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Molecular Genetics of Genome Defense

The Hammond Lab specializes in modifying the genomes of fungi for use in experiments that address fundamental questions of biology. Currently, our two major projects involve a genome defense process called Meiotic Silencing by Unpaired DNA (MSUD) and a selfish genetic element called Spore killer.

These projects involve an organism called Neurospora crassa. This filamentous fungus was first made famous in the 1940s by Beadle and Tatum, who were among the first to recognize its usefulness for genetic studies. Since then, experimentation with N. crassa by geneticists, biochemists, and other scientists from around the world have contributed to making it a premier model organism for discovering and understanding key biological processes.

In N. crassa, and possibly many other organisms, MSUD carefully examines the locations of genes between pairs of homologous chromosomes. Any gene found to be out of place is prevented from being expressed. Although the mechanism behind this remarkable feat is essentially unknown, we do know that it requires several proteins that surround the nucleus. Next, we hope to identify and characterize MSUD proteins that interact directly with chromosomes, as they are likely to be directly involved with detecting genes that are in the wrong place.

While MSUD may defend the genome against external invaders, like viruses, genomes can also fall prey to internal agents, such as their own genes. Spore killer is an example of what can happen when a genome’s own gene (or group of genes) becomes selfish. Spore killer is a member of a broad class of DNA molecules called meiotic drive elements, examples of which exist in a diverse array of organisms, including plants, flies, and mammals. Through studies of Spore killer, we hope to learn more about meiotic drive elements and the cellular processes that have evolved to protect genomes from them.

Selected publications:


Hammond et al. (2011) "SAD-3, a Putative Helicase Required for Meiotic Silencing by Unpaired DNA, Interacts with Other Components of the Silencing Machinery" G3 1:369-376.