes versicolor*, to facilitate lignin degradation and in turn manage thatch.



OBJECTIVES

- To verify effectiveness of laccase application on the physical and chemical properties of thatch layer on an ultra-dwarf bermudagrass and zoysiagrass grown under field conditions

MATERIALS AND METHODS

Experimental Design:

- Two year experiments were established each on ultra-dwarf bermudagrass and zoysiagrass in 2010 and 2011.
- Completely randomized design was used with two levels of laccase and four replications.

Treatment Methods:

- All treatments to plots were applied as 410 mL solution
- Laccase was applied on plot size of 1858 cm^2.
- Treatments included laccase at activity levels of 0 and 2.0 units cm^{-2} applied every two weeks.
- Laccase was applied for a period of six months.

Data Collection:

- Sampling was conducted prior to treatment (baseline) after six months of treatment application.
- Samples were analyzed for thatch layer thickness, organic matter content and lignin content.

RESULTS

Thatch Layer Thickness

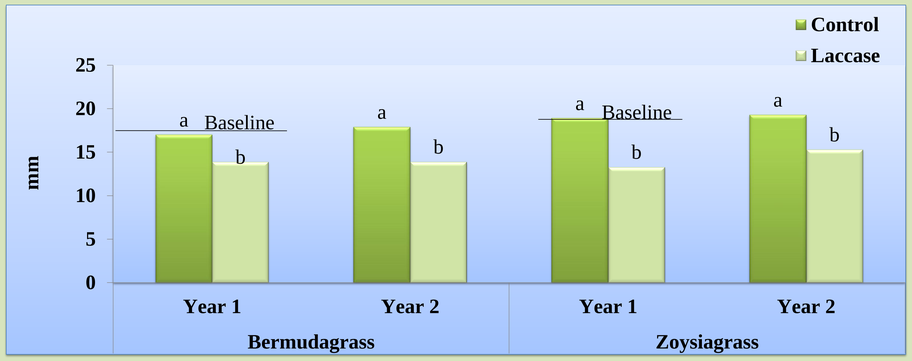


Fig. 1. Thatch layer thickness after six months of laccase application on ultra-dwarf bermudagrass and zoysiagrass. Values are means of four replicates and treatment means within each year with same letter above the bars were not significantly different according to Fisher's LSD at $\alpha = 0.05$.

Organic Matter Content (OM_U, 0-2.5 cm)

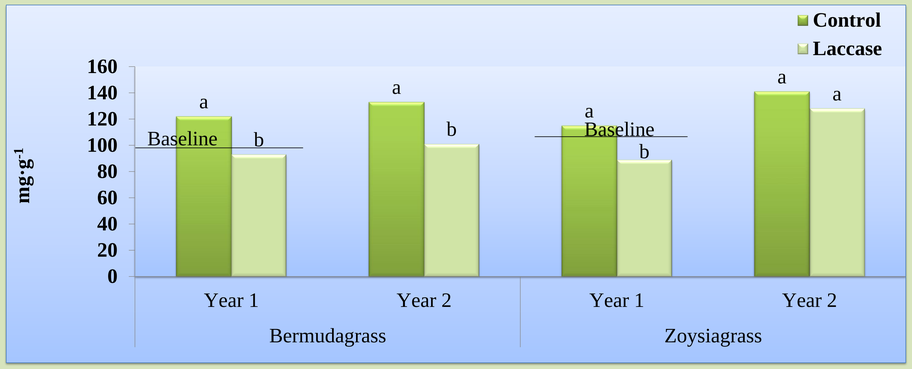


Fig. 2. Organic matter content (OM_U, 0-2.5 cm) after six months of laccase application on ultra-dwarf bermudagrass and zoysiagrass. Values are means of four replicates and treatment means within each year with same letter above the bars were not significantly different according to Fisher's LSD at $\alpha = 0.05$.

	Organic matter (2.5-5.0 cm) OM_L		Organic matter (0-5.0 cm) OM		Acid-soluble lignin L_S		Acid-insoluble lignin L_I	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
	---------- $g \cdot kg^{-1}$ ----------							
Bermudagrass								
Control	9.9a†	22.2a	47.5a	58.1a	41.5a	49.5a	317.5a	412.1a
Laccase	6.1a	9.2a	38.2b	44.5a	36.7b	39.5b	272.8b	364.5b
Zoysiagrass								
Control	66.9a	68.0a	87.2a	94.0a	23.7a	29.6a	385.7a	430.4a
Laccase	77.3a	66.6a	82.1a	89.4a	20.6b	22.3b	344.7b	381.2b

Table. 1. Organic matter content (OM_L, 2.5-5.0 cm, OM, 0-5.0 cm), acid-soluble lignin (L_S), and acid-insoluble lignin (L_I) content after laccase treatments on ultra-dwarf bermudagrass and zoysiagrass. Organic matter and lignin content values are on dry wt. basis.

Total Lignin Content (L_T)

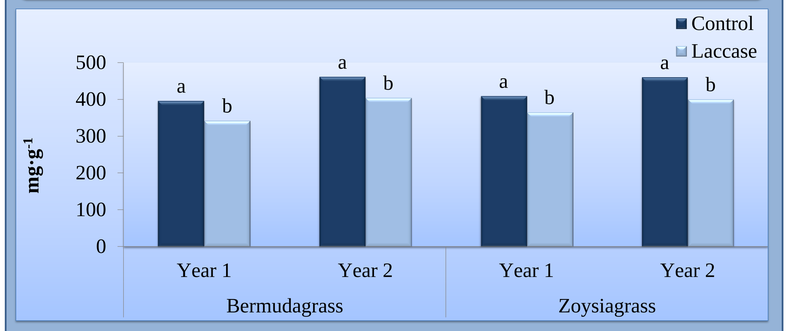


Fig. 3. Total lignin (L_T) content after six months of laccase application on ultra-dwarf bermudagrass and zoysiagrass. Values are means of four replicates and treatment means within each year with same letter above the bars were not significantly different according to Fisher's LSD at $\alpha = 0.05$.

Saturated Hydraulic Conductivity

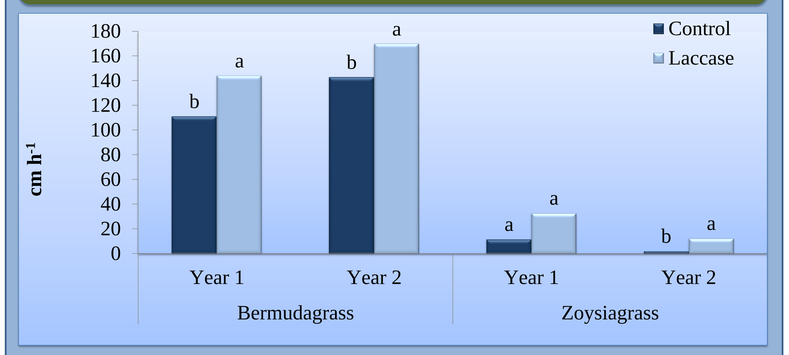


Fig. 4. Saturated hydraulic conductivity after six months of laccase application on ultra-dwarf bermudagrass and zoysiagrass. Values are means of four replicates and treatment means within each year with same letter above the bars were not significantly different according to Fisher's LSD at $\alpha = 0.05$.

CONCLUSIONS

- Application of laccase for six months at 2.0 units cm^{-2} had positive impacts on physical and chemical properties of that layer in bermudagrass and zoysiagrass that resulted in no net accumulation of thatch and organic matter when compared to baseline data.

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