Bio-detection of buried landmines by autonomous microbial-electronic modules

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Abstract

Landmines and explosive remnants of war pose a global humanitarian problem which claims numerous casualties long after the conflict has ended. Current approaches for the location of landmines, such as metal detection, which require physical presence at the minefield, involve high risk to personnel; these methods are also costly, time consuming, and have a high rate of false positive results. No currently viable technology allows the remote detection of buried explosive devices. A possible solution may be provided by the use of genetically engineered microorganisms, molecularly “tailored” to emit an optical signal in the presence of trace explosives escaping for the landmine and accumulating in the soil above it. This optical signal, , can serve to generate a physical map of the mine location. We have previously described the remote detection of buried landmines using alginate-encapsulated fluorescent microbial (Escherichia coli) bioreporters. Since than we have modified the system to one based on bioluminescent (rather than fluorescent) bacteria, and have employed several synthetic biology approaches to significantly enhance their major performance parameters: higher signal intensity, faster response time, and lower detection threshold of the target explosives. These advanced sensor strains have been incorporated into independently deployable electronic modules that sensitively report on the presence of trace explosives under their footprint.