Honeybees for Detection of Chemical Explosives and Environmental Contaminants

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Performers

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DISCUSSION TOPICS

- What Do We Know About Bees?
- Applications
- Bee Research History
- Air Force Needs
- Goals and Objectives
- Demonstration Plan
- Technology Transfer Strategy
- Benefits and Issues

What do we know about bees?

- Bees passively collect environmental information (absorbed or ingested) while flying or by contacting dusty surfaces and gathering specific contaminants in plant nectar, pollen, resins, water
- Bees can be trained to be sensitive detectors or chemicals (explosives, drugs) and are at least as good as dogs in smelling odors
- Bees can find targets in the field and be tracked using electronic devices
- Bee hives can be instrumented to detect what bees bring back

Applications

- Chemical collection and detection
  - Explosives
    - RDX, HMX, TNT
  - Environmental contaminants
    - VOCs, SVOCs, heavy metals, pesticides, PCBs
  - Illegal drugs
- Biologics
  - Spores, viral agents, pest and parasites
- Security and homeland defense
  - Concealed targets, crowd control, search and rescue

Bee Research History

- In 1974, the University of Montana (UM) initiated research using honey bees for biomonitoring experiments
- In 1978, EPA sponsored a pilot investigation of the feasibility of using honey bees for monitoring environmental contamination
- In 1982, the Pacific Northwest Laboratories joined UM and EPA in another research project using honey bees to determine exposure levels, identify sources and map the distribution of trace elements and radionuclides
- During 1995-2000, demonstration of honey bee biomonitoring technology was conducted at Aberdeen proving ground, MD to access toxic chemical contaminants in military-unique, terrestrial ecosystems

Air Force Needs

- AF needs
  - Pre-planning for environmental process
    - Help to allocate AFCEE resources and set priorities
  - Detection of unexploded bombs on weapons ranges
  - Field application verification of technology for use in environmental investigations and monitoring
    - Implementation of field pilot test
    - Analytical confirmation of bee contaminant detections
    - Implementation of full-scale demonstration project
  - Attain EPA and public buy-in for this technology

Goals and Objectives

- Goals
  - Determine utility as low-cost capability for wide area sampling
    - Site Characterization, LTO, LTM, Weapons Ranges
  - Determine capability to locate hot spots
    - Unexploded bombs or contaminant sources
  - Gain EPA acceptance for use in cleanup process
- Objectives
  - Correlate contaminant concentrations in honeybees with concentrations in soil and water
  - Prepare protocol acceptable to EPA
  - Answer deployment questions
    - How many hives? How long /when to monitor? Where to locate?

Demonstration Plan

- Field Tests to Evaluate Usability
  - Correlate honeybee and actual site concentrations
    - Volatile organic compounds and metals
- Wide-area screening at ranges and other large AF sites
  - Perform site characterization
  - Detect hot spots
    - Energetic Compounds and Location of UXO
- Develop EPA technology demonstration report/protocol
- Include this technology as part of the AFCEE “tool box” of innovative technologies
- Partner with other DoD agencies to continue evaluating bee technology on other environmental investigation/monitoring projects

Technology Transfer Strategy

- Phase I: Field tests to evaluate usability
  - Continued AFCEE and support contractor involvement in assisting application of this technology at a selected field demonstration site
  - Develop and submit honeybee application strategy plan to DARPA for their review and approval
    - AFCEE will request additional funding from DARPA to initiate field demonstration
  - Conduct Phase I field demonstration at a range operated by the Montana National Guard
    - DARPA will subcontract the University of Montana to provide technical oversight
- Phase II: Full scale site characterization with regulatory oversight and participation
  - Develop a funding/partnering strategy with involved agencies (DARPA, AF, EPA, SERDP, ESTCP, etc.) to provide funding, technical assistance and a site for full scale demonstration project

Technology Transfer Strategy

- Conduct full-scale characterization at selected range site
  - Verify honeybee contaminant concentrations obtained at a known UXO impacted demonstration site with rigid QA/QC analytical methods and protocols
  - Conduct a second demonstration over a large unknown area to screen for localized “hot spots”
  - Verify honeybee “hot spot” detection areas with laboratory analysis
- Phase III: Development of EPA, Tri-Service and Interstate Technology Regulatory Council (ITRC) protocol
  - Add this technology to AFCEE’s “tool box” of innovative technologies
    - Work with SERDP, ESTCP, RPMs, Team Chiefs to implement technology at other installations

Benefits and Issues

- Benefits
  - AF gains low-cost, environmental assessment capability acceptable for wide area sampling
    - No such capability exists now
  - Reduced costs for site characterization and LTM
  - Technology transfer to other DoD agencies and industry
    - EPA buy-in and technology acceptance
  - Develop tool for military applications for UXO detection and homeland defense
- Issues
  - Usability of chemical information for decision making
  - Technology acceptance and implementation
  - Management and regulatory buy-in
  - Reduced innovative technology budgets