Fact Sheet

STRATEGIES TO PREDICT AND INFLUENCE PATHOGEN PERSISTENCE IN SOILS

PROBLEM

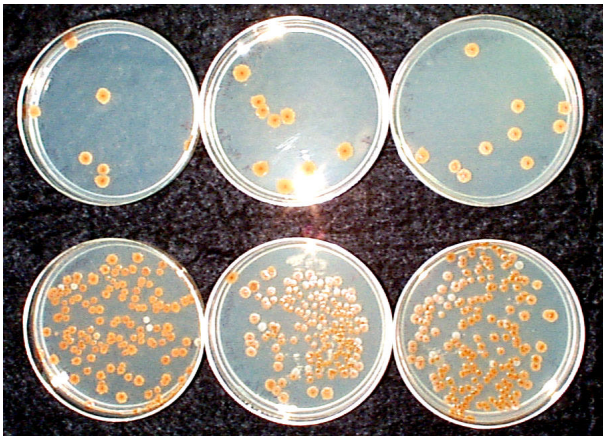
Biological weapons of mass destruction (BWMD) are increasingly recognized as a major threat to U.S. personnel. Decontamination to prevent later exposure to residual pathogens is recognized as a major gap in both military and homeland defense capabilities. Existing vaccines may be ineffective against genetically altered forms of these bacteria.

The most probable mechanism for BWMD use is aerial dispersion of endospores, which can infect personnel by both immediate and delayed exposure. Endospores—microbial structures that withstand extreme environmental stresses such as cold, heat, radiation, acidity, toxic chemicals, and desiccation—are remarkably difficult to kill compared to the normal or "vegetative" bacterial growth. Endospores can rapidly revegetate following inhalation, ingestion, or open-wound penetration. Delayed exposure, such as from inhaling infected soil dust, is a major threat from pathogenic endospores dispersed onto soil because of the endospores' resistance to environmental stresses. Pathogenic endospores dispersed on frozen or cold soils could theoretically remain viable for years, resulting in a long-term threat to both military and civilian personnel.

Bacillus anthracis is a naturally occurring soil microorganism, yet in temperate climates its density is usually acceptably low, probably due to natural competition from indigenous microorganisms in soil. Decontamination of endospore-contaminated soils is exceedingly difficult. In cold climates, attenuation through natural competition would be much slower than in temperate climates and pathogen density would most likely remain nearly the same as that immediately following endospore dispersal. Conditions favoring a decrease in pathogen density would occur only during limited thawing cycles or perhaps under snow cover, but at a slower, and unknown, rate. Our inability to predict the persistence of endospores in frozen and seasonally frozen soils presents a critical knowledge gap for protecting U.S. personnel.

SOLUTION

We are investigating factors that influence the dormancy, growth, and survival of specific microbial communities in soils that are frozen or undergoing freeze–thaw cycles so that we can predict or modify their persistence. An understanding of the mechanisms by which soil conditions affect pathogen fate is essential to developing strategies that can be used on a field scale to advantageously influence endospore persistence. We are pursuing the hypothesis that we can decontaminate seasonally frozen soils that harbor artificially elevated levels of pathogenic endospores by altering growth conditions and competition.



Surrogate organism, Bacillus globigii *(BG) growing on 0.1X TSA.*

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