Citrus Black Spot and its management in Brazil

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First occurrence in São Paulo 1992

Citrus spp.: Lemons, Sweet oranges, Mandarin & Tangerines, Tangors, Hybrids

Never found in Persian (Tahiti) lime

Resistant Genotypes:
- Chinotto mandarin (C.myrtifolia)
- Poncirus trifoliata
- Kumquat (Fortunella spp.)
- Severinia buxifolia

(Aguilar-Vildoso et al., 2002)

Reduction of fruit value in the fresh fruit market

Florida: “CBS causes early fruit drop, reduces crop yield and renders the highly blemished fruit unmarketable” (USDA, 2010).

Importance

To restrict exportation of fresh fruits (mostly to European countries)

Citrus Black Spot

CEAGESP, June 2010
Brazilian Citrus Industry

Production Destination (%)

- Processing: 65.9%
- Brazilian Fresh Fruit Market: 33.5%
- Fresh Fruit Exportation: 0.6%

Source: Abecitrus, 2006.

Brazilian Exportation of Citrus Fresh Fruits

Sweet Oranges

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ton</td>
<td>50,118.7</td>
<td>20,652.1</td>
<td>50,140.5</td>
<td>49,748.7</td>
<td>36,257.2</td>
<td>26,185.2</td>
</tr>
</tbody>
</table>

Source: SECEX / DATAFRUTA / IBRAF

Brazilian Exportation of Citrus Fresh Fruits

Mandarins

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ton</td>
<td>18,014.1</td>
<td>12,474.8</td>
<td>10,713.1</td>
<td>6,227.7</td>
<td>6,761.1</td>
<td>4,411.9</td>
</tr>
</tbody>
</table>

Source: SECEX / DATAFRUTA / IBRAF

Brazilian Exportation of Citrus Fresh Fruits

Tahiti Lime

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ton</td>
<td>37,326.2</td>
<td>44,758.2</td>
<td>51,480.7</td>
<td>58,209.1</td>
<td>60,335.4</td>
<td>66,374.1</td>
</tr>
</tbody>
</table>

Source: SECEX / DATAFRUTA / IBRAF

Citrus Black Spot

(Guignardia citricarpa)

Importance

Premature fruit drop reducing yield

8/27/2010
**Citrus Black Spot Control**
Valencia sweet orange – Mogi Guaçu, 2001/02

**FRUIT DROP**

<table>
<thead>
<tr>
<th></th>
<th>1st Spray</th>
<th>2nd Spray</th>
<th>3rd Spray</th>
<th>4th Spray</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benomyl</td>
<td>17.3**</td>
<td>20.4a</td>
<td>33.5b</td>
<td></td>
</tr>
<tr>
<td>Pyraclostrobin</td>
<td>20.4a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trifluroxime</td>
<td>21.0a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>30.7b</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Values followed by same letter do not differ significantly (Duncan, P ≤ 0.05).**

**Fruit Drop**
20 4
23.0 a
63.7b

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**Importance of fruits and dead branches**

![Diagram showing the importance of fruits and dead branches as a source of inoculum.]

**Importance of leaves, fruits and branches as source of inoculum**

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**Citrus Black Spot Management**

**Preventive Measures**
- Regulatory measures
- Use of clean propagative materials
- Control led traffic of people, vehicles and equipments

**Citrus Black Spot Disease Cycle**

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**Citrus Black Spot Management**

**Preharvest Measures**

**Postharvest Measures**
Regulatory Measures

Interstate trade of fresh fruits with leaves is forbidden in Brazil.

Export of Citrus Fresh Fruits to European Countries

Requirements

1. Registration of Orchards plots (up to 3 months before harvesting)
2. Registration of Packinghouses (January 1st. to April 30th)
3. Field inspection for CBS detection (State Regulatory Office inspectors)
4. Fruit Sampling for Lab Test to accelerate fruit symptom development (Sampling date must be informed to the State Regulatory Office at least 7 days in advance)

Sampling fruits for the Lab Test to accelerate CBS symptom development.

- at least 30 days before harvesting
- in declining trees
- in the lower canopy
- in the face of the tree most exposed to sunlight
- mature fruits or fruits that have reached final size
- in 1% of the trees (samples must have at least 20 fruits)

Citrus Black Spot

( Guignardia citricarpa )

Test to accelerate fruit symptom development

- Deep fruits in ethephon solution (750 ppm) for 5 minutes
- Incubation of fruits at temperatures ≥ 25°C, under continuous light, during 28 days
- Microscopic and visual observations of fruits for CBS symptoms
**Citrus Black Spot**  
*Guignardia citricarpa*

### Symptoms in Fruits Treated with Ethephon
- Freckle spot
- Virulent spot

**Test to accelerate fruit symptoms development**
- Deep fruits in ethephon solution (750 ppm) for 5 minutes;
- Incubation treated fruits at temperatures ≥ 25°C, under continuous light, during 28 days;
- Microscopic and visual observations of fruits for CBS symptoms;
- Diagnosis confirmation by isolating *Guignardia citricarpa*;

### Export of Citrus Fresh Fruits to European Countries
#### Requirements
- 5. Preharvest field inspection for CBS detection (State Regulatory Office inspectors);
- 6. Packinghouse inspection during processing and packing (Regulatory Federal Office inspectors);

### Citrus Black Spot
#### Preventive Measures
- Healthy nursery trees:

### Production of nursery trees free of *G. citricarpa*
- Optimal conditions for infection: temperature: 21 – 32°C, wetting period: 24-48h
**Production of nursery trees free of**

*G. citricarpa*

- **Healthy nursery trees:**
  - Controlled traffic of vehicles

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**Citrus Black Spot Management**

**Cultural Practices**

- Removal of fallen leaves from the orchard floor
Citrus Black Spot Management

Cultural Practices

Use of mulching over leaf litter;

Horticultural Practices for Citrus Health

- Weed Control

Source: Bellotte, J.A.M. 2006

Forage interplanting for mulching production

Interplanting with Coastalcross grass (Cynodon dactylon cv. coastcross) or Peanut

Source: F.A. Azevedo
# Citrus Black Spot Management

## Forage interplanting for mulching production

**Comparison of Moving Machines**

- **Conventional Mowing Machine**
- **"Ecological" Mowing Machine**

*Source: F.A. Azevedo*

Reduction of disease severity by 23% to 46%-

## Cultural Practices

- **Pruning and removal of dead branches**

*NOZAKI (2007) – Positive correlation between dead branches and CBS severity (false melanose type symptom)*

- **Irrigation management**

*Plasmodiophoraceae production favored by alternating leaf wetting and leaf dryness.*

## Horticultural Practices for Citrus Health

- **IRRIGATION**

  - to provide uniform and regular blossoming;
  - to reduce water stress
  - to reduce leaf fall during autumn and winter
### Citrus Black Spot Management

#### Cultural Practices

- Earlier harvesting.

#### Chemical Management

**COPPER FUNGICIDES**

<table>
<thead>
<tr>
<th>Copper Form</th>
<th>Rate (g metallic Cu/100L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper acetate</td>
<td>90 - 100</td>
</tr>
<tr>
<td>Copper hydroxide</td>
<td>90</td>
</tr>
<tr>
<td>Cuprous oxide</td>
<td>75</td>
</tr>
<tr>
<td>Copper oxychloride</td>
<td>90</td>
</tr>
</tbody>
</table>

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*In October of each year.*

**Number of pseudothecia of Guignardia citricarpa in the orchard floor (0.25 m²), below the canopy of the trees.**

Citrus Black Spot
Chemical Management

**Dithio-carbamates**

<table>
<thead>
<tr>
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<th>Rate (g a.i./100L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mancozeb</td>
<td>110 – 160</td>
</tr>
<tr>
<td>Propineb</td>
<td>70</td>
</tr>
</tbody>
</table>

**BENZIMIDAZOLES**

<table>
<thead>
<tr>
<th></th>
<th>RATE (g a.i./100L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benomyl</td>
<td>25</td>
</tr>
<tr>
<td>Carbendazin</td>
<td>25</td>
</tr>
<tr>
<td>Thiophanate-methyl</td>
<td>37.5</td>
</tr>
</tbody>
</table>

**STROBILURINS**

<table>
<thead>
<tr>
<th>FUNGICIDES</th>
<th>Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(g a.i./L)</td>
</tr>
<tr>
<td>Azoxystrobin</td>
<td>4 – 8</td>
</tr>
<tr>
<td>Pyraclostrobin</td>
<td>3.75</td>
</tr>
<tr>
<td>Trifloxystrobin</td>
<td>3.75</td>
</tr>
</tbody>
</table>

(*) Rates recommended by the Citrus Integrated Production Committee.

CITRUS BLACK SPOT CONTROL
Fungicide Sprays at Low and High Volume
Field Trials

► Rio Claro, 2003/04
► Rio Claro, 2004/05
► Mogi Guçu: 2007/08 e 2008/09

Thank you