Researchers Lauded for Helping DoD Sustain Training Ranges Using Natural and Transgenic Grasses

WASHINGTON – In its ongoing effort to sustain mission-critical training ranges, the Department of Defense (DoD) is enlisting a different sort of fighting force: plants. It turns out that grasses growing on ranges throughout the nation can serve as tools in the military's arsenal in combating environmental contamination.

Recent research has demonstrated that enzymes in certain plants found on military installations can actually break down toxic energetic compounds such as TNT and RDX. These findings are significant because these plants could then be used to contain and clean up contaminants resulting from military training and testing operations.

Deposition of energetic compounds occurs during training with live munitions, which is essential to maintain the readiness of our forces. These compounds may then percolate through the soils and, in some cases, migrate to contaminate groundwater and potentially drinking water in communities near the ranges. This new research provides an innovative strategy that harnesses natural processes to prevent degradation of the land and water on DoD's hundreds of ranges and in the communities surrounding them.

Two research projects that help advance this solution were selected to receive 2009 Project-of-the-Year Awards from the Department of Defense's Strategic Environmental Research and Development Program (SERDP). The awards were presented at the annual Partners in Environmental Technology Technical Symposium & Workshop sponsored by SERDP and its sister program, DoD's Environmental Security Technology Certification Program (ESTCP). A record-breaking 1,150 environmental professionals from government agencies, academia, and the private sector participated in the conference, which was held last month in Washington, D.C.

"The findings of these projects offer a long-term, sustainable solution in a very different way so that the ranges, as living ecosystems, use their own resources to degrade and remove contamination on site," said Dr. Jeffrey Marqusee, Director of SERDP and ESTCP.

Dr. Jerald Schnoor and his team from the Department of Civil and Environmental Engineering at The University of Iowa received a Project-of-the-Year Award for Environmental Restoration for advancing the understanding of how existing, naturally occurring native plants, through the process of phytoremediation, can degrade and contain certain toxic energetic compounds such as RDX that contaminate subsurface soils on the ranges. The fundamental molecular biology conducted by these researchers has vastly improved scientific understanding of the structure and the mechanisms of the enzymes that have been identified in the microorganisms that degrade the toxic energetic compounds. Their findings provide the knowledge needed to make more effective and efficient use of naturally occurring grasses on ranges to support phytoremediation.

For their work in addressing the challenge posed by TNT, an energetic compound that is toxic to many plants, Dr. Neil Bruce and his team from the University of York Centre for Novel Agricultural Products (United Kingdom), University of Washington, and U.S. Army Engineer Research and Development Center-Cold Regions Research and Engineering Laboratory also received a Project-of-the-Year Award for Environmental Restoration. These researchers succeeded in creating transgenic grasses with unique abilities both to detoxify TNT and degrade RDX. "This work is a huge leap forward in developing grasses with specific abilities for use on training ranges," said Dr. Marqusee.

Using genetic engineering techniques in greenhouse settings to develop the transgenic grasses, the researchers modified grasses that naturally grow on DoD ranges, so as to avoid introducing invasive plant species. The findings from this project represent a crucial step in the process that eventually could result in the widespread use of engineered plants to remove toxic energetic compounds from the soil on military training ranges.

SERDP, DoD's environmental science and technology program, funds projects across the broad spectrum of basic and applied research, as well as exploratory development. SERDP focuses on cross-service requirements and pursues solutions to the Department's most intractable environmental problems. ESTCP is DoD's environmental technology demonstration and validation program. The Program's goal is to identify and demonstrate cost-effective technologies that address DoD's highest priority environmental requirements. Demonstrations are carried out at DoD facilities and sites to document improved efficiency, reduced liability, and direct cost savings.

Other SERDP and ESTCP 2009 Project-of-the-Year Award recipients include the following:

Wide-Area Detection and Identification of Underwater UXO; Dr. Brian Houston, Naval Research Laboratory, Washington D.C.; SERDP Project of the Year for Munitions Management. A significant number of active and former Department of Defense installations have adjacent coastal and inland waters containing military munitions, some partially or completely buried in sediment and some lying on the sediment floor. There is little historical information about the locations or quantities of munitions in the underwater environment so technologies are needed to efficiently assess potentially contaminated areas. Existing underwater search techniques are limited in part because they are unable to see beneath the sediment floor.

Dr. Houston and his project team have developed an effective technique for wide-area detection and identification of underwater munitions using an innovative structural acoustic sonar system. Instead of using images, structural-acoustics uses the "ringing" that objects make when hit by soundwaves. By interpreting the sound patterns and tone, researchers are able to discern information about the size and nature of an object. This technology holds tremendous potential to provide DoD with a new capability to identify and characterize underwater munitions sites at high coverage rates.

Efficient Remote Methods to Map and Monitor Coral Reefs; Dr. Pamela Reid, University of Miami School of Marine Atmospheric Science; SERDP Project of the Year for Sustainable Infrastructure. Coral reefs are threatened and in decline across the globe. To monitor the health of a reef and assess impacts and recovery, DoD needs an accurate depiction of large areas of the reef so as to compare its condition over long periods of time. In the past, divers would be sent down to characterize a reef's condition, but that approach was costly and inefficient and it did not provide a consistent historical record or a quantitative assessment.

Dr. Reid and her research team have developed an innovative technology that increases the speed and repeatability with which reef plots can be mapped and inventoried. Remotely operated underwater video is used to create two-dimensional spatially accurate reef mosaics. These mosaics can serve as a tool for monitoring disease, injury, bleaching, and mortality—important indicators of reef health. This technology will provide accurate and defensible inventories of coral reefs under DoD purview.

Perchlorate Alternatives for Incendiary and Pyrotechnic Formulations; Dr. Trevor Griffiths, QinetiQ Ltd., Sevenoaks, Kent, United Kingdom; SERDP Project of the Year for Weapons Systems and Platforms. Perchlorate is a contaminant of significant environmental concern throughout the nation. There are many sources of perchlorate including the military, which uses it as a high energy oxidizer in rocket propellants and pyrotechnics. Perchlorate can be released into the environment during manufacture, demilitarization, or when ammunition fails to function correctly.

Dr. Griffiths and his colleagues developed environmentally benign, perchlorate-free incendiary and pyrotechnic mix formulations for projectiles such as those used in tanks and howitzers. The ingredients used in these formulations can be obtained readily, and their cost is comparable with those presently used for the incendiary compositions. The results of this project demonstrate that perchlorate can be eliminated from these applications without degrading performance. Perchlorate-free alternatives will enable the Department of Defense to significantly reduce human health and environmental risks while sustaining essential training activities.

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Sampling Protocol for Characterizing Energetic Residues on Military Training Ranges; Mr. Alan Hewitt, U.S. Army Engineer Research and Development Center Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire; ESTCP Project of the Year.
The use of munitions during live-fire training exercises on DoD ranges presents a risk of contaminants leaching into the soil and groundwater and potentially migrating to areas outside of the range. To determine the likelihood of such impacts, the military needs methods that provide accurate estimates of the amount and type of contaminants in the soil. Traditional environmental sampling techniques have proven inaccurate and expensive when deployed on ranges, where the form and distribution of contamination is qualitatively different from industrial pollution.

Mr. Hewitt and his team have demonstrated a scientifically defendable sampling protocol designed specifically for characterizing energetic residues on training ranges, an approach for which they gained the approval of the Environmental Protection Agency. This new approach, EPA Method 8330B, addresses the uncertainty due to the heterogeneity of energetic residues on military ranges and provides an accurate sampling process.

These new techniques enable range managers to make sound risk management decisions for ranges that enhance DoD's ability to meet or exceed environmental stewardship requirements while maintaining training and testing activities. Cost savings for sample handling, processing, and analysis using these techniques are estimated at 50 to 80 percent.

Robotic Laser Coating Removal System; Mr. Timothy Hoehman, Tinker Air Force Base, Oklahoma; ESTCP Project of the Year. Aircraft are routinely inspected for corrosion of metal components. These inspections require that paints be removed and, after the inspection is complete, the aircraft is subsequently repainted. Coating removal operations at military rework facilities involve chemical and mechanical processes that result in significant emissions of volatile organic compounds, organic and inorganic hazardous air pollutants, and hazardous waste.

Mr. Hoehman and his team demonstrated and validated the Robotic Laser Coating Removal System as an alternative technology to remove coatings from large aircraft components. The system uses an integrated, advanced laser coating removal unit with a particle capture system. This robotic system has the potential to reduce the environmental impacts associated with coatings removal, reduce labor and chemical costs, and enable workers to remove coatings in a fraction of the time, limiting the amount of time military aircraft are out of service. Cost savings from Air Force-wide implementation are estimated at $67 million.

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