Uptake and translocation of acibenzolar-S-methyl in tomato plants after soil application

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Introduction
Acibenzolar-S-methyl (ASM) is a plant activator that is used to protect several plant species against a broad spectrum of diseases and pests, including bacteria, fungi, viruses, and nematodes.

In particular, ASM has no antimicrobial activity, but induces host plant resistance by activating the natural systemic acquired resistance (SAR) response found in most plants. ASM is the first synthetic pesticide developed as a SAR activator and can be applied as a foliar spray, seed treatment, root dip, and soil drench treatment.

The major metabolic pathway of ASM in plants and soil involves hydrolysis of the parent molecule to the acidic metabolite CGA 210007 (Fig. 1).⁷

Despite the numerous reports regarding the suppression of plant pathogens and its ability to induce SAR in tomato after foliar application, little information exists in the literature for the persistence and translocation of the parent molecule ASM and its acid derivative CGA 210007 in plant tissues.⁶ Additionally, there are many recently reported studies on the effects of SAR activators, such as ASM, as elicitors of resistance when applied as direct soil treatment. On the other hand, no data are available in literature to assess the root uptake and translocation of ASM in above-ground parts. The aim of this study was to measure the uptake, translocation, and persistence behaviour of ASM residues in tomato plants treated by soil application into the root zone.

Materials and methods
Plant material and experimental design
Tomato seeds, cv. ACE55, were individually sown in 8x8 cm plastic pots containing potting soil, and seedlings were kept at 18-25°C under laboratory conditions and received about 14 h of natural light and 10 h of darkness daily. During the growing period, plants were fertilized with a soluble 20-20-20 (N-P-K) fertilizer (0.4 g per pot) at 10-day intervals. Seedlings were kept at 18-25°C, and irrigated regularly. ASM (Bion 50 WG; Syngenta Crop Protection Inc, Australia) and its acid metabolite CGA 210007 were sprayed onto the above-ground parts of tomato, cv. ACE55, treated by soil drench. Each value is an average of three replicates. Vertical bars represent the standard deviation of the mean.

Results and discussion
The recoveries obtained for ASM and CGA 210007 were 81-96% and 76-82%, respectively, with %RSD values <8% at the 0.05-10.0 μg g⁻¹ fortification levels. Mean residue values of ASM quantified as the parent compound and its major degradation product CGA 210007 in plant tissues were determined by HPLC-diode array detection. The recoveries obtained for ASM and CGA 210007 were 81-96% and 76-82%, respectively, with %RSD values <8% at the 0.05-10.0 μg g⁻¹ fortification levels. Mean residue values of ASM quantified as the parent compound and its major degradation product CGA 210007 in plant tissues were determined by HPLC-diode array detection. The recoveries obtained for ASM and CGA 210007 were 81-96% and 76-82%, respectively, with %RSD values <8% at the 0.05-10.0 μg g⁻¹ fortification levels. Mean residue values of ASM quantified as the parent compound and its major degradation product CGA 210007 in plant tissues were determined by HPLC-diode array detection. The recoveries obtained for ASM and CGA 210007 were 81-96% and 76-82%, respectively, with %RSD values <8% at the 0.05-10.0 μg g⁻¹ fortification levels. Mean residue values of ASM quantified as the parent compound and its major degradation product CGA 210007 in plant tissues were determined by HPLC-diode array detection. The recoveries obtained for ASM and CGA 210007 were 81-96% and 76-82%, respectively, with %RSD values <8% at the 0.05-10.0 μg g⁻¹ fortification levels.

Fig. 1. Chemical structure of acibenzolar-S-methyl (ASM) and its acidic metabolite CGA 210007

Conclusions
Rapid and markedly high the translocation of ASM residues from roots to above-ground parts of tomato
Further studies should be done to correlate the use of ASM as a soil application in controlling foliar diseases

Acknowledgment
The authors wish to thank Syngenta Crop Protection, Inc. for providing Bion 50 WG and the metabolite CGA 210007.

References

Table 1 Operating parameters of the HPLC-UV system

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Autosampler</td>
<td>AS5000</td>
</tr>
<tr>
<td>Detector</td>
<td>UV6000D diode array detector</td>
</tr>
<tr>
<td>Analytical column</td>
<td>Hypersil C18 (4.6 mm x 150 mm, 5 μm), Thermo, USA</td>
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<td>Mobile phase</td>
<td>acetonitrile:water (40:60, v/v) with 0.6 mL L⁻¹ acetic acid</td>
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<td>Flow rate</td>
<td>1 mL min⁻¹</td>
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<td>Column temperature</td>
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<tr>
<td>Injection volume</td>
<td>20 μL</td>
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<tr>
<td>UV detection</td>
<td>254 nm (ASM)</td>
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<tr>
<td>Retention time</td>
<td>11.98 min (ASM)</td>
</tr>
<tr>
<td></td>
<td>2.78 min (CGA 210007)</td>
</tr>
</tbody>
</table>

HPLC analysis
Instrumental analysis was performed using a SpectroSYSTEM (Thermo Separation Products, Austin, TX, USA) HPLC system. The operating parameters of the HPLC-UV system are summarized in Table 1.