Plant Pathology Seminar Series

Fungal Anastomosis: How Chemical Signaling between Hyphae Directs Fungal Growth and Reproduction (Or: How Fungi Flirt)

By: Henry Hurt, MS Student

Abstract

Filamentous fungi rely on complex signaling mechanisms to coordinate the growth and fusion of hyphae during anastomosis (Lee et al. 2010). Anastomosis is the process of hyphal fusion resulting from selective weakening of fungal cell walls followed by formation of new septa between the fused hyphae and is a vital part of many fungal life cycles (Lee et al. 2010; Moore et al. 2020). The benefits of anastomosis include more efficient nutrient sharing, faster signaling, and the facilitation of karyogamy (Moore et al. 2020). While chemical signals conveying genetic information are vital for anastomosis, many of the specific signaling mechanisms remain unknown (Francisco et al. 2020). The primary factors that determine whether two hyphae can undergo anastomosis are the vegetative compatibility group (VCG) and mating type of fungi (Moore et al. 2020). Vegetative compatibility is determined by 7-12 genetic loci, depending on the taxon, and serves as a self-recognition mechanism for closely related species (Moore et al. 2020). Signaling to determine if two fungi are vegetatively compatible occurs both before and after anastomosis, depending on the taxon involved (Novais et al. 2017). Fungi that reproduce sexually must also signal the mating type to find and grow towards a compatible partner (Hartmann et al. 2021). Mating type in dikaryotic fungi is determined by the *MAT* locus, which contains genes governing sexual development, including pheromones and their conjugate receptors (Lee et al. 2010). Pheromones are released from and detected at the apical tip of hyphae, where they trigger chemotrophic growth towards a signal from a different mating type (Bassilana et al. 2020). In Ascomycota, the genes governing pheromones and their receptors are tightly linked in the *MAT* locus (Hartmann et al. 2021). As a consequence, Ascomycota mating types are bipolar, meaning that only two mating types are possible as an outcome of sexual reproduction (Lee et al. 2010). In the α – mating type, the *MAT*α idiomorph up-regulates the α -pheromone receptor Ste3 and down-regulates the a-pheromone receptor Ste2. By contrast, over half of Basidiomycota taxa have developed more than two *MAT* idiomorphs as well as unlinked loci, resulting in tetraploid mating types and far more complicated pheromone signaling (Lee et al. 2010). Asexual fungi use many of the same chemical signals as sexual fungi, providing insights into the mechanisms of how sexual fungi attract each other (Vitale et al. 2019). For example, a population of unisexual α –type idiomorphs of *Fusarium oxysporum* not only contained the genes for both α – and a – pheromones, but secreted and reacted to both. This supports the hypothesis that chemotrophic growth towards a particular pheromone is a result of down-regulation of receptors rather than possession of one pheromone-receptor pair (Vitale et al. 2019). Although we have limited understanding of fungal extracellular signaling, it is clearly vital for coordinating efficient growth and performing successful sexual reproduction. Further research in fungal extracellular signaling promises significant insights in the evolution of sexual reproduction (Lee et al. 2010), methods of plant pathogen control (Francisco et al. 2020), and the role of mycorrhizae in plant communication (Novais et al. 2017).

4:10 pm | February 14, 2022| Plant Pathology 515, Fall 2021
Zoom Link: https://wsu.zoom.us/j/95784966313?pwd=YUpybkxkckR0ZU1hMEY5N2RLa29udz09
Meeting ID: 957 8496 6313
Passcode: 2996
Call in number: 1 253 215 8782

College of Agricultural, Human, & Natural Resource Sciences
Washington State University

Select References:

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