

Development of a Method for Conducting Outdoor Field Trials Using a Compact Aerosol Test System (CATS)

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Introduction

- Advanced biological detector characterization requires challenges resembling real-life threat releases.
- Field testing is the most realistic method of simulating a biological release; however, field trials are costly and often time prohibitive.
- An alternative method for testing biological detectors with simulated threat aerosols while sampling outdoor background air was developed using the Compact Aerosol Test System (CATS) (see Figure 4).
- The CATS is a hybrid chamber-field trial system, allowing a user to disseminate biological aerosols in a confined space while drawing in outdoor background air.
- The portability of the CATS allows the operator to conduct trials with biological releases in actual deployment environments.
- The adaptability of the CATS is conducive to a wide variety of experimental setups.

Materials and Methods

- The CATS consists of a 0.2 m³ aluminum duct (see Figure 1 1) raised on a platform with ports along the bottom to allow for aerosol sampling.
- Blowers (see Figure 1 3) draw in outdoor background air while maintaining a vacuum within the duct. Exhaust air is HEPA-filtered (see Figure 1 2) prior to release.
- Control software (see Figure 1 4) generates a biological spray that simulates a field release.
- The Aerosol Diluter (see Figure 1 5) equipped with a Sono-Tek Ultrasonic Nebulizer (see Figure 1 6) generates a cloud of 2 μm *Bacillus atrophaeus* (BG) spore agglomerates.
- Trials are refereed with a Mattson Garvin Slit-to-Agar (STA) Sampler (see Figure 1 7) to calculate the biological aerosol concentration throughout the trial.
- For initial testing, a concentrated Fluorescent Aerosol Particle Sensor (CFLAPS) (see Figure 1 8) was used as the detector under test and the XMX/2L-MIL (see Figure 1 9) was used as the biological collector under test.

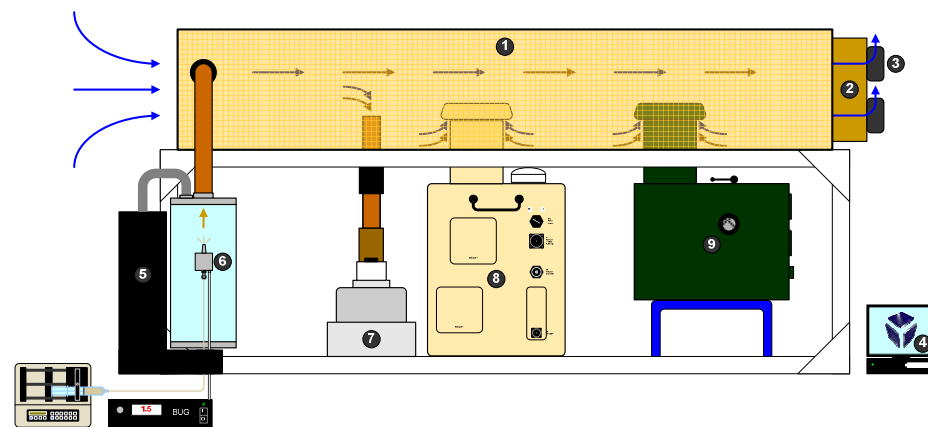


Figure 1. A diagram of the CATS showing the air flow path of the outdoor air and biological simulant. Outdoor air is drawn through the aluminum duct 1 while the biological simulant is disseminated by the Sono-Tek Ultrasonic Nebulizer 6 through the Aerosol Diluter 5. The mixture of outdoor air and biological simulant is drawn by the blowers 3 past the reference sampler 7, the CFLAPS 8 and the XMX/2L-MIL 9 before being exhausted through the HEPA filter 2. The disseminator, blowers and reference sampler are remotely manipulated by the control software 4.

Results

- The graphs display representative results from a CATS trial (see Figure 2) and a field trial (see Figure 3).

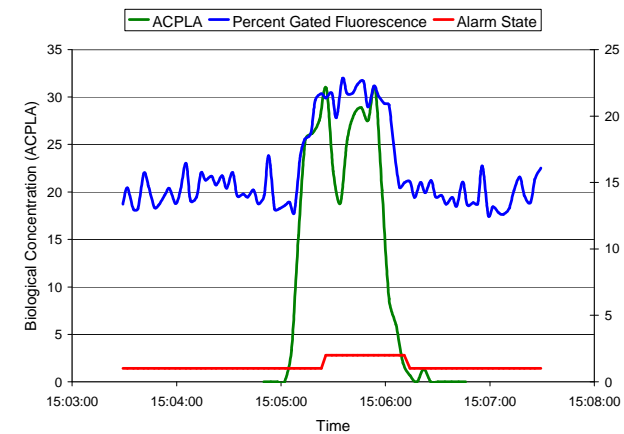


Figure 2. Data collected during a CATS trial. The biological concentration, measured in Agent Containing Particles per Litre of Air (ACPLA), is the data collected by the reference samplers. The percent gated fluorescence and alarm is the detector response from the device under test, the CFLAPS.

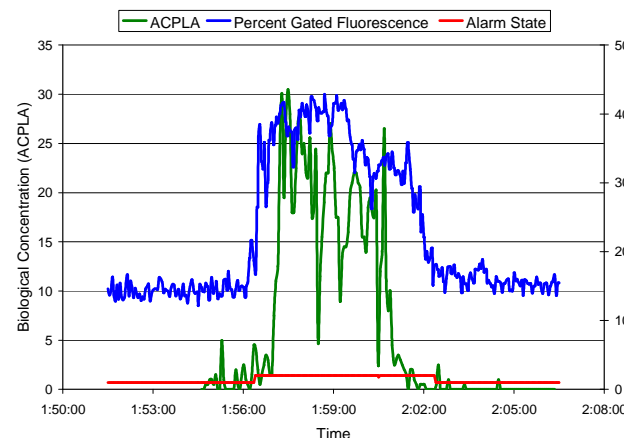


Figure 3. Data collected during a field trial. The biological concentration, measured in Agent Containing Particles per Litre of Air (ACPLA), is the data collected by the reference samplers. The percent gated fluorescence and alarm is the detector response from the device under test, the CFLAPS.

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Discussion

- In both the CATS and field trial situations, the biological cloud is able to produce a sharp and distinctive rise in detector response (percent gated fluorescence) triggering an alarm.
- Similar biological cloud profiles were observed by the reference samplers in both the CATS tests and field trials suggesting that the CATS dissemination profile is similar to that of a field trial dissemination.
- In an eight-hour shift, the CATS could generate at least twenty trials as a ten minute purge was all that was required. (This contrasts with a typical field trial that averages three tests over a similar shift).
- Although a single trial was presented in Figure 2, other tests demonstrated that a range of biological concentrations could be disseminated in the CATS.

Summary

- The CATS combines outdoor background air sampling and biological dissemination without contaminating the test site.
- The dissemination of a biological cloud within the CATS while sampling outdoor background air reflects actual deployment scenarios.
- The CATS provides a feasible and inexpensive alternative to field trials while producing repeatable tests with a turn around time of under ten minutes.

Future Research

- Research is currently being done to allow the dissemination of alternate biological simulants, such as *Pantoea agglomerans*, MS2 and ovalbumin.
- The functionality of the CATS has been demonstrated and can now be used to determine the probability of detection and reduce false alarm rates for a wide range of biological detectors.



Figure 4. A typical outdoor setup of the CATS, Aerosol Diluter and equipment under test.