Greening Disease Management in Brazil

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~ 85% SP
BA
SE
PR
RS

Pictures: Agropratinha
What is going on?

Orange at Processing plant gate (Sep. 10, 2010):

Araraquara: R$ 15,14 ( US$ 8.20 ) / 90 lb Box

Bebedouro: R$ 15,00 ( US$ 8.10 ) / 90 lb Box

Source: Cepea/Esalq/USP (citroscepea@esalq.usp.br )
Citrus production...

Source: FAO Statistics Division, 14 July 2010 (* 2009 = preliminary)
Citrus production...

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Citrus production...

source: FAO Statistics Division, 14 July 2010 ( * 2009 = preliminary)
That imposes small genetic variability:
(example in Brazil)

**Citrus sinensis** L. Osbeck (~ 90 %)

<table>
<thead>
<tr>
<th>Scion</th>
<th>Hamlin</th>
<th>Pera</th>
<th>Valência</th>
<th>Natal</th>
<th>Others</th>
</tr>
</thead>
</table>

<table>
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<tr>
<th>Rootstock</th>
<th>Rangpur lime</th>
<th>Others</th>
</tr>
</thead>
</table>

**Citrus limonia** Osbeck (~ 95 %)

Fotos: E.F.Carlos
Biotic stresses in Brazil

Pictures: Fundecitrus, E.F.Carlos, outros
HLB in SP
March of 2004
CCSM and Fundecitrus

Araraquara

Fotos: E.F.Carlos, 08 Jul 2005

Texeira et al (Plant Disease, v.89: 107, 2005)
Colleta-Filho et al (Plant Disease, v.89: 848, 2005)
2004
Araraquara
March of 2004
CCSM and Fundecitrus

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Fotos: E.F.Carlos, 08 Jul 2005
6 months later (Jan 8, 2006):

And more:
- Characterization of symptoms
- Real Time PCR
- Distribution in the tree
- Training scouts

Confirmed by PCR
Normative Law number 10, March 18th 2005, “Greening Task Force”:

1) Inspection
2) Tagging trees
3) Help
4) Corrections

CDA
Sampling

analysis, diagnosis, official reports

Grower

Sep. of 2006: new law, farmers need to do the inspection
2008: new law again, removal of affected blocks
Levantamento amostral

<table>
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<tr>
<th>Blocks with &gt;= 1 + tree</th>
<th>2008</th>
<th>April 2009</th>
<th>Aug 2010 (07Sep.2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18.6%</td>
<td>24.0%</td>
<td>38.9%</td>
</tr>
<tr>
<td>Trees with HLB</td>
<td>0.58%</td>
<td>0.87%</td>
<td>1.87%</td>
</tr>
</tbody>
</table>

Obs. just to compare: ~ 50 % of the trees with CVC

Source: C.Massari et al (Fundecitrus), and prof. J.C.Barbosa (Unesp)
Incidence of HLB in São Paulo (and MG)

State wide survey
% Blocks with >= 1 + tree :

2009 Average = 24.0%
2010 Average = 38.9%

Source: C. Massari et al (Fundecitrus), and prof. J.C. Barbosa (Unesp)
So, what are growers normally doing now?

A) With low HLB intensity:
- following the law (inspection + eradication)
  - + vector control

B) With high HLB intensity:
- many are not following the law
  - + vector control
  - attempting nutritional programs, etc
HLB effect (“guesstimated”)

- Losses caused by HLB in São Paulo
  - Officially: 511,627 (Sep 5th, 2008)
  - Volunteered: ~ 6 million trees removed (?)
  - If so, total: ~ 6.5 million trees lost
  - Infected but symptomless yet?

- What is the impact?
  - Actual citrus belt with ~ 200 million trees
  - So, ~ 3.25 % lost in 5 years (+ the asymptomatic trees)
  - Regular grove renew from 6 to 10% per year
  - New citrus area in the Southwestern SP and Northern Paraná

- So, regular losses so far, but tremendous risk !!!
Citrus industry in Paraná (~ 30,000 ha)
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Picture: Cocamar

Paranavaí
Citrus industry in Paraná (~ 30,000 ha)

Pictures: E.F.Carlos, P. Emerson, I. Lopes
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HLB in Paraná

54 counties with HLB (Croce-Filho et al, SEAB/DEFIS/DDSV, 2010), but things are different in Paraná...

- very low intensity (so far !)
- 90 % of growers are integrated in some organization (cooperatives, companies, grower association, etc)
- more political power in agriculture
- coordinated inspection and management (eradication)
- properties normally don’t have citrus neighbors
- psyllids are not easily seen
Cooperatives are experienced organization on other commodities…

Some managers and directors:

Strong holds also with official institutions:

Universities

Foto: E.F.Carlos, Jul 2009
Research work on HLB

Need alternatives to grow citrus

- New managements and treatments
  - Early productive groves
  - New scions, roostocks, …
  - High density, nutrition, precision agriculture, and more…

- Evaluating germplasm collection
  - Is all really susceptible?

- Building artificial resistance
  - Genetic engineering and biotechnology
How is our Lab. of Biotechnology “managing” HLB?
Importing germplasm: ~ 400 genotypes for future tests
Creating transgenics on mature tissues, pioneer work done by prof. L. Vieira et al, IAPAR:

Pictures: L. Vieira and his students

After 1 year
Strategies and actual status
(Vieira’s group)

1) Valencia against citrus canker (Vieira and group, 1999-2001)
   • Lytic peptides / attacks bacterial membrane
   • being tested against canker and HLB now

picture: E.F.Carlos
Strategies and actual status  
(Vieira’s group)

1) Valencia against citrus canker (Vieira and group, 1999-2001)

2) Drought resistant Swingle and Carrizo rootstocks
   • Other rootstocks also: Trifoliata, Flying Dragon, …

Campos et al, 2009

Also less vigour, so potential for high density plantings
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1) Valencia against citrus canker (Vieira and group, 1999-2001)
2) Drought resistant Swingle and Carrizo
3) More strategies against HLB
   • Blocking “communication” between bacterial cells
   • Being tested against HLB (no results yet)

picture: E.F.Carlos
Strategies and actual status
(Vieira’s group)

1) Valencia against citrus canker (Vieira and group, 1999-2001)
2) Drought resistant Swingle and Carrizo
3) More strategies against HLB
   • Orange trees more responsive to HLB (no results yet, but eventually more susceptible…)
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1) Valencia against citrus canker (Vieira and group, 1999-2001)
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3) More strategies against HLB
   • RNA interference against HLB and psyllid vector (under construction …)
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1) Valencia against citrus canker (Vieira and group, 1999-2001)
2) Drought resistant Swingle and Carrizo
3) More strategies against HLB
4) Canopies with higher TSS (total soluble solids)
   • More efficient nutrient uptake
   • Osmotic protection
   (no results yet)
Proposal for the 13th International Citrus Congress

Londrina, 2016
Muito obrigado !!!

specially to Conference organization,
Renée G. Schneider, Michelle D. Danyluk, Tim M. Spann, and others

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http://www.iapar.br/