Do elevated CO_2, ozone (O_3) and diesel fumes alter the volatile organic compound (VOC) emissions of plants under insect attack?

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Plant VOCs are critical to **ecosystem functionality**:

- Signalling impending herbivore attacks to neighbouring plants
- Helping pollinators locate food sources
- Alerting predators to presence of prey

Improved knowledge of VOC emission profiles under complex and changing pollutant scenarios could pave the way for better **plant health monitoring** – enhancing food security and ecosystem health

Characterising VOC emissions is critical to accurate **atmospheric processes modelling.** Plant VOCs play an important role in atmospheric chemistry, contributing to the production of tropospheric ozone and particulate matter, as well as increasing the lifetime of important greenhouse gases, such as methane.

What do we gain from answering this question?

How are we approaching the question?

Figure 1.
Aerial view of the arable land that houses the University of Reading FADOE (free air diesel and ozone enrichment) experiment. Photo credit; David Casebow (2020)

We are measuring plant responses to herbivory under combined pollutants (diesel and ozone) in **semi-natural** growing conditions over several seasons at University of Reading's **FADOE** facility (Fig. 1.). VOCs collected from the enclosed 'headspace' of plants are being analysed using GC-MS and GC-FID to determine potential differences in herbivore-induced profiles.

We are also using state–of–the-art CO_2 glasshouse facilities at the University of Birmingham, to expose developing crop plants to **elevated levels of carbon-dioxide**. Plants will then be exposed, short-term, to herbivory and ozone concurrently, in chamber experiments. We aim to characterise VOC profiles of herbivorised plants under **a 'multiple pollutant'** scenario.

Plant **VOC profiles are complex**, containing many compounds, and often increasing in complexity under insect attack.

In an attempt to characterise profiles and find **trends across plant groups** and herbivore **guilds**, we are undertaking a systematic review and meta-analysis.

Elucidating specific **'herbivore-induced plant volatiles'** will enable us to focus our efforts on the most relevant VOCs for our plant models.

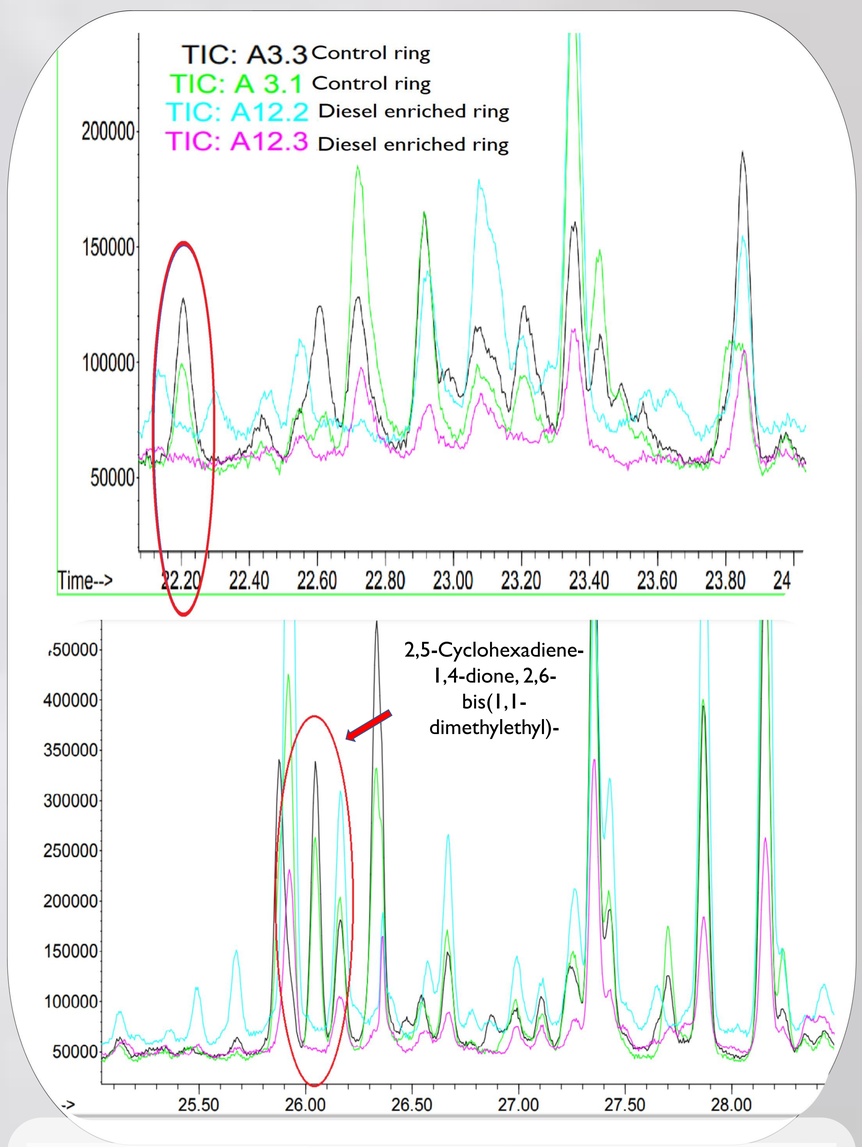

Figure 2. Overlaid chromatogram of VOCs collected from the headspace of four native black poplar saplings, two developing under diesel (pink and blue lines) and two developing under ambient air (green and black lines).

Preliminary field results from baseline headspace measurements of black poplar (*Populus nigra* subsp. betulifolia) following the 2021 growing season show differences in VOC profiles between diesel exposed and control plants (Fig. 2.).

We do not yet know whether diesel exposure, either alone or in combination with ozone, will alter the 'defensive' profile of black poplar under herbivory, but preliminary data measuring VOC profiles of saplings exposed historically to these pollutants looks to show some differences … Watch this space!

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