Detection of buried explosives using fluorescent microbial bioreporters

Shilat Simanowitz*, Etai Shpigel and Shimshon Belkin

Department of Plant and Environmental Sciences, Institute of Life Sciences, The Hebrew University of Jerusalem, Jerusalem, Israel

There are over a hundred million landmines scattered all over the world. These landmines cause thousands of injuries and deaths each year. The detection of landmines today requires human intervention in the field, which is a very dangerous and slow process. In addition, the explosive substances seep into the ground, polluting soils and groundwater.

For most landmines, the common explosive is 2,4,6-trinitrotoluene (TNT), which is often accompanied by the relatively volatile 2,4-dinitrotolene (DNT). The latter is considered a "signature chemical" for TNT-based explosives. Another chemical of interest is ammonium nitrate, a prevalent component of improvised explosive charges.

Previous work in our lab has developed several bacterial bioreporter strains that respond to the presence of TNT, DNT, or Nitrate compounds by the emission of a bioluminescent signal. In the present study, I have redesigned those sensor strains so that the optical signal emitted in the presence of the target compounds will be fluorescence rather than bioluminescence. This has been accomplished by employing fluorescent proteins as the reporter entities, with different fluorescent colors assigned to different target compounds. A bacterial (*E. coli*) "multi-sensor" has been successfully designed and constructed, which emits green fluorescence in the presence of DNT and a yellow signal when it senses nitrate compounds, such as ammonium nitrate. This has been achieved by cloning the EGFP (λex: 488; λem: 507) and the YPet (λex: 517; λem: 530) protein genes downstream from the *yqjF* and the *hcp* or *hmp* gene promoters, respectively.

*Shilat.Simanowitz@mail.huji.ac.il