M & I
Microbiology
and Immunology
University of North Carolina at Chapel Hill

DISSERTATION SEMINAR

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“Microbial interactions affecting sporulation and specialized metabolite production.”

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Bondurant G-100

Dissertation Advisor: Dr. Elizabeth Shank

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ABSTRACT

Gabrielle Grandchamp: Microbial interactions affecting sporulation and specialized metabolite production
(Under the direction of Elizabeth Shank)

In microbial communities, bacteria chemically and physically interact with one another. Some of these interactions are mediated by secreted specialized metabolites that act as cues or signals to alter gene expression and cell physiology. Ultimately, the outcomes of these microbial interactions can affect development and function of the community. In my dissertation, I examine multiple microbial interactions to characterize the impact of chemically mediated exchanges on cell physiology, specifically sporulation and specialized metabolite production.

Bacillus subtilis is a well-characterized soil microbe that can differentiate into multiple cell types including metabolically dormant endospores. We were interested in identifying microbial interactions that affect sporulation in *B. subtilis.* Using a fluorescent transcriptional reporter, we observed that coculturing *B. subtilis* with *Escherichia coli* promotes sporulation gene expression via a secreted metabolite. We identified the sporulation-promoting cue as the siderophore enterobactin. *B. subtilis* has multiple iron acquisition systems that are used to import the *B. subtilis*-produced siderophore bacillibactin as well as to pirate exogenous siderophores such as enterobactin. Examining *B. subtilis* mutants, we discovered that *B. subtilis* requires genes for siderophore uptake and putative hydrolysis to sporulate in response to enterobactin. Additionally, we found that siderophores from a variety of other bacterial species also promote sporulation in *B. subtilis*. When screening soil samples for sporulation-promoting bacteria, we identified *Panotea agglomerans.* Through a candidate-gene approach we determined that genes in two predicted siderophore biosynthetic gene clusters are required for sporulation-promoting activity. Our results demonstrate that siderophores can act not only as bacterial iron-acquisition systems, but also as interspecies cues that alter cellular development and accelerate sporulation in *B. subtilis*.

Coculturing bacteria has been demonstrated to alter the expression of many specialized metabolite biosynthetic gene clusters. In efforts to characterize interactions between soil bacteria and identify novel antibiotics that inhibit *Staphylococcus aureus*, we screened cocultures of actinomycetes isolated from the same soil particles for antibiotic activity. We found that multiple pairs of actinomycetes elicit coculture-specific antibiotic production and display activity against *S. aureus*. These results demonstrate the utility of our coculture screen and identified a potentially novel antibiotic with activity against antibiotic resistant strains of *S. aureus*.