Plant Pathology Seminar Series

A Light in the Darkness: History, Phylogeny, Physiology, and Applications of Bioluminescent Fungi

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Abstract:

Our record of bioluminescent fungi dates back nearly two millennia, but research into bioluminescent fungi has been sparse. More than 150,000 species of fungi that have been described, but only 71 species are known to bioluminescence. Of the 71 known species of bioluminescent fungi, all are white-rot basidiomycetes and saprotrophs (with the exception of some phytopathogens) that fall into four distinct lineages within the order of Agaricales. A luciferin (heat-stable substrate) and lucerifase (enzyme) mechanism of luminescence was hypothesized but not confirmed until Airth and Foerster used Dubois' hot-cold extract method in 1959. Failure to replicate their results led researchers to suggest non-enzymatic mechanisms until Oliveira and Stevani verified the results of Airth and Foerster in 2009. Oliveira and Stevani went on in 2012 to confirm cross-reactivity of luciferin and luciferase extracts both within the Mycenoid lineage and between all four lineages of bioluminescent fungi. Originally hypothesized to be a two-enzyme process, the mechanism behind bioluminescence in fungi involves four enzymes and begins with caffeic acid, an organic compound frequently found in many plants and an intermediate of lignin biosynthesis. The genes of the four enzymes directly involved in fungal bioluminescence have been successfully sequenced, cloned, and expressed within several organisms including yeast, tobacco, Arabidopsis, tomato, dahlia, and other ornamental plants. Current applications of fungal bioluminescence include ecological toxicity assays, as well as molecular imaging techniques. With the recent breakthrough in developing a bioluminescence gene cassette specifically for expressing bioluminescence within eukaryotes, there are many opportunities to develop in vivo bioluminescence assays for research and medical applications.

References:

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3. Oliveira, AG, Desjardin, DE, Perry, BA, Stevani, CV. (2012). Evidence that a single bioluminescent system is shared by all known bioluminescent fungal lines. *Photochemical and Photobiological Sciences,* **11**: 848 - 852.
4. Stevani, CV, Oliveira, AG, Mendes, LF, Ventura, FF, Waldenmaier, HE, Carvalho, RP, and Pereira, TA. (2013). Current Status of Research on Fungal Bioluminescence: Biochemistry and Prospects for Ecotoxicological Applications. *Photochemistry and Photobiology,* **89:** 1318 – 1326.
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4:10 pm | Date February 13th, 2023 | Plant Pathology 515, Spring 2023

Zoom Link: https://wsu.zoom.us/j/95501196325?pwd=aGdCeTZGM0pQaXZoY05qT3M0SFVHQT09

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