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Predicting the origin of soil evidence: high throughput eukaryote sequencing and MIR spectroscopy applied to a crime scene scenario

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Soil can serve as powerful contact trace evidence in forensic casework, because it is highly individualistic and can be characterised using a number of techniques. Complex soil matrixes can support a vast number of organisms that can provide a site-specific signal for use in forensic soil discrimination. Current DNA fingerprinting techniques rely on variations in fragment length to distinguish between soil profiles, and focus solely on the microbial community. However, the recent development of high throughput sequencing (HTS) offers the potential to provide a more detailed picture of the soil community than traditional methods by allowing access to the non-culturable microorganisms, identify specific bacteria, fungi, and plants within soil as biological markers [1], [2], [3], [4], [5]. In this study, soil DNA profiles of six samples recovered from a suspect's belongings in a mock-case scenario were compared to those collected from seven reference locations across South Australia to demonstrate the application of HTS to forensic soil analysis. Our results demonstrate the utility of non-microbial DNA to discriminate between different sites, and exclude a suspect from all but one location. In addition, we show that the discriminatory power of HTS is comparable to that obtained by mid infrared spectrometry (MIR) analysis, a method currently accepted in court. Through design of a mock case scenario, we highlight the considerations and potential limitations of this method in forensic casework.

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