

Possible I.S. Projects with Dr. William Morgan

Biology; Biochemistry & Molecular Biology

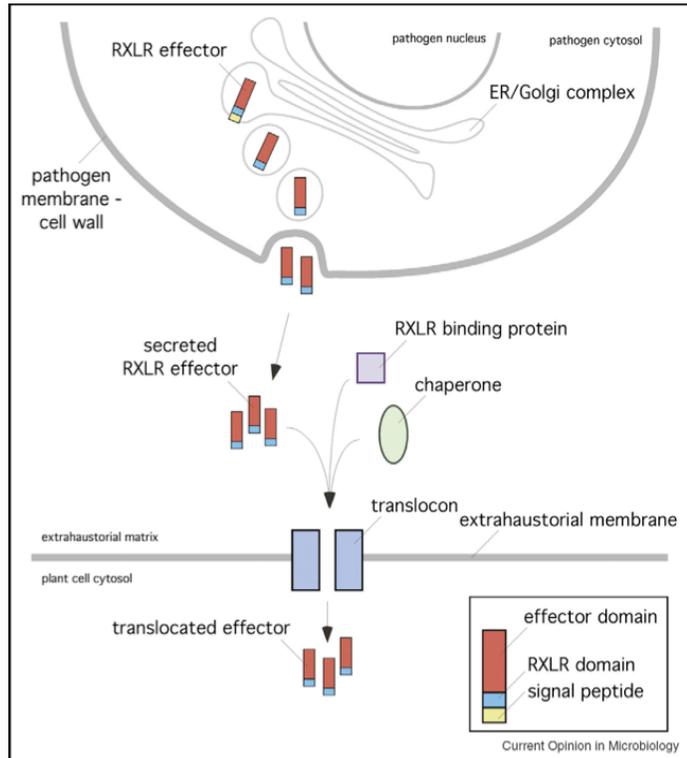
2013-2014 Academic Year

Functional genomics of pathogen effector proteins

Pathogen effector proteins

To establish a successful infection, a pathogen must manipulate the host's defense response and other cellular functions for its own ends. Recently it has been found that many pathogens alter host activities by transporting so-called *effector* proteins into the host cell (Chisholm *et al.*, 2006; Haldar *et al.*, 2006).

Once inside the host cell, the pathogen effector presumably manipulates host cellular processes. But what exactly is the function of each effector protein delivered into the host cell? So far, the functions of only a handful of effector proteins have been elucidated (Chang *et al.*, 2004; Kamoun, 2006). For example, some host-targeted effectors have been found to suppress programmed cell death, the primary defense response of infected plant cells (Abramovitch *et al.*, 2003). Other host-targeted effectors also possess a nuclear localization signal, suggesting a possible role in manipulating patterns of host gene expression (Kamoun, 2006). However, for the most part the function of effector proteins within the host cell remains largely unknown.



A hypothetical model for secretion and delivery of select pathogen effectors into the host cell. (Adapted from Morgan and Kamoun, 2007.)

The plant pathogen *Phytophthora infestans*

Phytophthora infestans causes late blight of tomato and potato. One of the most notorious plant pathogens of modern history, *P. infestans* was responsible for the Irish potato famine in the 1840's and still causes billions of dollars of crop losses annually (reviewed in Kamoun and Smart, 2005). *P. infestans* has resurged in recent years, because current control measures are becoming increasingly ineffective due to the rapid evolution of this fungal-like pathogen. Therefore, it is hoped that a detailed molecular understanding of the interaction between *Phytophthora infestans* and its plant hosts will lead to better means for controlling this and related pathogens.

Identifying novel host processes targeted by individual pathogen effectors

Although useful for testing pathogen effectors for previously reported functions, the previous project will not reveal the function of effectors with novel activities. Therefore, several investigators have begun to use the exceptional power of yeast functional genomics to explore the role of pathogen effectors (*e.g.*, Kramer *et al.*, 2007). A preliminary step is to identify pathogen proteins that cause mild to severe toxicity in yeast, presumably as a result of targeting a conserved biological pathway. During her I.S. research,

Minyoung Heo (BCMB □10) found that the expression of several *P. infestans* genes inhibited the growth of yeast cells. Preliminary microarray studies were then conducted to identify which yeast genes are transcribed at higher or lower levels in the presence of the pathogen protein.

What would a student researcher do? Replicates of the microarray study are needed to ensure confidence in the preliminary findings. An I.S. student could repeat the microarray study to ensure a sufficient sample size using the previously tested *P. infestans* gene or others that inhibit yeast growth. A fellow student could develop a complementary approach using a mutant screen. In this procedure, the *P. infestans* gene is introduced into the nearly 6000 different mutant yeast strains with individual gene knockouts. Then those strains that are hypersensitive to the effector are identified. The combination of microarray and mutant screen approaches should reveal which biological pathway an effector targets.