

# Meeting the Challenge of the Asian Citrus Psyllid in California Nurseries

*A two-day workshop in Riverside, California*

**June 11-12, 2009**



Florida-Foundation Block



Brazil-Citrus Nursery



M. Rogers

## Organizing Committee:

- T. Delfino**-California Citrus Nursery Society  
**A. Eskalen**-Dept. of Plant Pathology & Microbiology, University of California Riverside  
**R. Lee**-USDA- ARS, National Clonal Germplasm Repository for Citrus and Dates  
**G. Vidalakis**-Citrus Clonal Protection Program, Dept. of Plant Pathology & Microbiology, University of California Riverside



## Invited Speakers:

- J. Ayres**-Fundecitrus, Brazil  
**J. Bethke**-UC, CA  
**G. Baze**-Golden Pacific Structures, CA  
**T. Delfino**-CCNS, CA  
**F. Dixon**-Wells Fargo, CA  
**D. Elder**-American Ag Credit, CA  
**T. Gast**-Southern Gardens Citrus, FL  
**P. Gomes**-CHRP, USDA -APHIS, NC  
**E. Grafton-Cardwell**-UCR, CA  
**D. Howard**-AgraTech, CA  
**N. Jameson**-Brite Leaf Nursery, FL  
**R. Keijzer**-KUBO, The Netherlands  
**P. Llatser**-AVASA, Spain  
**S. McCarthy**-CDFA, CA  
**G. Vidalakis**-UCR-CCPP, CA

Registration: <http://ccpp.ucr.edu> & <http://eskalenlab.ucr.edu>

## Location:

Sunkist Center  
Citrus State Historical Park  
9400 Dufferin Avenue  
(Corner of Van Buren Blvd)  
Riverside, California

## Sponsored by:



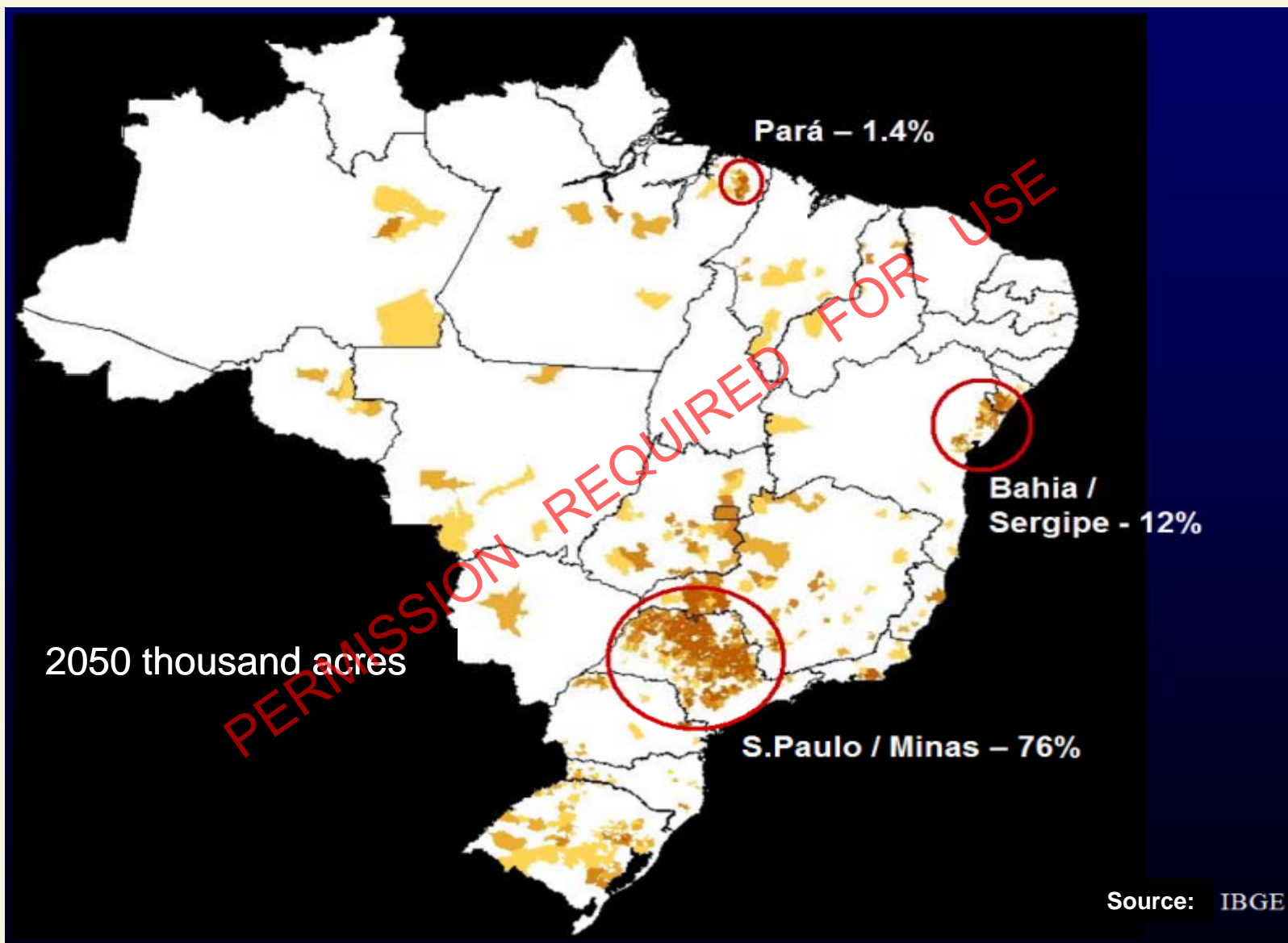
Information on line at: <http://eskalenlab.ucr.edu>



# "The Sao Paulo State Citrus Nursey Experience"

*Antonio Juliano Ayres*  
*Fundecitrus*

## Brazil - Orange production area







## Citriculture in São Paulo State

- 350 millions of orange boxes (2008)
- 1.65 million of acres (orange 95%)
- Average productivity: 22 ton/ha
- 85% groves without irrigation
- 50 % of the orange juice market
- 400,000 direct jobs
- Challenge: HLB





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# Important diseases - The Beginning



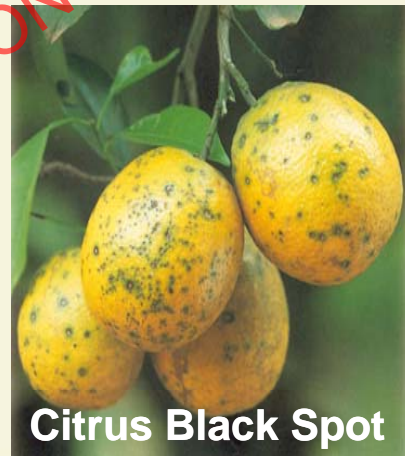
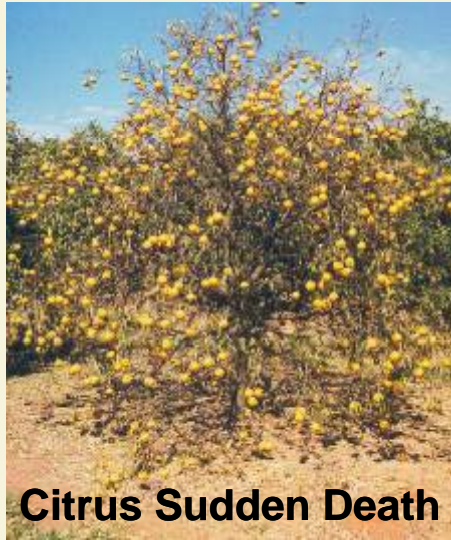
**TRISTEZA**



**GUMMOSIS**



# Main Challenges - Today





# Citrus Leprosis Virus

- Important problem in the 70's and 80's;
- Transmission by mite (*Brevipalpus phoenis*);



## Strategies of Control:

- Monitoring the mite;
- Spray with miticide;
- Pruning of symptomatic branches.



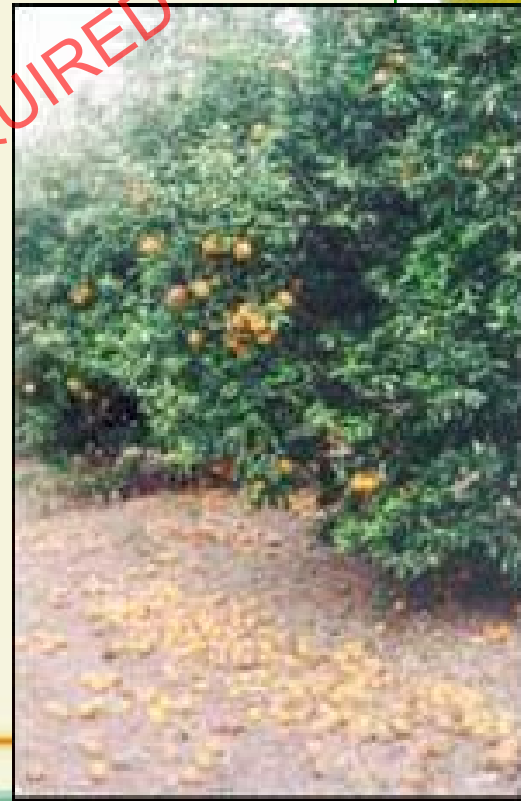
# Black Spot

- Causal agent: *Guinardia citricarpa* (fungi);
- Detection in São Paulo in 1992;
- Importance: fruit drop.




## Management:

- Spray with fungicide (2 – 4 times/year);
- Health citrus material (screenhouse nurseries).



# Citrus Canker

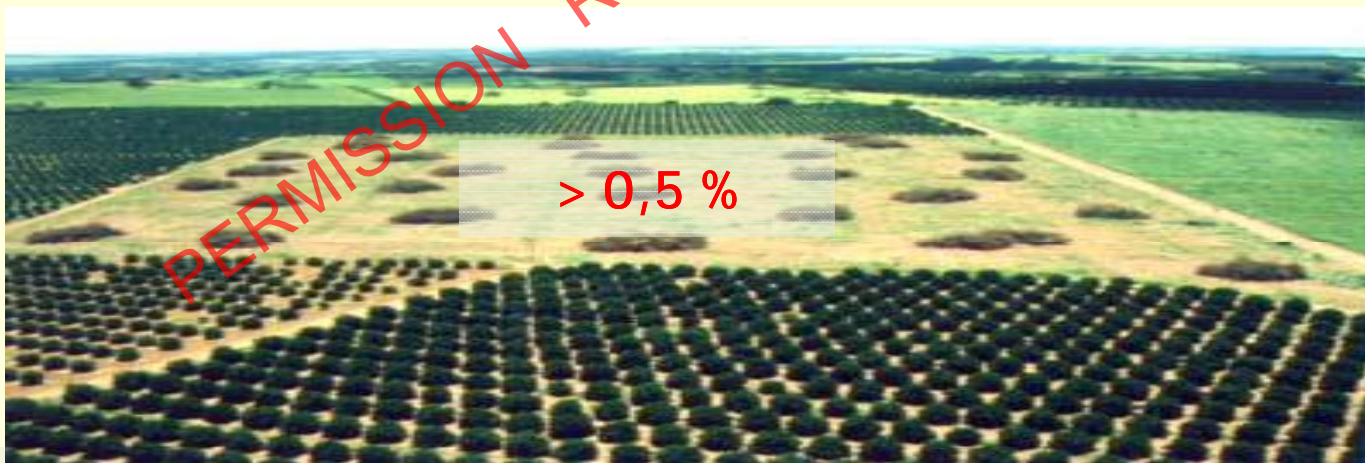
- Causal agent: *Xanthomonas axonopodis* pv. citri;
- Eradication Program since 1957;
- After introduction of citrus leaf miner in 1996 there was a change in the epidemiology of the disease;
-  Strategies of Control:
- Change in the law: more inspections and stronger eradication procedures;
- Fundecitrus: 1500-4000 inspectors;
- Screenhouse nurseries.





# Citrus Canker

## Law





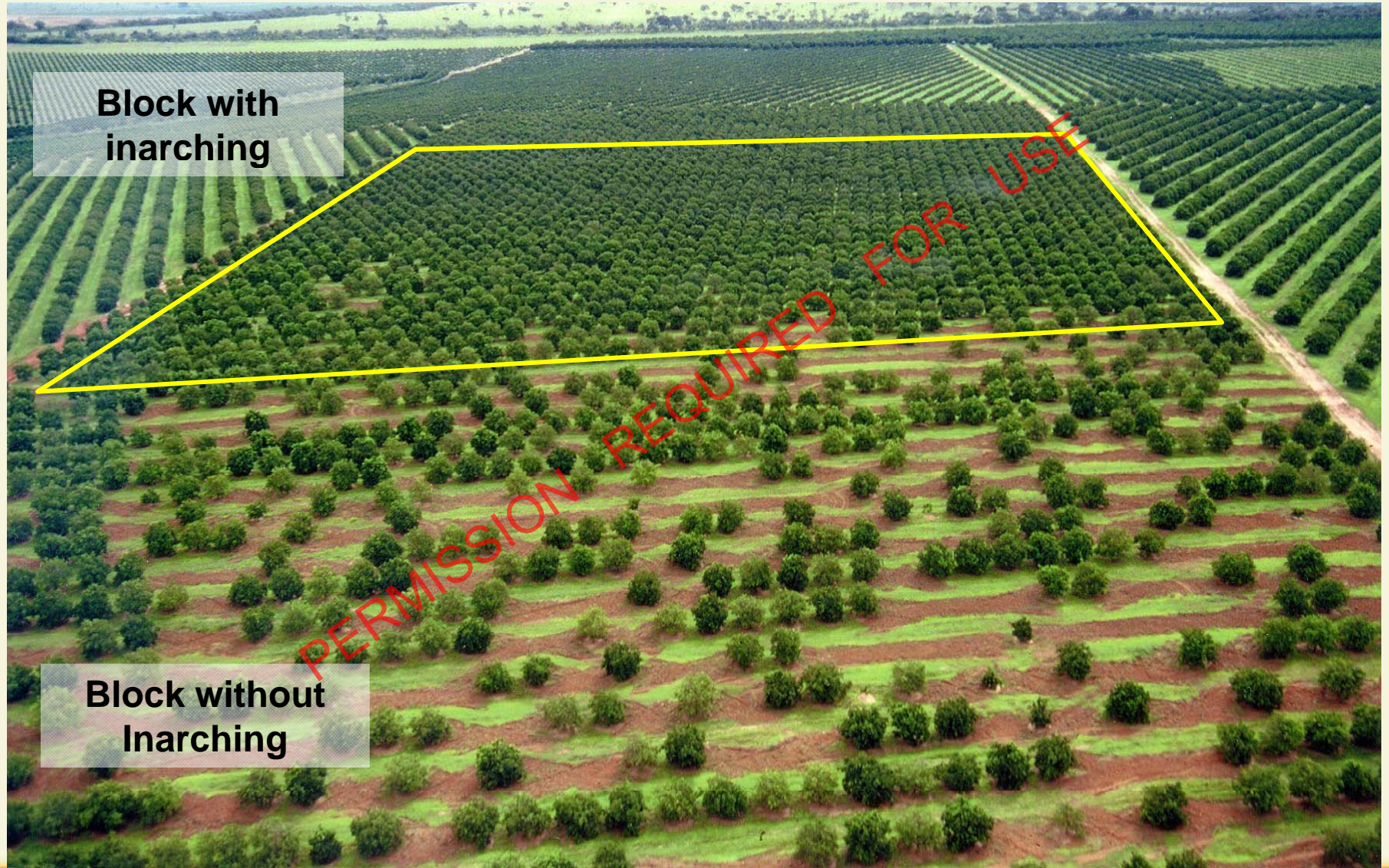
# Citrus Sudden Death (CSD)

- **Detection in 2001: new disease (similar to quick decline);**
- **Susceptible rootstock: Rangpur, Volkameriano and rough lemon;**
- **Causal agent: virus;**
- **Vector: probably aphids;**
- **Disease is restricted to the North of São Paulo and South of Minas Gerais State.**





# Inarching effect





# Citrus Variegated Chlorosis (CVC)

- **Causal Agent:** *Xylella fastidiosa*;
  - **Transmission:** sharpshooter and contaminated buds;
  - **Importance:** new disease, productivity reduction, etc.
  - **CVC intensity in 2005:** 43%
- ➔ **Solution - Development of management practices:**
- **Health nurseries trees (screenhouse nurseries);**
  - **Vector control;**
  - **Pruning/removal of symptomatic trees.**



# CVC – Symptoms and Damages



*Xylella fastidiosa*

70% weight reduction





# 1. Inspection and elimination of symptomatic trees



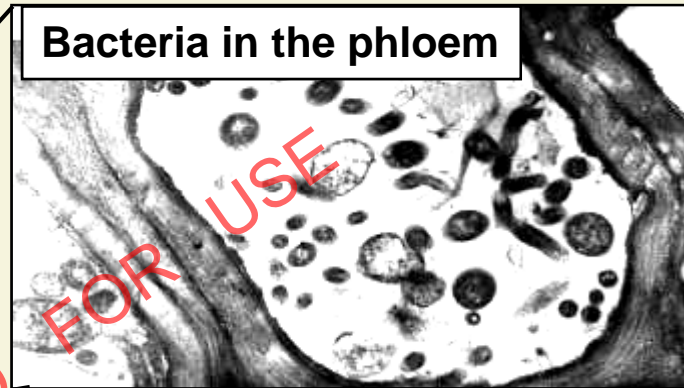
## 2. Chemical control of sharpshooters



## 3. Healthy young plant



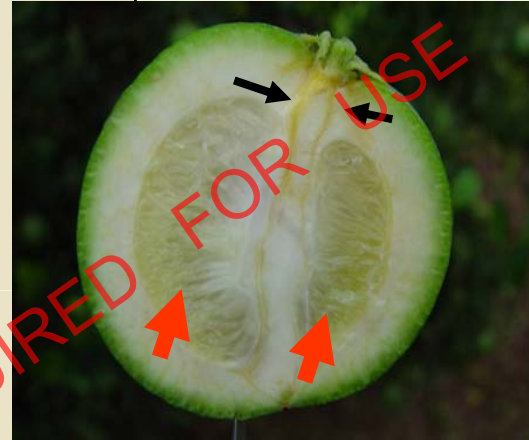
# Huanglongbing - Destructive disease



Transmitted by insect and grafting

# Huanglongbing (HLB): Main Challenge

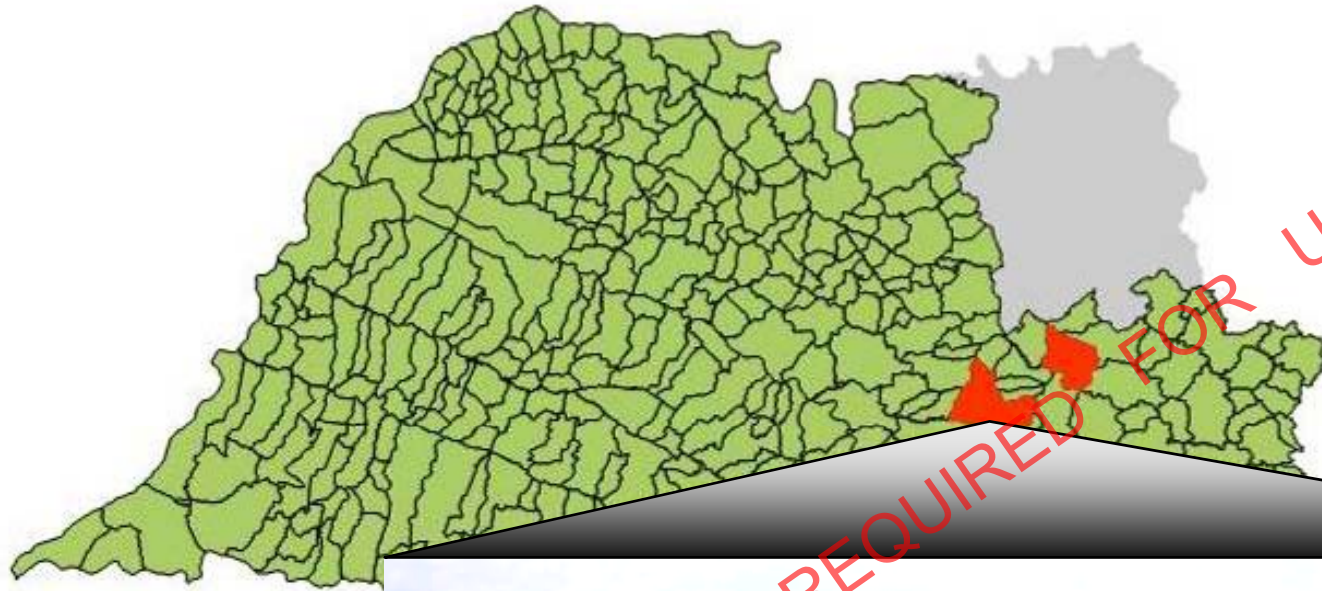
- Presence of *Diaphorina citri* since 1942;
- Detection of HLB: March, 2004;
- Bacteria:  
*Candidatus Liberibacter asiaticus*  
*Candidatus Liberibacter americanus*





# HLB Affected Municipalities in São Paulo State

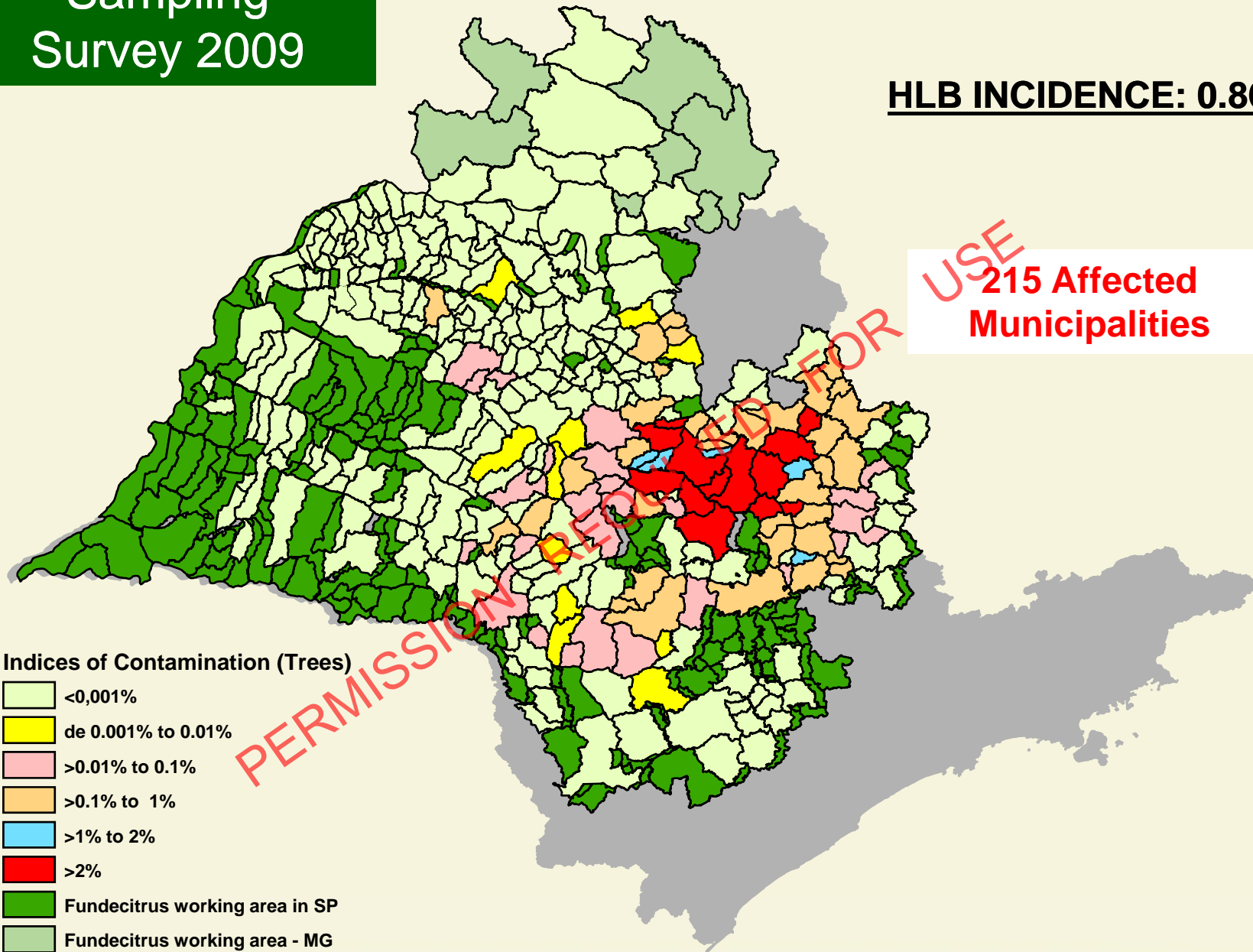
March, 2004



Source: Fundecitrus

# Sampling Survey 2009

**HLB INCIDENCE: 0.86%**

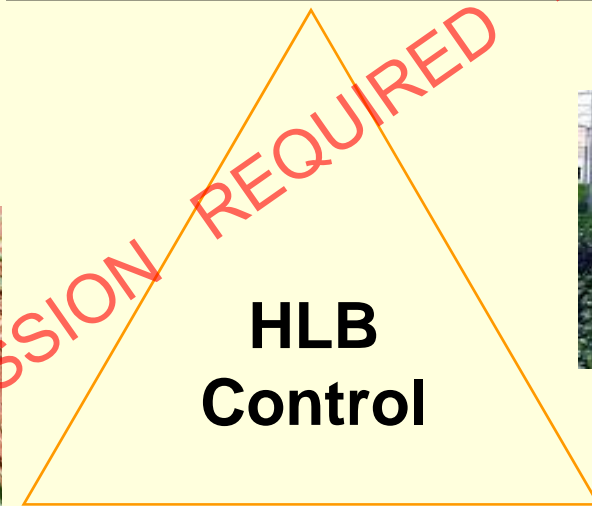




# 1. Inspection and elimination of symptomatic trees



## 2. Chemical control of psyllids



## 3. Healthy young plant





# Citrus Nursery Program in São Paulo State

- **Voluntary Field Nursery Program**
- **Mandatory Screenhouse Nursery Program**

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# Citrus Nursery Program in São Paulo State

- Field Nursery Program (until 1998):

- About 1000 nurseries (10 to 20 million trees/year);
- Most of the field nurseries were closed to the groves;
- Risk of contamination of diseases as *Phytophythora*, nematode, citrus canker and CVC.

**Important:**



The risk of CVC in the nurseries was the main point to have a “mandatory screenhouse nursery program” !!!





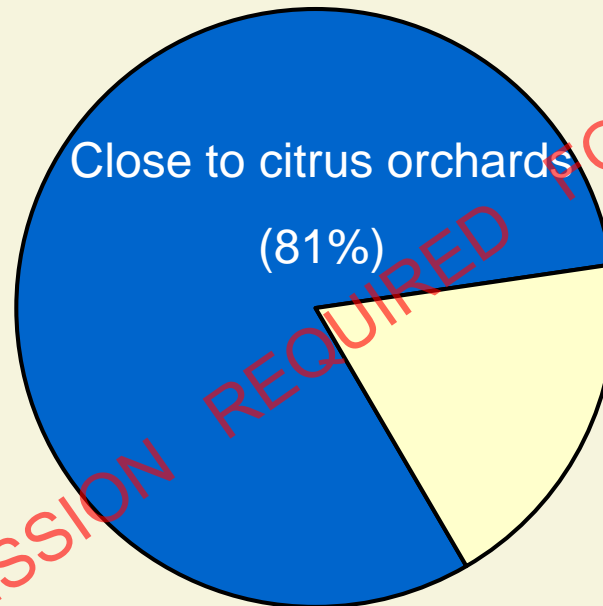
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# Citrus Nurseries in São Paulo, Brazil

## LOCATION



Far from citrus orchards  
(19%)

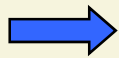




# Phytophthora Risk in Field Nursery

## A) Phytophthora (Gomosis):

High incidence in the nurseries. WHY?

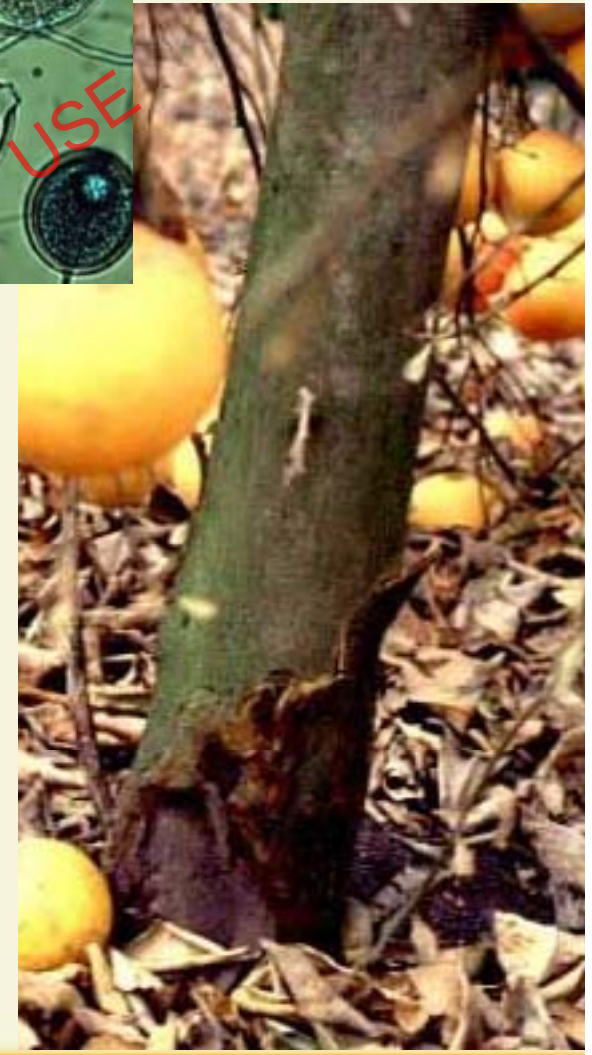


- Small distance from groves;
- Contamination of soil, water and seedlings;
- Intensity of Rain (1200 – 1500 mm/year);
- Production of nursery in the same area;
- Susceptible rootstock: Rangpur, Cleopatra and Sunki;
- Overhead irrigation

Important:



Same risk in relation to nematodes!!!













## Phytophthora Symptoms



# Citrus Canker Risk in Field Nursery

Some cases of canker in the nurseries  
(“Nursery eradication by law”).

WHY?

- Small distance of groves (risk of disease spread by wind and personnel);
- Presence of citrus leaf miner in the nurseries;
- Environment condition (intensity of rain, overhead irrigation etc).





# CVC Risk in Field Nursery

## C) Citrus Variegated Chlorosis (CVC):

- A lot of groves affected by CVC were close to nurseries;
- It was almost impossible to control sharpshooters in the nurseries;
- High risk to contaminate nurseries trees.

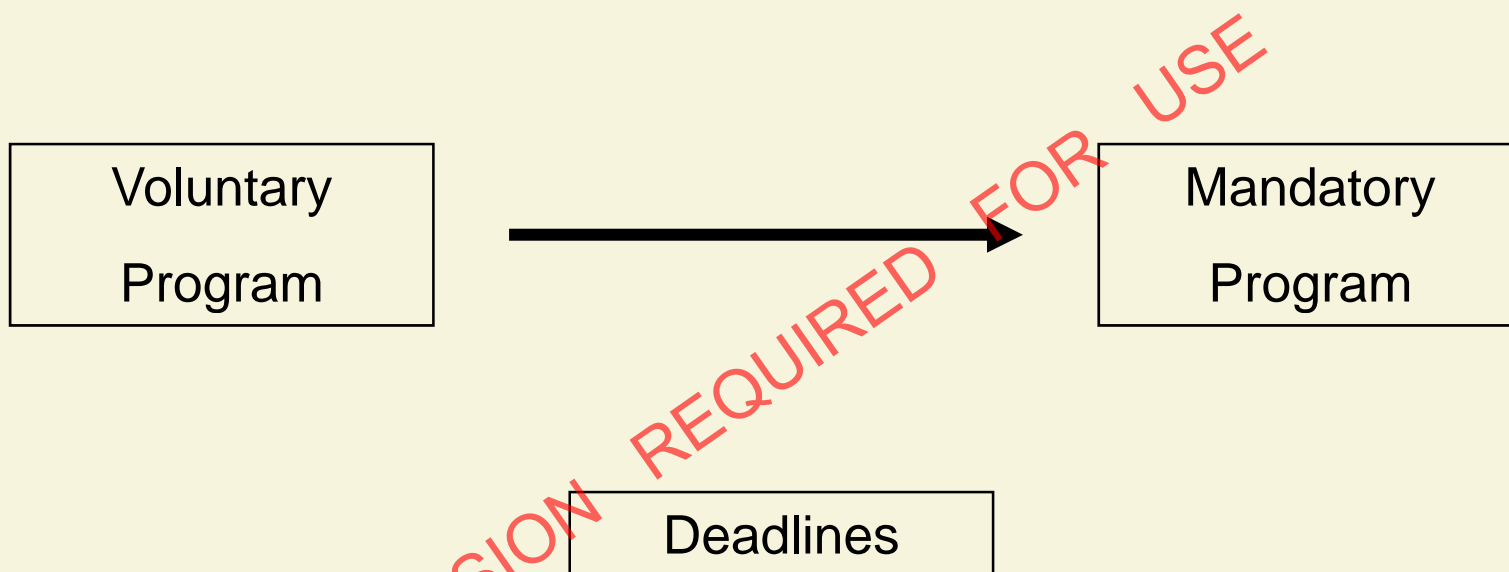
# Presence of the Sharpshooters that are vectors of CVC in the field nurseries



FUNDECITRUS SURVEY



# Citrus Nursery Tree Certification Program in the State of São Paulo



## Requirement

## Deadline for Fulfillment

Production of seedlings in screenhouse

July, 2000

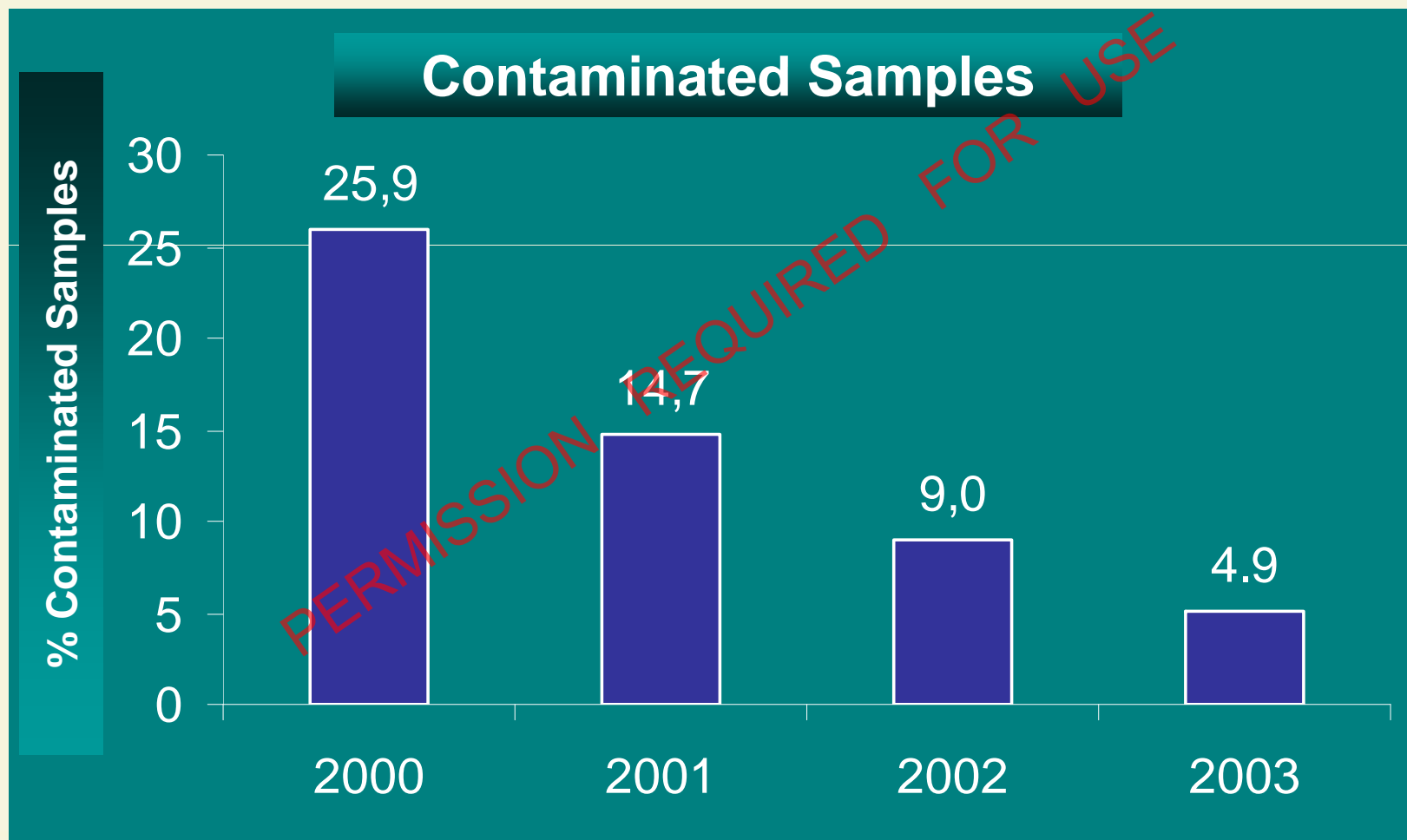
Production of nursery trees in screenhouse

January, 2001

Commercialization restricted only to nursery trees produced in screenhouse

January, 2003

# Detection of *Phytophthora* in Screenhouse Nurseries



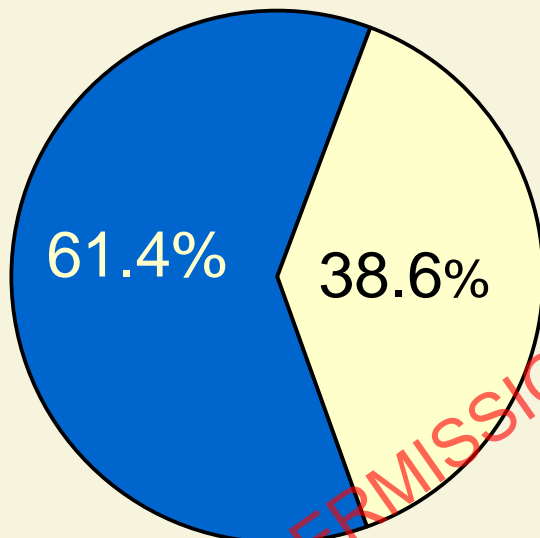


# Citrus Nurseries in São Paulo

NEMATODE SURVEY

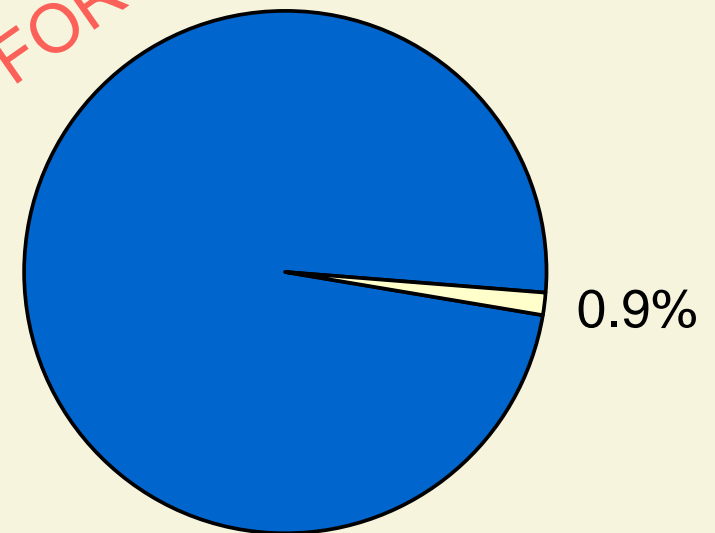
April to May, 2000

Field nurseries





1,334 samples from 300 nurseries

Screenhouses



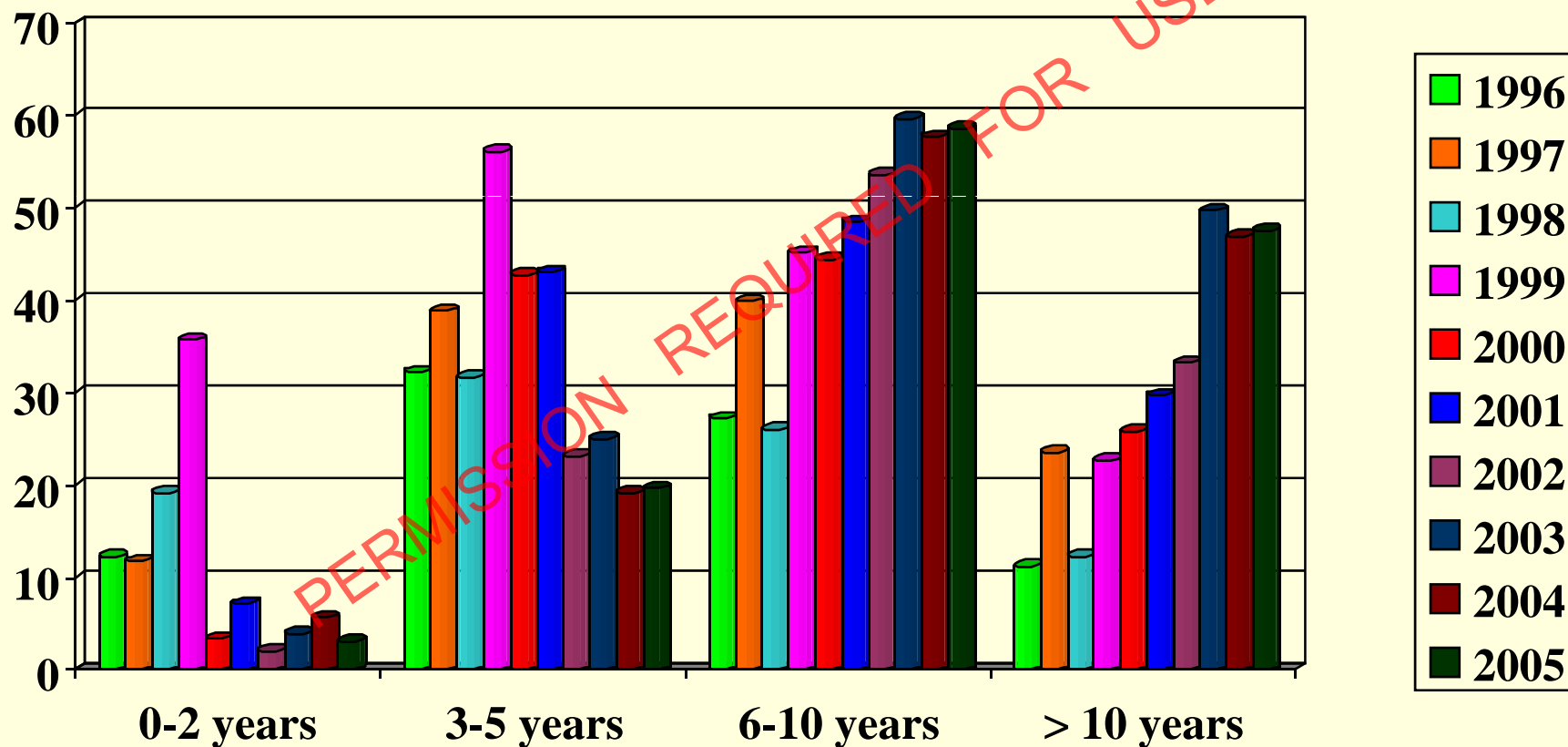
586 samples from 94 nurseries

 Nematode contaminated samples

 Samples free of nematodes

Source: UNESP/Jaboticabal

# Groves: CVC Intensity by Age 1996 - 2005





# Mandatory Screenhouse Nursery Program

- 1- Legislation
- 2- Number of nurseries
- 3- Varieties X Rootstocks
- 4- Quality of Nurseries Trees
- 5- Time to produce a nursery tree
- 6- Nursery structure
- 7- Operation system
- 8- Main results of this program.

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# 1- Legislation

**GOAL:**

**Produce a good nursery tree**

**(Genetics, Health and Vigour)**



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# NURSERY: MANDATORY PROGRAM

	<b>Field</b>	<b>Screen</b>	<b><u>Total</u></b>
1998	948	24	972
2009	00	543	543



Nursery Trees: 18 million

Rootstocks: 8 million

*(April, 2009)*



## 3- Varieties X Rootstocks

Varieties	%
PERA	33,36
VALENCIA	26,61
HAMLIN	11,78
NATAL	5,89
“FOLHA MURCHA” VALENCIA	4,60
OTHERS	17,76
<b>TOTAL</b>	<b>100</b>

Rootstocks	%
RANGPUR LIME	58,28
SWINGLE CITRUMELO	20,39
SUNKI MANDARIN	11,29
VOLKAMERIANO LEMON	3,83
CLEOPATRA MANDARIN	3,42
OTHERS	2,79
<b>TOTAL</b>	<b>100</b>

Source: Fundecitrus (April, 2009)

## 4- Nursery Tree Quality

Genetics



Vigour



Health





# Genetics

- **Combination of variety and rootstock (productivity, fruit quality, etc.)**
- **It's essential to have a "system" that control the production of citrus buds and seeds of rootstock.**



# Vigour

## → Function of:

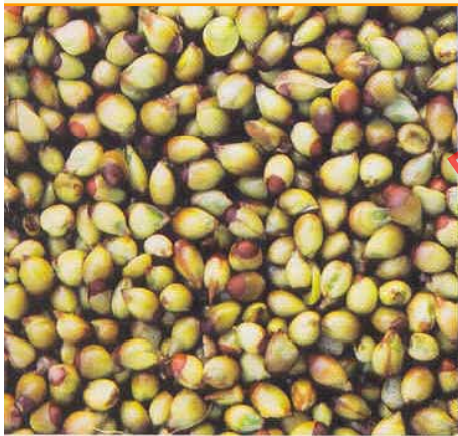
- **Rootstock selection;**
- **Screenhouse condition: light, temperature etc;**
- **Management practices: irrigation, nutrition and quality of “substrate”;**
- **Size of plastic bag or container and space between nursery trees.**







## Healthy: Citrus Material Control



# 5- TIME TO PRODUCE A NURSERY TREE

Phases	Time in Months
Seedling	3 – 4
From transplanting seedlings to graft	3 – 4
From graft to nursery tree	4 – 6
<b>Total: 10 – 14 months</b>	



# 6- Nursery Structure

- Isolation and wind-break
- Disinfestation System
- Bath, Dressing room and laundry
- Seed and Budwood Storage
- Seedling and Nursery Screenhouse
- Nursery Tree Screenhouse Storage

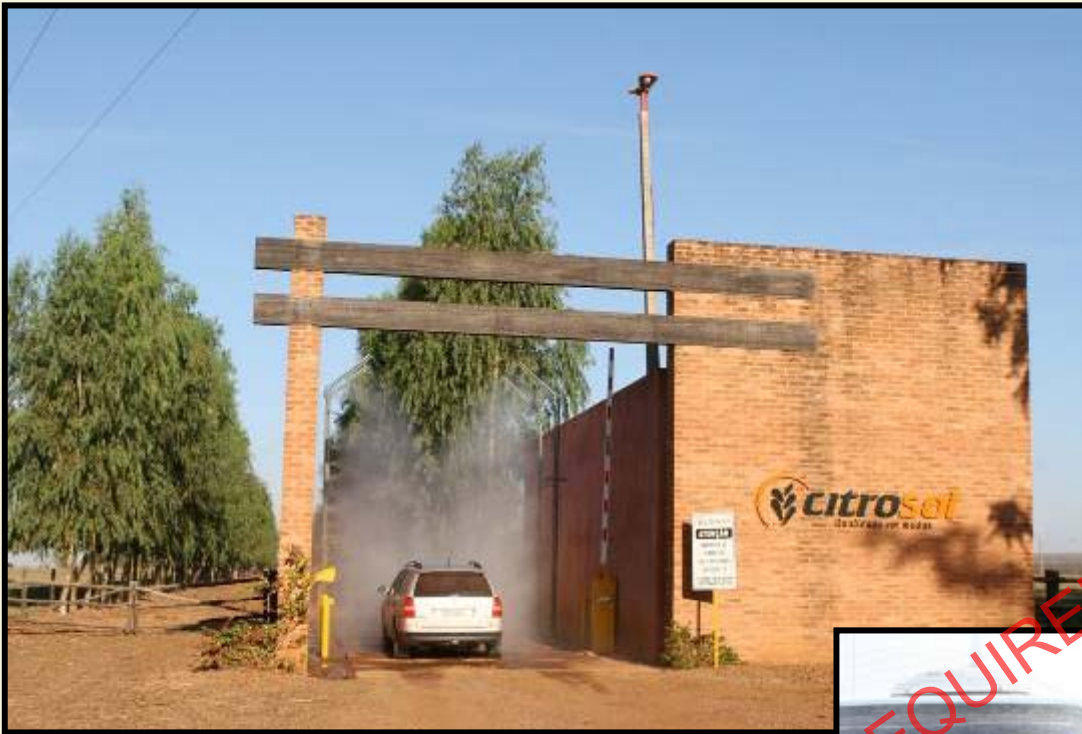
## Isolation and wind-break





# Nursery Office





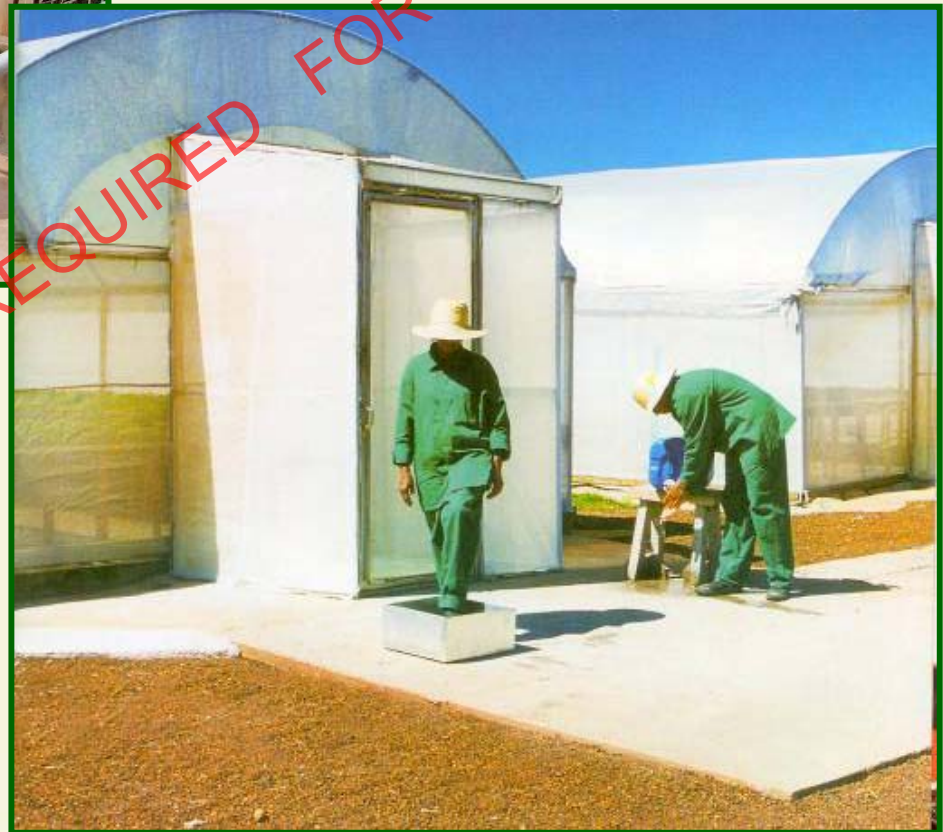
## Vehicle Disinfestation







**Personnel  
Disinfestation**



## Bath and Dressing Room





# Laundry

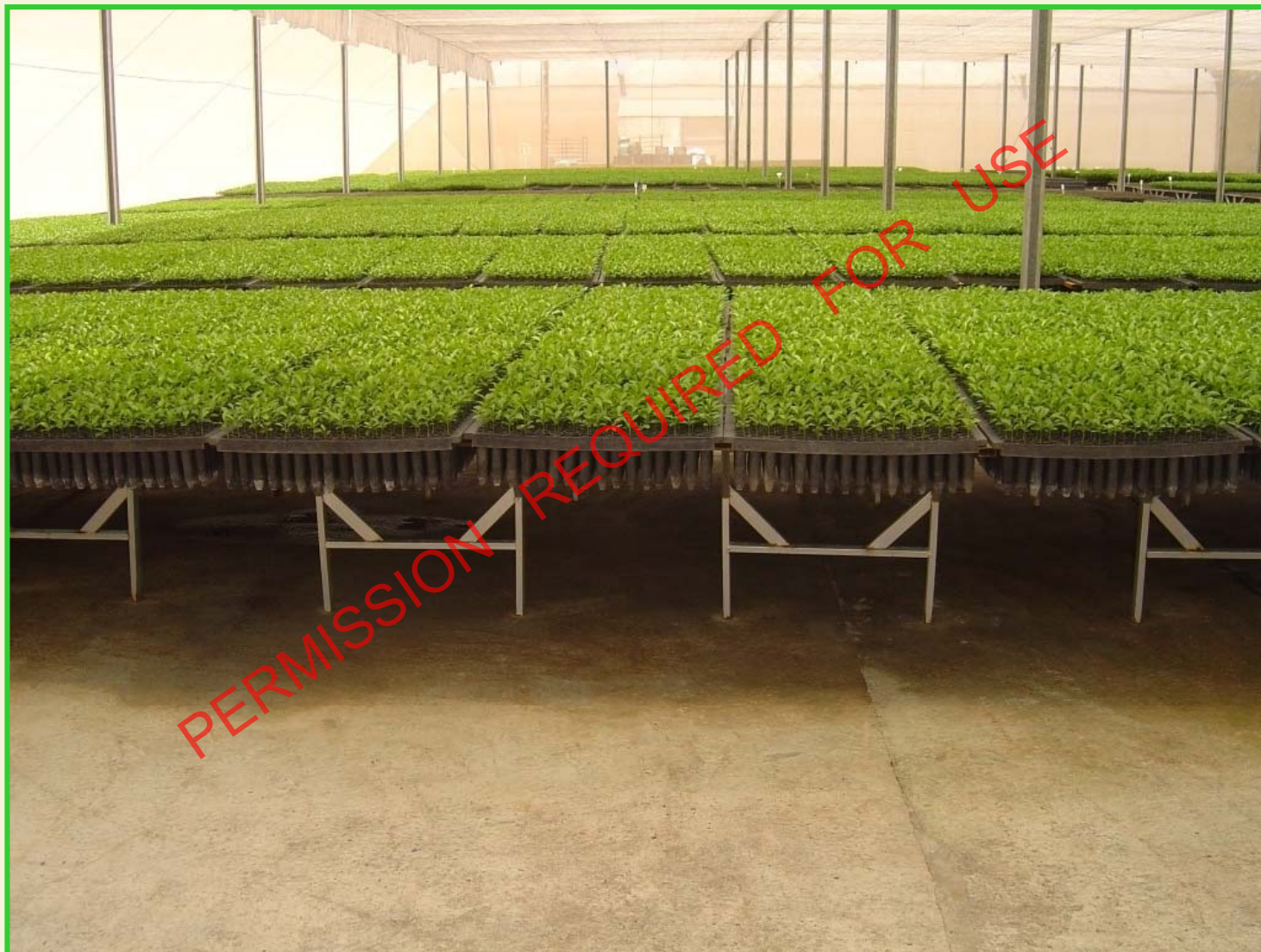




**Seed and Budwood  
Storage**



# Internal Seedling Screenhouse



## External Screenhouse





## Internal Screenhouse

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## Internal Screenhouse with Aluminet curtains

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## Internal Screenhouse Nursery Tree Storage

FOR USE



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## External Screenhouse Nursery Tree Storage





“Quem produz as melhores mudas de citrus...”



**citrosol**



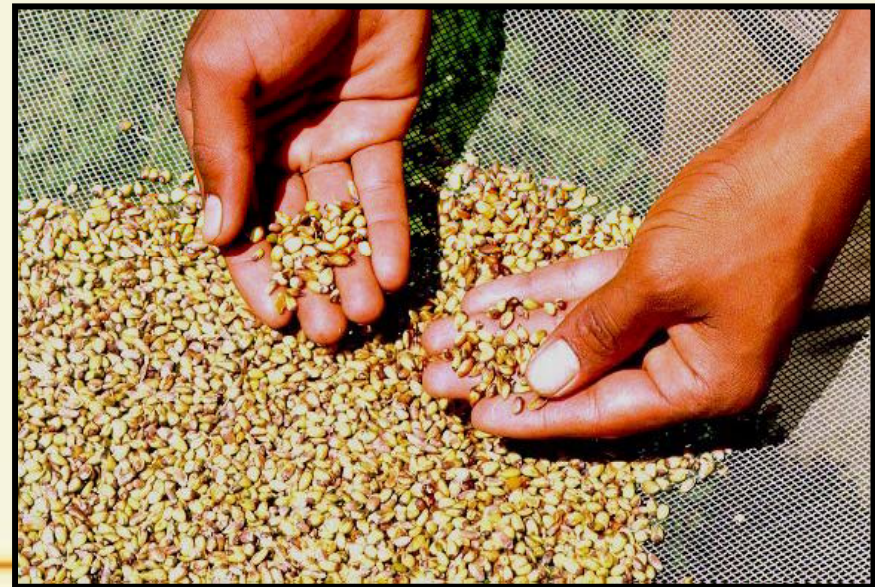
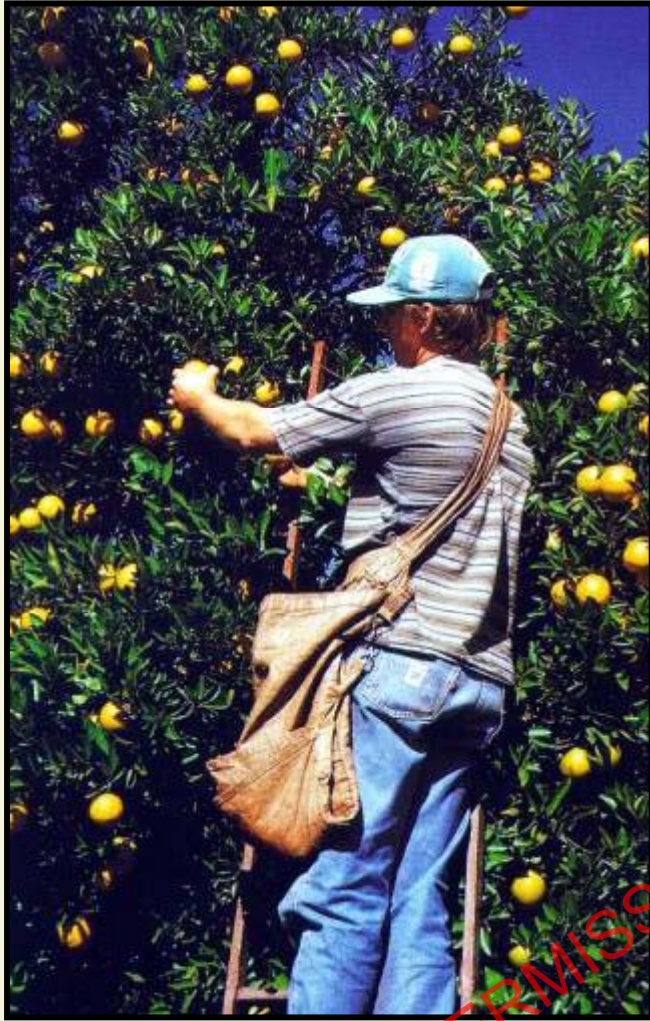
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# 7- Operation System

- Seed and Seedling Production
  - Substrate Operation
- Bud Production and Graft Procedures
  - Bench and Floor
  - Tree Spacing
  - Fertirrigation
  - Chemical Control
  - Human Resources

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## Seed Manipulation



# Screenhouse Seedling





# Substrate Operation



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## Substrate Operation





**Bench and Floor**



## Nursery Tree Spacing



USE







**Budwood production-  
Increase block  
Annual disease testing and  
pest inspections**



# Graft Operation





Grafted plants

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# Fertirrigation





# Insecticide in the Nursery







**Human Resources**





## Human Resources



## Main Results of the Mandatory Screenhouse Nursery Program

- a) Nematode Absence in the nurseries
- b) Strong Reduction of *Phytophythora* and Citrus Canker in the nurseries
- c) Bad environment condition to Black Spot in the nurseries
- d) Absence of CVC and HLB in the nurseries!



**HEALTH NURSERY TREES**





“Nursery young trees with high quality are the basis of the competitive citriculture”

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**Thank you!**