Spatially resolved real-time volatile profiling reveals novel plant volatile release patterns in open headspace environments

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Volatile organic compounds (VOCs) shape ecological interactions between plants and other organisms. Yet most of our current knowledge is based on constrained dynamic headspace systems (e.g. glass bottles), and we know relatively little about volatile dynamics under realistic, open-air conditions. To address this limitation, we developed a field-compatible analytical system that combines proton-transfer-reaction time-of-flight mass spectrometry (PTR-ToF-MS) with an automated robotic sampling arm that allows real-time measurements of VOCs within a defined vertical plane. Using this system, we mapped emission patterns of maize plants that were induced by mechanical damage, herbivore feeding, and the volatile (Z)-3-hexenyl acetate (HAC). Wounding and herbivory resulted in highly localised VOC emissions around the wound site. HAC exposure generated broader and more diffuse VOC emission patterns that depended on the site of exposure. Our system is thus capable of mapping volatile dynamics in open headspace environments and allows us to uncover novel emission patterns. This work provides a foundation for a more realistic understanding of volatile emission and response patterns in natural and agricultural systems in the future.