B55 Potential Use of Microbial DNA Profiling in Soil Forensics

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This presentation will acquaint the audience with the profiling technique called amplicon length heterogeneity-polymerase chain reaction (ALH-PCR) that has been widely accepted in various scientific disciplines. The potential application of ALH-PCR to the forensics field, particularly soil discrimination by microbial DNA profiling will be discussed. The dis- criminatory power of ALH-PCR will be compared with soil macronutrient and trace element analyses.

This presentation will impact the forensic community and/or humanity by demonstrating that soil is a ubiquitous material that is trans- ferred easily from one place to another and is highly variable, making it physical evidence of significant value. Increasing the tools available for forensic soil comparison as well as their power and ease of use will provide forensic investigators with a simple approach to use this type of evidence which is otherwise seldom used to assist in forensic investigations.

Soil is ubiquitous material that is transferred easily from one place to another and is highly variable, thus making it useful for forensic trace evi- dence. Increasing the tools available for forensic soil comparison as well as their power and ease of use will provide forensic investigators with a simple approach to use this type of evidence, which is otherwise seldom used in forensic investigations. The authors propose that soil types drive the microbial community structure inherent to them. If this is true, microbial community profiles obtained from soils at body dump sites and/or crime scenes can be used to link a suspect to a crime.

Standard soil nutrient analyses (total carbon and total nitrogen) were performed on pristine samples collected seasonally, from three of the six Florida Miami-Dade County soil types as described by the United States Department of Agriculture (USDA). The chemical profiles of elements commonly found in soils (Al, B, Ca, Cu, Fe, K, Mg, Mn, Na, P, S, Si and Zn) were obtained using inductively coupled plasma optical emission spec- troscopy (ICP-OES). ICP-OES applies sufficient heat to the sample to ionize it and separate the elements present based on their optical emission capacity. The microbial profiles were obtained using ALH-PCR analysis of a molecular marker, namely 16S rRNA gene. The ALH technique uses the natural genetic variability of microorganism 16S rRNA genes to produce different fingerprint patterns based on the length of amplicons. The gener- ation of these profiles can be considered as a “microbial signature” of a par- ticular soil type. The entire nutrient, chemical and microbial profiles were subjected to statistical analysis of similarity (ANOSIM) to test for signifi- cance at the $p < 0.01$ level.

Data comparison suggested that microbial DNA analyses were better suited than other analyses as a forensic marker for soil discrimination. Nutrient analyses were non-discriminative, whereas the chemical data was able to discriminate between some soil types but was not as consistent as the microbial data.

Soil characterization by 16S rRNA eubacterial amplicon length com- parisons using the ALH technique is a simple, relatively fast, method that combines state-of-the-art equipment and basic DNA profiling knowledge to obtain profiles that can be used by forensic scientists to establish possible sources of origin of soil samples or more importantly, a match of soil evi- dence to a crime scene.

Amplicon Length Heterogeneity (ALH), Microbial Forensics, Soil Forensics

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