



Applications



Pictures: Pixelquelle.de

- > Biological research:
- > Real-time measurement of plant defense and leaf wounding reactions

NEED FOR HIGH TIME RESOLUTION

In nature reactions often happen very fast. Common methods of analyzing compounds released when leaves are wounded do not have the capability to monitor reactions of the plants in a time resolution high enough to reveal underlying reaction sequences.

Thus interesting relations stay in the dark and cannot be interpreted by scientists. Research in the fascinating world of interactions between animals and plants is usually limited by instrument response times.

THE REAL-TIME MONITORING SOLUTION

Ionic Analytik with its ultra-sensitive online measuring solutions enables research groups all over the world to identify and quantify which reactions happen in nature.

Leaf wounding and the subsequent interactions between animals and plants can be analyzed in real-time without the loss of precious information on the details.

An example is given on the back of this page.

PTR-MS measurement has been used when analyzing VOC emission after leaf cutting. Similar compounds are emitted from different plants: for example "green-leaf volatiles", C6-aldehydes, alcohols, terpenoids and phenolic compounds. See figure 1.

PTR-MS

- > very low detection limit (ppt-range)
- > real time measurement
- > online monitoring
- > no sample preparation

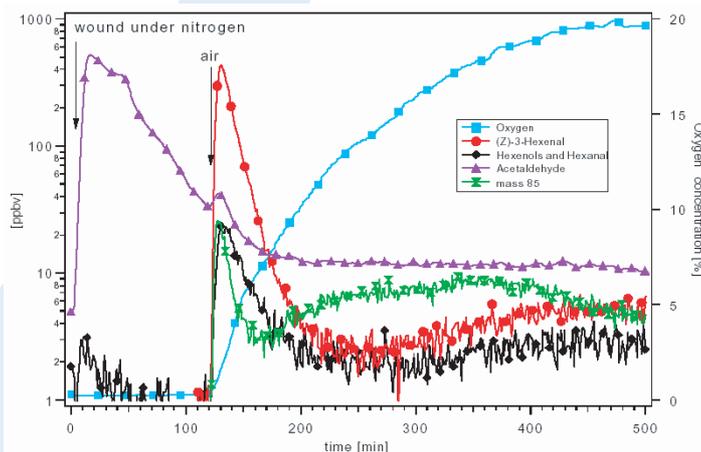


Fig. 1: Leaf wound reactions after cutting. Under nitrogen atmosphere and later when in contact with air.



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REAL-TIME MONITORING OF PLANT DEFENSE REACTIONS WITH PTR-MS

Online measurement of compounds emitted from leaf wounds is a challenge. Especially when the reactions from plants directly after the attack have to be quantified PTR-MS is the only suitable technique.

A very low reaction time combined with a detection limit in the pptv-range allow researchers to trace leaf reactions in real time.

RESULTS

Plants have many enemies in nature and have learned over the time to defend themselves.

Apart from direct defense mechanisms like toxins, digestibility reducers, and other deterrents there exist also indirect mechanisms involving the third trophic level: indicating herbivore attack with release of volatile organic compounds (VOCs).

Scientists* have shown that plants under attack from caterpillars, release volatile organic compounds (VOCs). Volicitin in the saliva of caterpillars induces defense genes leading to the formation of indole and other VOCs which attract wasps. The wasps use the caterpillars in their reproduction cycle and by that, do a favor to the plants. This is systematically shown in figure 2:

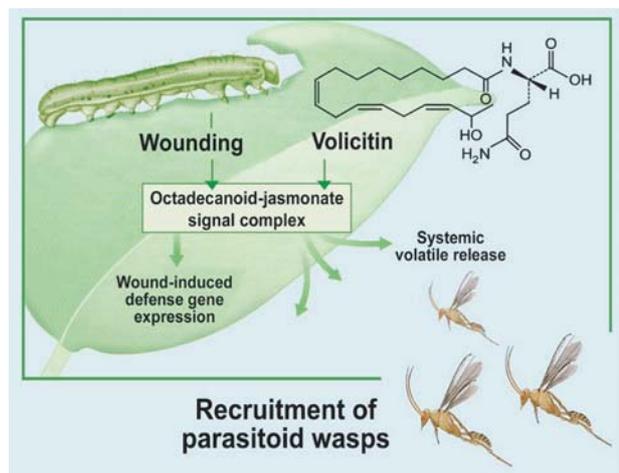


Fig. 2: Schematic drawing of plant defense mechanism.
Source: Alborn et al. (1997). Science 276: 945-949.

When caterpillars feed on maize indole is produced and can be detected online with PTR-MS as is shown in figure 3:

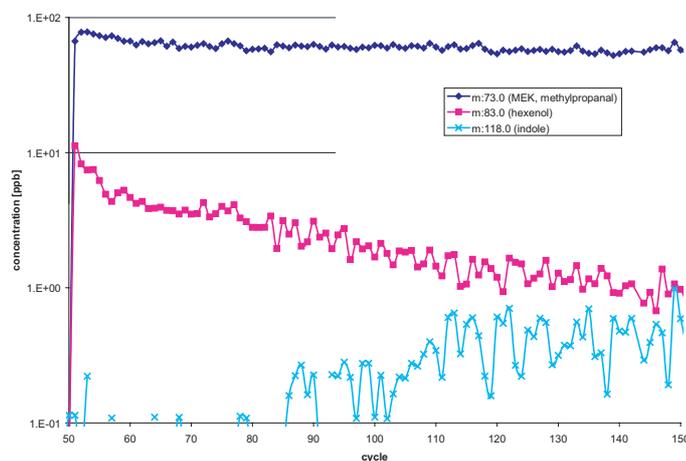


Fig. 3: Plant reactions under attack from caterpillars. Indole (designated by the blue crosses) is released when a leaf wound (as indicated by the primary VOCs, designated by the blue diamonds and the red squares) has contact to caterpillar saliva.



Fig. 4: Wasps are attracted by VOCs, released by plants as a reaction to caterpillar attacks. Picture: Held.

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