The Effect of Fungicides, Essential Oils, and Heated Solutions on Citrus Black Spot Lesion Development After Harvest

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Overall Objective
- Identify an effective method(s) to control or limit citrus black spot (CBS) development after harvest.

Objectives
- Postharvest hot water dipping to control citrus black spot (CBS) on “Valencia” orange fruit.
- Postharvest (heated) fungicide treatment to control citrus black spot (CBS) on “Valencia” orange fruit.
- Postharvest essential oil treatment (dipping or waxing) to control citrus black spot (CBS) on “Valencia” orange fruit.

Hot water to inhibit mycelium growth

Effects of hot water on mycelium growth of three isolates:

- GC1
- PPST
- CNGC

Hot water dipping on CBS development

Effects of hot water dipping on lesion development on asymptomatic fruit:

- Dry Control
- 25°C/2min
- 56°C/2min
- 59°C/1min
- 62°C/30S

New lesions per fruit

Treatments

ab

a

b

ab

ab
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Essential oils to inhibit mycelium growth

Isolates

<table>
<thead>
<tr>
<th>Isolates</th>
<th>CNGC</th>
<th>PPST</th>
<th>GC1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carvacrol</td>
<td>0.0594 ± 0.0089</td>
<td>0.0499 ± 0.0052</td>
<td>0.0689 ± 0.0007</td>
</tr>
<tr>
<td>Thymol</td>
<td>0.0689 ± 0.0024</td>
<td>0.0499 ± 0.0001</td>
<td>0.0663 ± 0.0014</td>
</tr>
<tr>
<td>Combination (1:1)</td>
<td>0.0677 ± 0.0024</td>
<td>0.0499 ± 0.0004</td>
<td>0.0694 ± 0.0015</td>
</tr>
</tbody>
</table>

Effective concentration of thymol and carvacrol to inhibit mycelium growth by 50% (EC50) of three isolates.

Effective oil solution dip on CBS development

- Thymol, carvacrol, and the combination (1:1) at 2 mg/ml resulted in phytotoxic peel injury, with the most severe damage caused by thymol which also caused peel injury at 1 mg/ml.

Fungicide treatment on CBS development

Effects of fungicides on lesion development on asymptomatic fruit.

<table>
<thead>
<tr>
<th>Fungicide</th>
<th>Water</th>
<th>Kyphos</th>
<th>Iru</th>
<th>Pyr</th>
<th>Azo</th>
<th>IMZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesions per fruit</td>
<td>0.00</td>
<td>0.25</td>
<td>0.50</td>
<td>0.75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>Funigicides on CBS development at 25 °C</th>
<th>Funigicides on CBS development at 16 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.00</td>
<td>0.25</td>
</tr>
<tr>
<td>Treat</td>
<td>0.50</td>
<td>1.00</td>
</tr>
</tbody>
</table>

- Thymol, carvacrol, and the combination (1:1) reduced the number of lesions formed on fruit, but not in a concentration-dependent manner. 0.5 mg/ml was the most effective concentration (p<0.05).
Essential oil solution dip on CBS development

Effects of thymol and carvacrol dip on CBS lesion development on symptomatic fruit.

- None of the treatments significantly inhibited lesion development on fruit that were symptomatic prior to treatment.

Essential oil mixed in wax on CBS development

Effects of thymol and carvacrol mixed in wax on lesion development on asymptomatic fruit.

- On fruit that were asymptomatic before treatment, coating with shellac containing 5 mg/ml of thymol, carvacrol, and the combination (1:1) reduced the number of lesions formed on fruit significantly (p<0.05).

Essential oil mixed in wax on CBS development

Fig 14. Effects of thymol and carvacrol mixed in wax on lesion development on symptomatic fruit.

- None of the treatments significantly inhibited lesion development on fruit that were symptomatic prior to treatment.

Thank you!

Question?