Predicting the consequences of different types of human intervention has become an increasingly important challenge in light of habitat fragmentation, climate change, invasive species, and genetically modified introductions. Genetic engineering has greatly increased the insect killing power of *Metarhizium* and *Beauveria* spp. In particular, fungi used as delivery systems for arthropod toxins kill rapidly and at very low spore doses. Before deploying such technology, risk assessment requires that we examine the transformed genotype in its interactions with its environment. However, the current predictive database for risk assessment of genetically engineered microbes is small. Lack of knowledge about the fate of genotypes at the population and ecosystem levels creates an inherent uncertainty about the efficacy, survivability, and environmental risk posed by any biocontrol agent, even the effective use of classical biocontrol agents.

We have conducted studies to investigate the maintenance, stability, proliferation, die-off and pathogenic effects of genetically tagged fungi applied to natural (turf) and agricultural (winter wheat) field sites. Our specific objectives included: 1) using microarray based mutation accumulation assays to reveal mobile genes and the capacity of *Metarhizium* for rapid evolution in gene expression; 2) determining whether persistence is dependent on recycling of fungi through insects; 3) determining whether a strategy for engineering reduced ability to survive on root exudates can be relied on to reduce persistence in field conditions and 4) evaluating the impact of inundative applications of transgenic *Metarhizium* on conspecific strains, mycorrhizal fungi and insects.

The impacts of this research provide: 1) insight into the intimate relationships between genes, organisms and the environment; 2) a model for analyzing microbial communities, metabolic potential, and diversity in the rhizosphere, and 3) informed risk assessment and testing of containment methods. The resulting containment mechanisms combine fitness with a level of safety greater than that of inefficient non-transgenic biocontrol agents.