Monitoring plant odors in tomato culture for in-situ stress detection
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Plants release a lot of volatile organic compounds (VOCs), which are produced either constitutively or after an induction by external stress factors. These factors could be identified by specific VOC or family of compounds activated and released in response to the stress. This preliminary study suggests that in-vivo monitoring of VOC signatures for crop management seems to be possible and would need to be tested with other genotypes, and portable devices for in-situ stress detection.

Materials and Methods

Plant Material:
- Momor (sensitive to abiotic stress)
- Monalbo (sensitive to biotic stress)

Plant Treatments:
See table 1

VOC stored in leaves:
VOC Extraction was realized with a solution of 10ml of dichlormethane (plus biphenyl as internal standard) in a ultrasonic bath during 10 min. Samples were concentrated with pure nitrogen gas to achieve a volume of 300 μl.

VOC emission capture: Cartridges filled with Tenax TA
- Enclosure device for abiotic stress encompassing one leaflet (fig. 1A)
- Enclosure device for biotic stress encompassing one leaf (fig. 1B)

VOC were analysed with a TD-GCMS Shimadzu QP2010 Splitless, injection in high pressure : 250 KPa for 1m/min Column DB 5 (60m 0.25mm 0.25mm)
Partie GC : 40°C 1 min, 4°C/min between 40 - 170°C, 10°C/min for 170 - 250°C and 250°C 6 min Partie MS: Solvant cut time : 5 min, End time: 47 min, Threshold : 100, carrier gas: helium, 70 eV

Statistical analyses:
T-test of Student was used to compare each treatment to the control

Table 1: Stress conditions applied to the two genotypes

<table>
<thead>
<tr>
<th>Family of stress</th>
<th>Stress</th>
<th>Temperature of measurements</th>
<th>Luminosity in PAR</th>
<th>Stress time exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abiotic</td>
<td>Heat</td>
<td>42°C</td>
<td>300</td>
<td>15 days</td>
</tr>
<tr>
<td></td>
<td>Drought (15 days)</td>
<td>30°C</td>
<td>400</td>
<td>15 days</td>
</tr>
<tr>
<td></td>
<td>Heat oxidative stress</td>
<td>42°C</td>
<td>2200</td>
<td>3h</td>
</tr>
<tr>
<td></td>
<td>After heat oxidative stress</td>
<td>30°C</td>
<td>400</td>
<td>3h</td>
</tr>
<tr>
<td>Biotic</td>
<td>Botrytis cinerea on leaves</td>
<td>30°C</td>
<td>400</td>
<td>5 days</td>
</tr>
<tr>
<td></td>
<td>Botrytis cinerea on leaves</td>
<td>30°C</td>
<td>400</td>
<td>15 days</td>
</tr>
</tbody>
</table>

4a: Comparison of the total foliar VOC emission rate (only monoterpens, products of LOX pathway and apocarotenoids were considered) between control plants of Momor and Monalbo tomato cultivars.

4b: Total VOC emission rates from tomato leaves during various abiotic stress and biotic stresses (stars denote statistical differences between treatments).

Conclusions & Perspectives

We detected quantitative and qualitative differences between the VOC emissions of two tomato genotypes that differ in their sensitivity to environmental stresses (Momor had lower emissions than Monalbo). Some compounds such as (E)-2-heptenal might be used as a potential marker of specific stress while others such as α-terpinene might indicate the global plant health status.

In the case of plants adapted to moderate drought, the detection of stress would require quantitative VOC emission measurements.

Monitoring VOC emissions in tomato culture might be suitable for the in-situ detection of plant health status, but more repetitions with other genotypes are necessary to draw final conclusions.