THE EXPERIENCE OF HLB MANAGEMENT IN BRAZIL

"FLORIDA CITRUS MUTUAL"

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- ***Citriculture in Brazil***
- ***HLB: History and Current Status***
- ***Factors that Affect the Success of HLB Management***
- ***Nutritional Program: A Beginning***
- ***Research Priorities***
- ***Citriculture Perspectives***

Citriculture in Brazil and in São Paulo State

- 80% of the Brazilian production


▪ 78% without irrigation

- 95% are sweet oranges (mainly for juice)
- Varieties: Pera, Valencia, Natal, Hamlin ….
- Rootstocks: Rangpur, Swingle, Sunki, Cleopatra ….

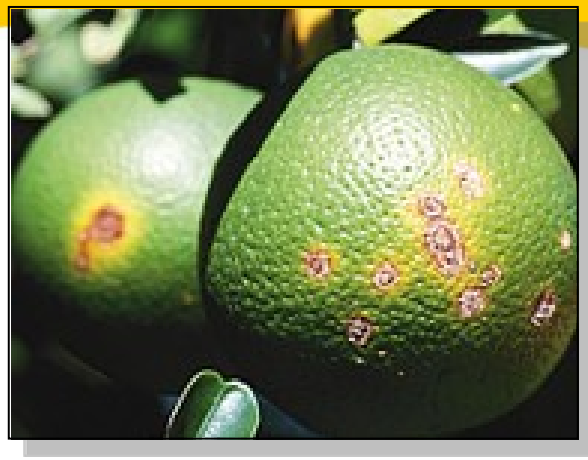

▪ 230,000 direct jobs

CHALLENGES ...

The Big Five from Africa

The King of the Five!

The Big Ones in Brazil !



Canker: 1.39% blocks

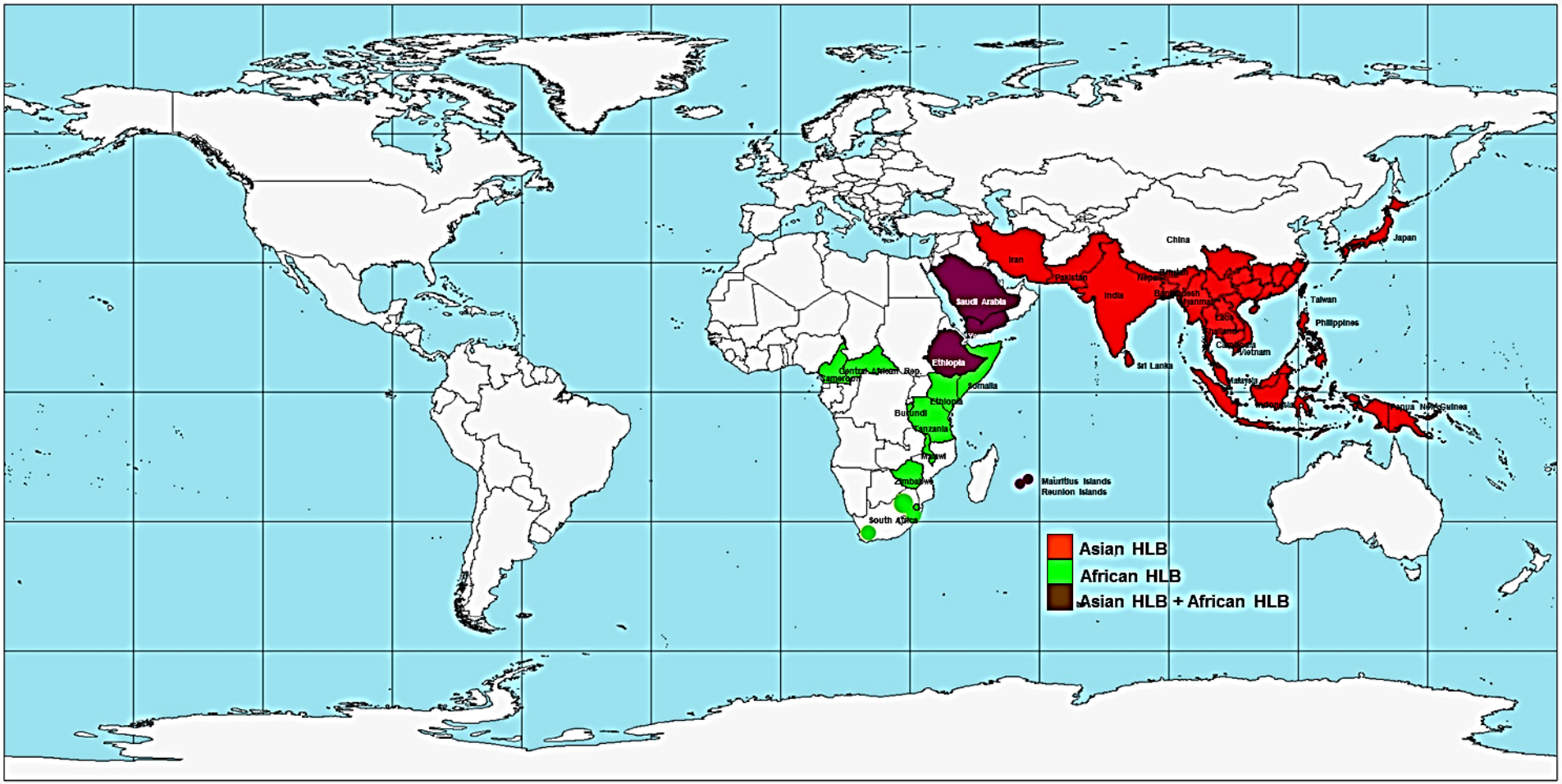
CVC: 38% trees

Leprosis: 26% trees

Black Spot: 51% trees

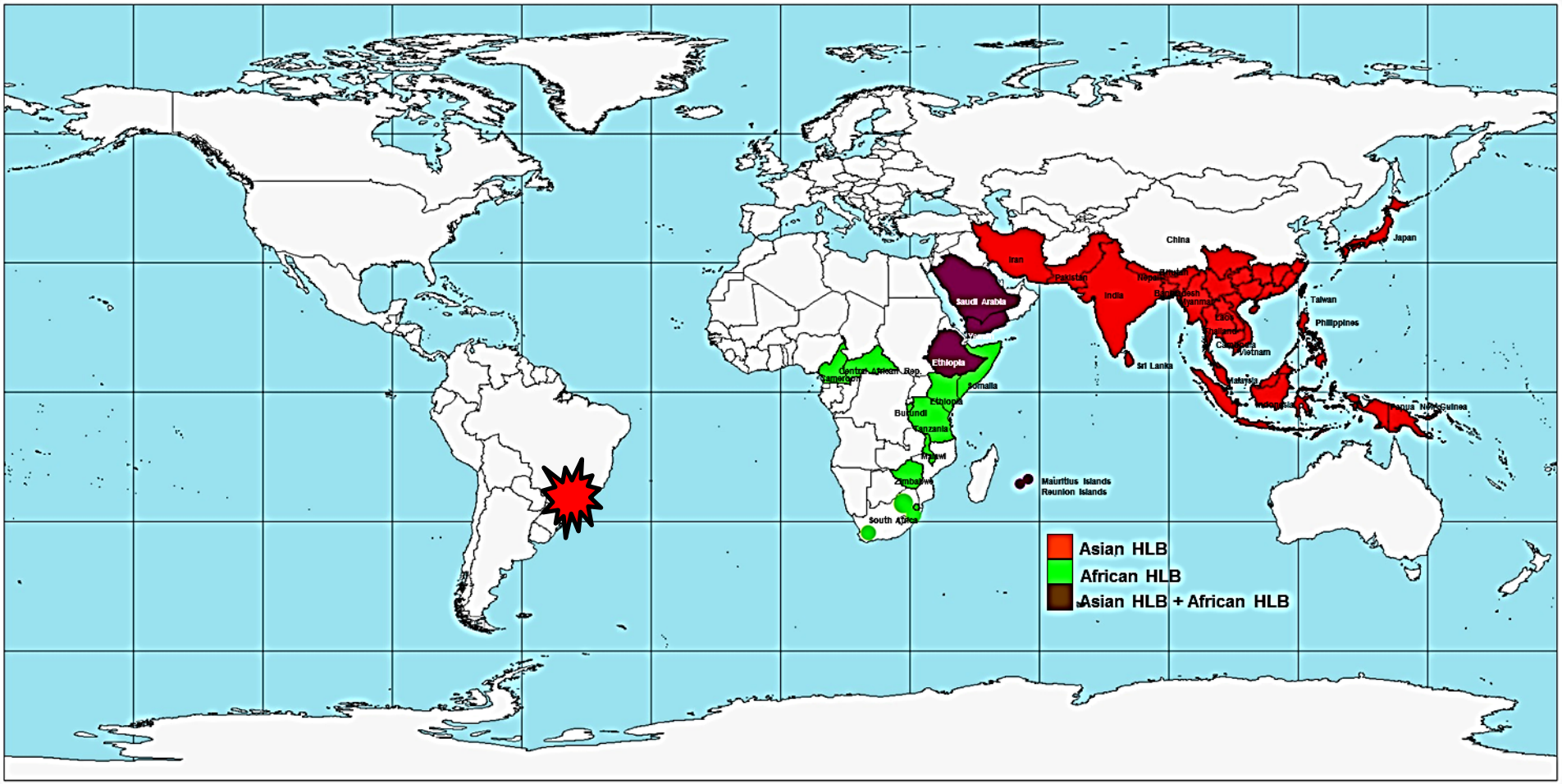
HLB: The King of the Big Five!

HLB in the world in 2003

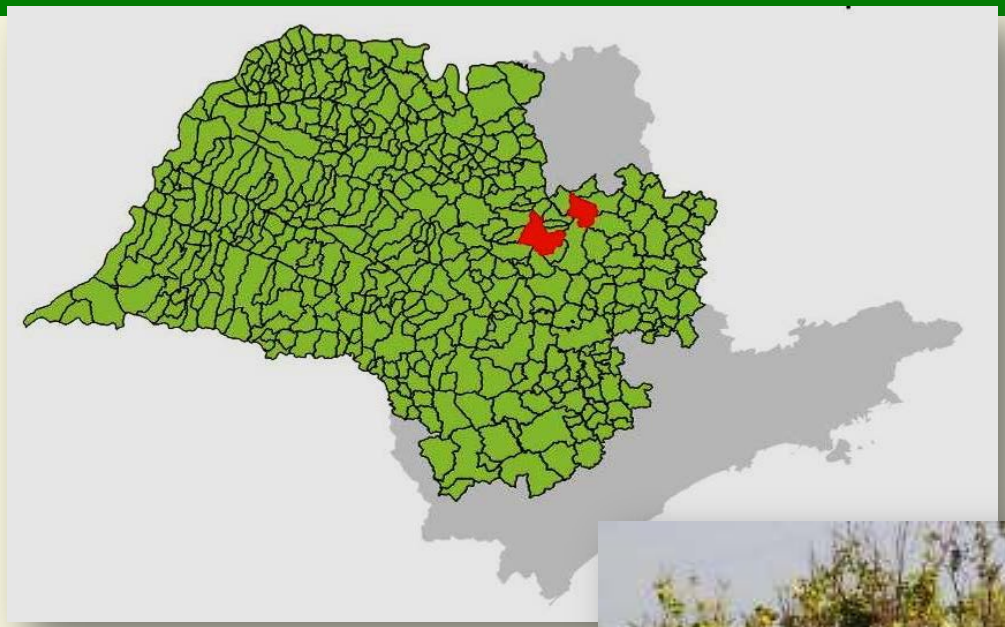


Diaphorina citri in Brazil : first report in 1942

HLB in the world in 2004



Symptomatic trees were found in Araraquara in March 2004



July 2004:

- *Candidatus* Liberibacter asiaticus (Las) was detected
- A new liberibacter was identified: *Candidatus* Liberibacter americanus (Lam)

Symptoms on Young Trees

Symptoms on Old Trees

Ca. Liberibacter americanus and *Ca.* L. asiaticus found in *Murraya exotica* (2005)

***Ca.* L. americanus**

- More severe symptoms
- Higher titers

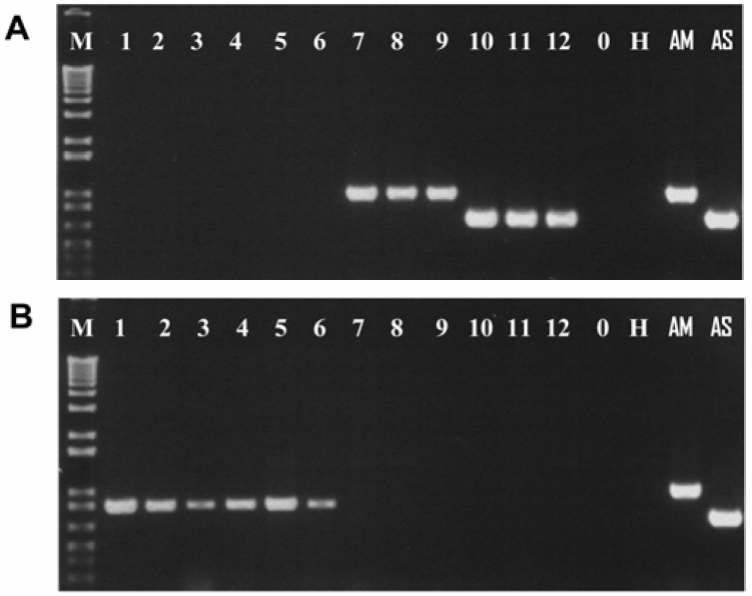
***Ca.* L. asiaticus**

- Less severe symptoms
- Lower titers

2007: A phytoplasm was found in trees with HLB symptoms but negative for all Liberibacters

PCR with primers specific for *Ca.* L. asiaticus or *Ca.* L. americanus

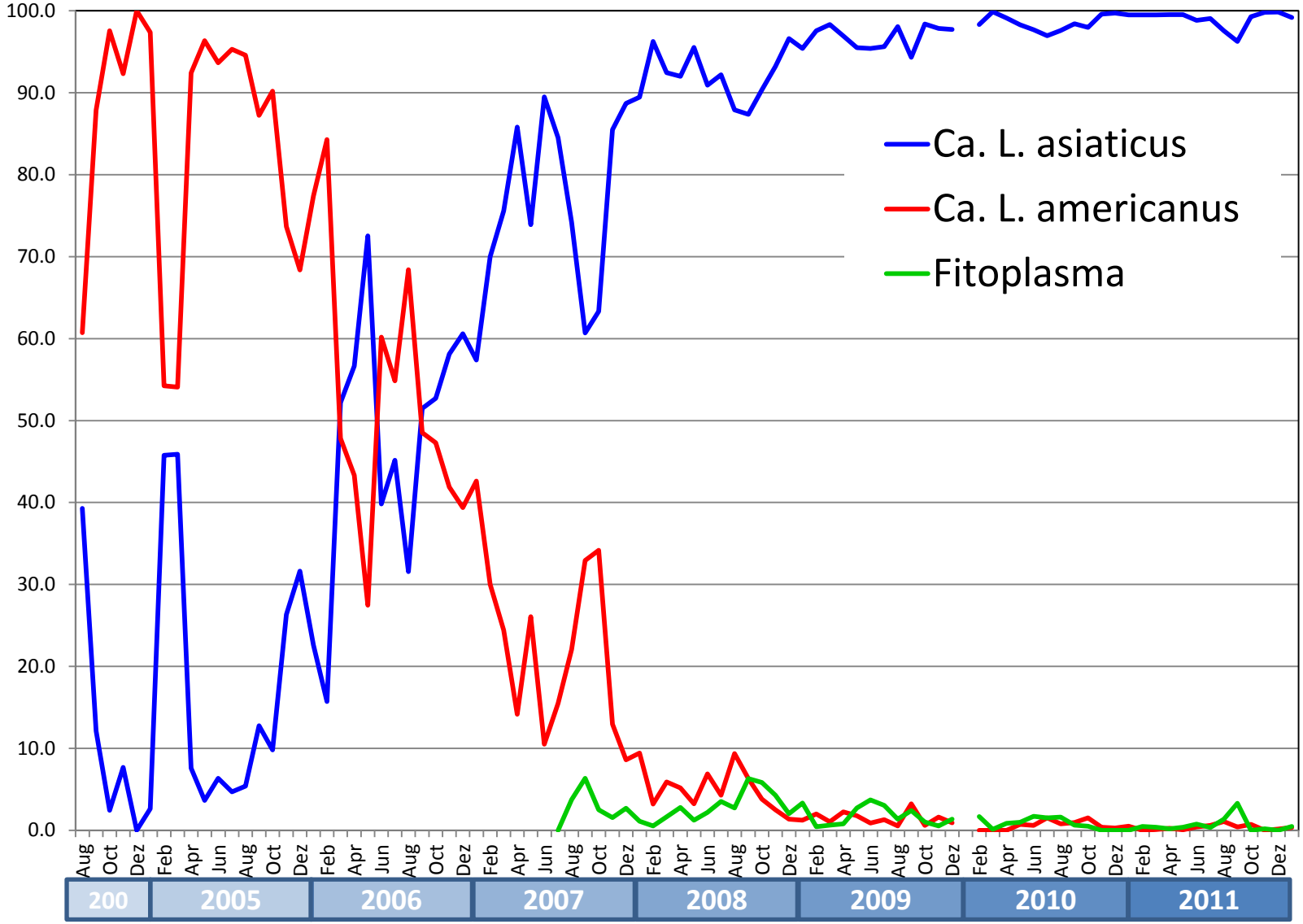
PCR with primers specific for Phytoplasma of group 16Sr 9



- Origin of the phytoplasm : *Crotalaria juncea* - cover crop (December 2008)

Teixeira et al.2009, Wulff et al 2008

Evolution of Lam, Las and the phytoplasma from field samples.



Fundecitrus HLB laboratory (*n* = 58.087):

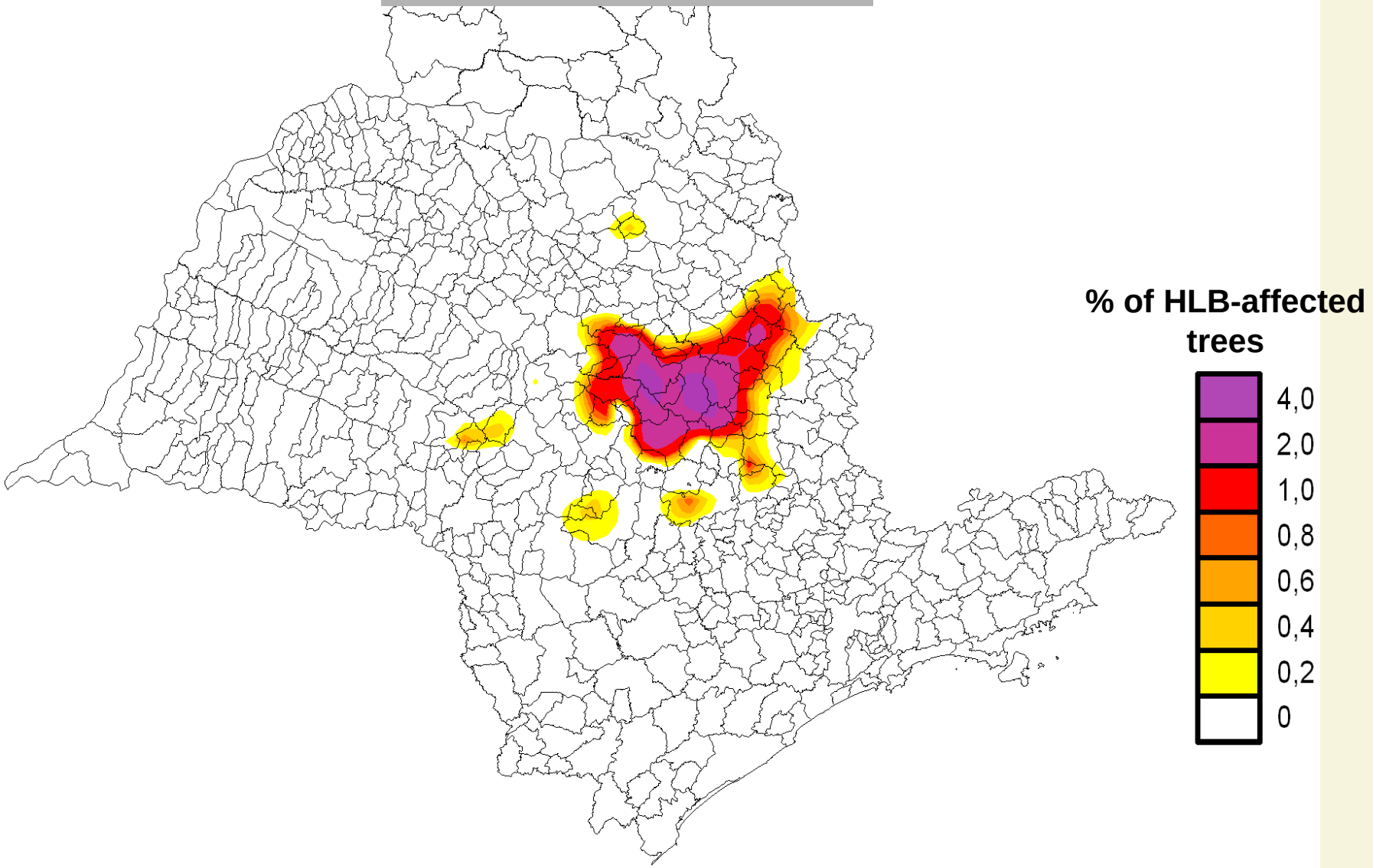
HLB Mitigation: Main actions

- Survey
- HLB management by the TPS
- Communication program
- Research
- ~~Mandatory tree elimination~~

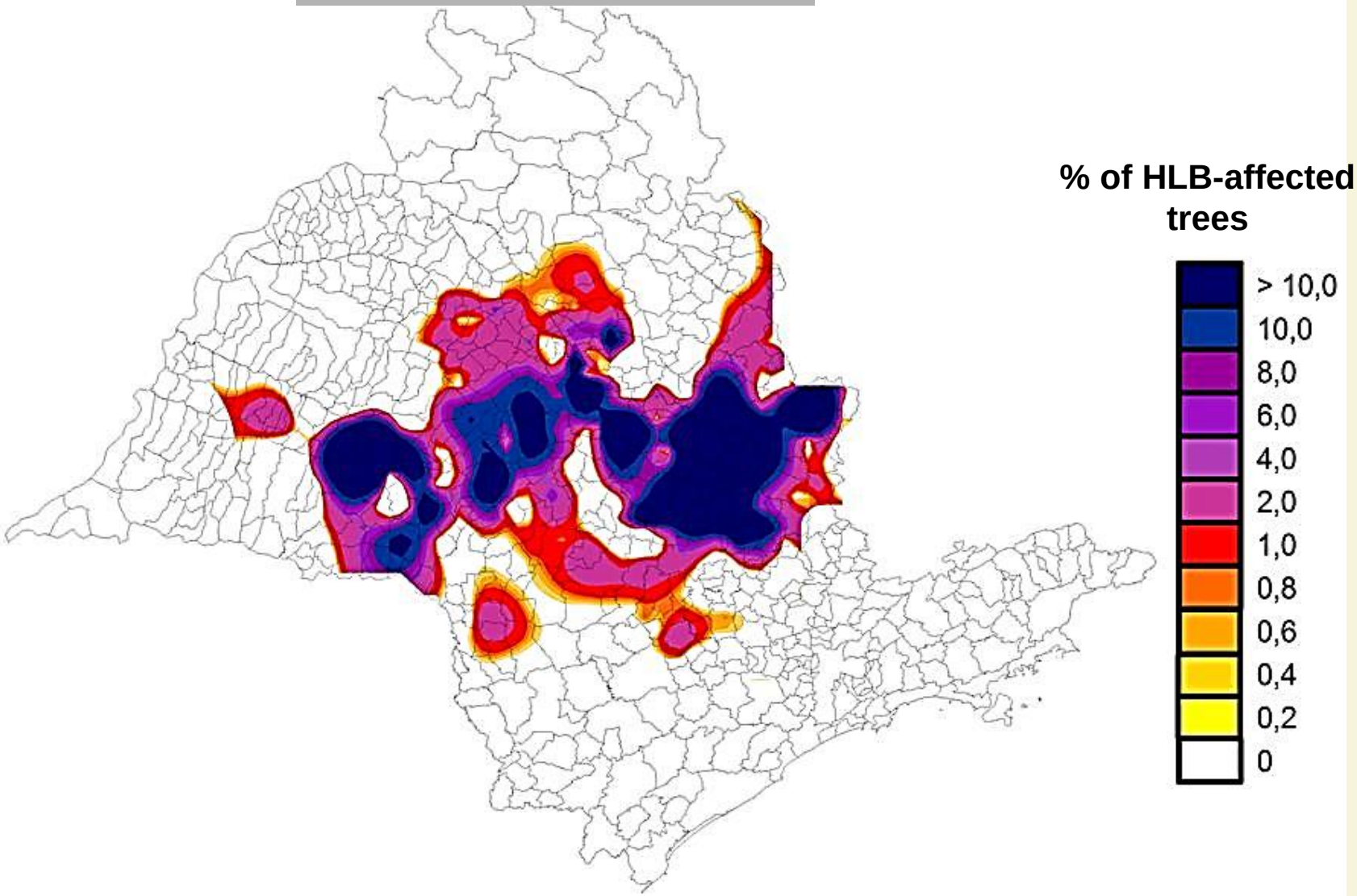
Fundecitrus trained 8,000 inspectors for identification of HLB-affected trees

HLB-affected Trees eliminated:

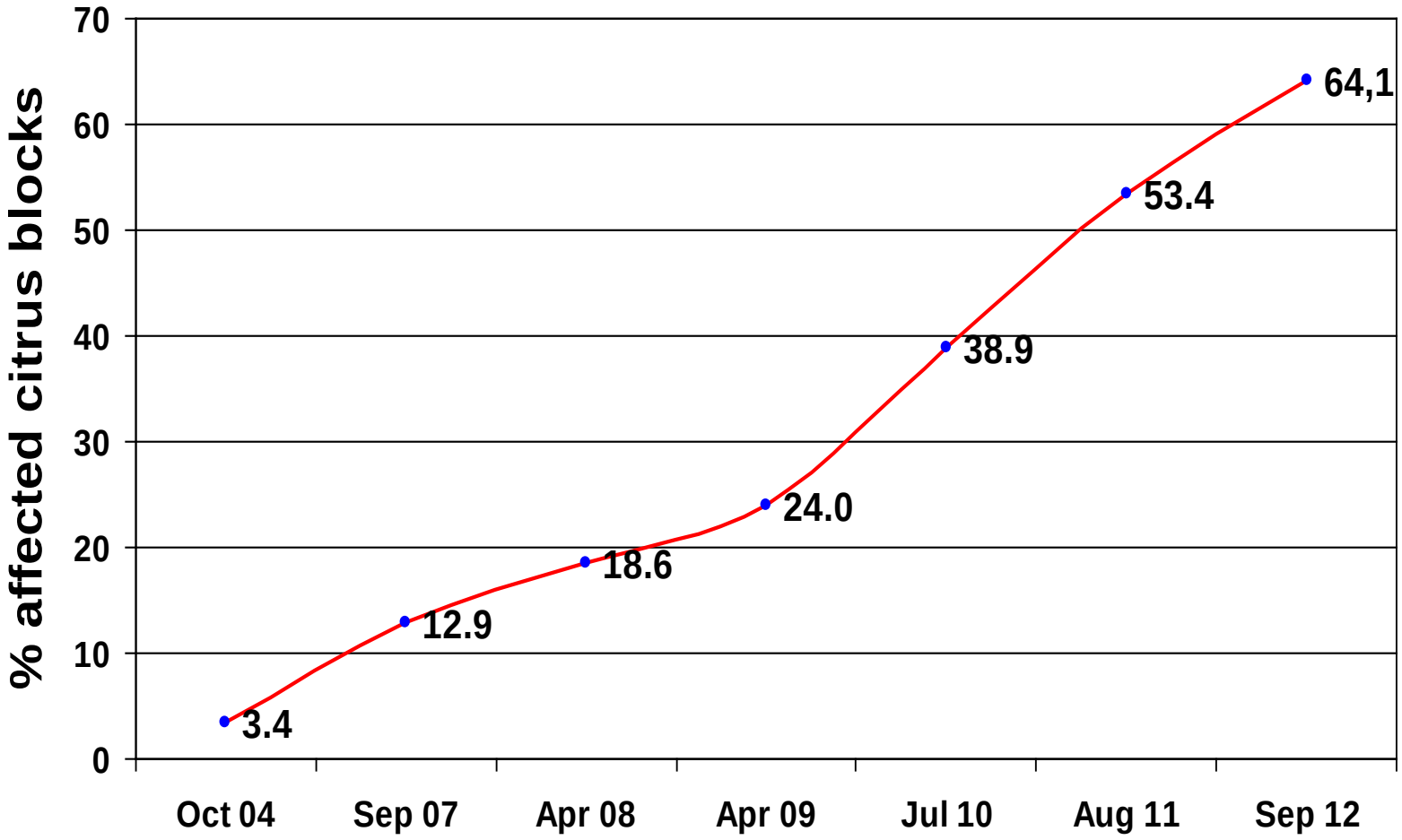
HLB in 2008



HLB in 2012

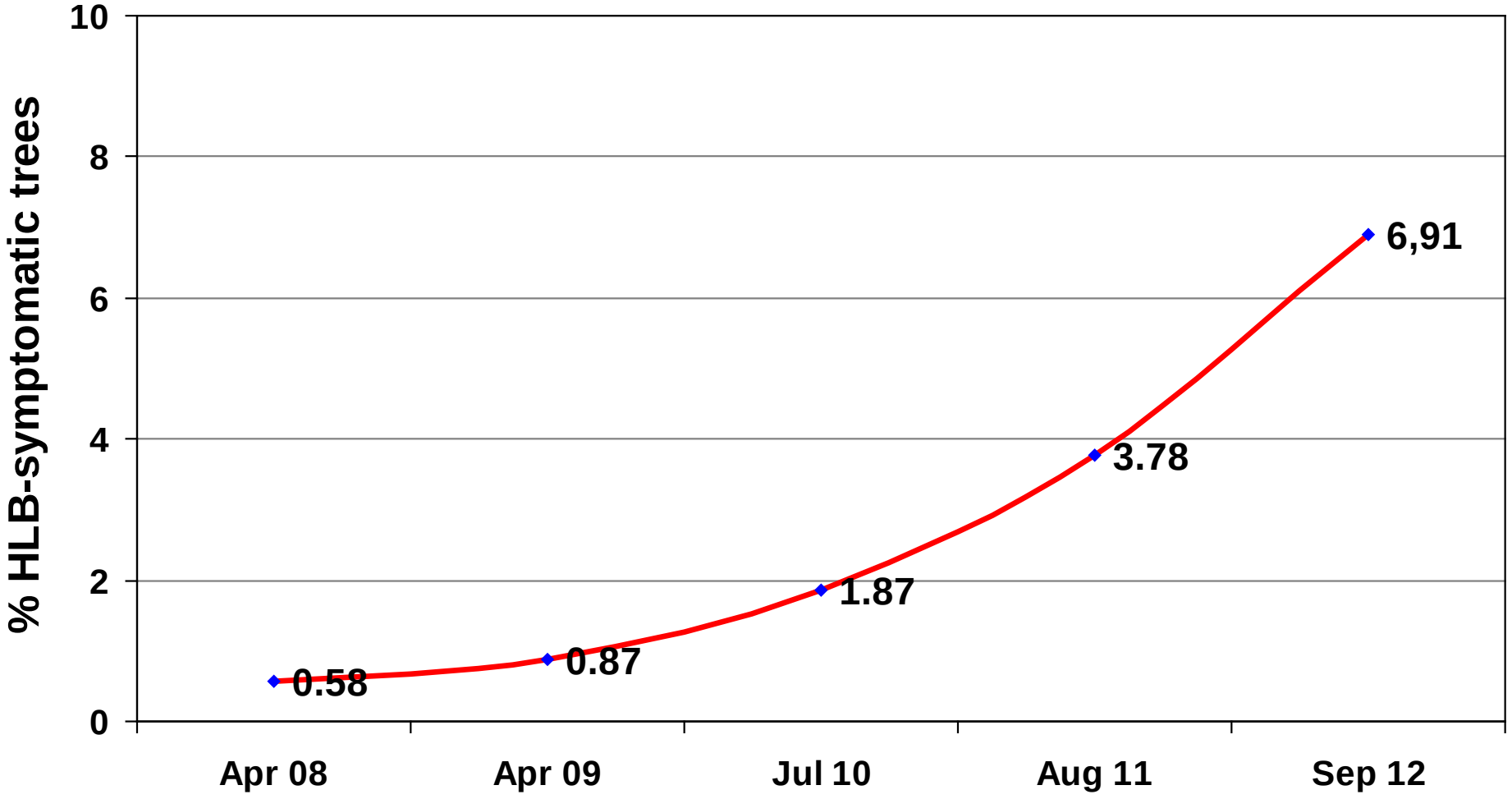


HLB Progress in Sao Paulo State
- % affected blocks -



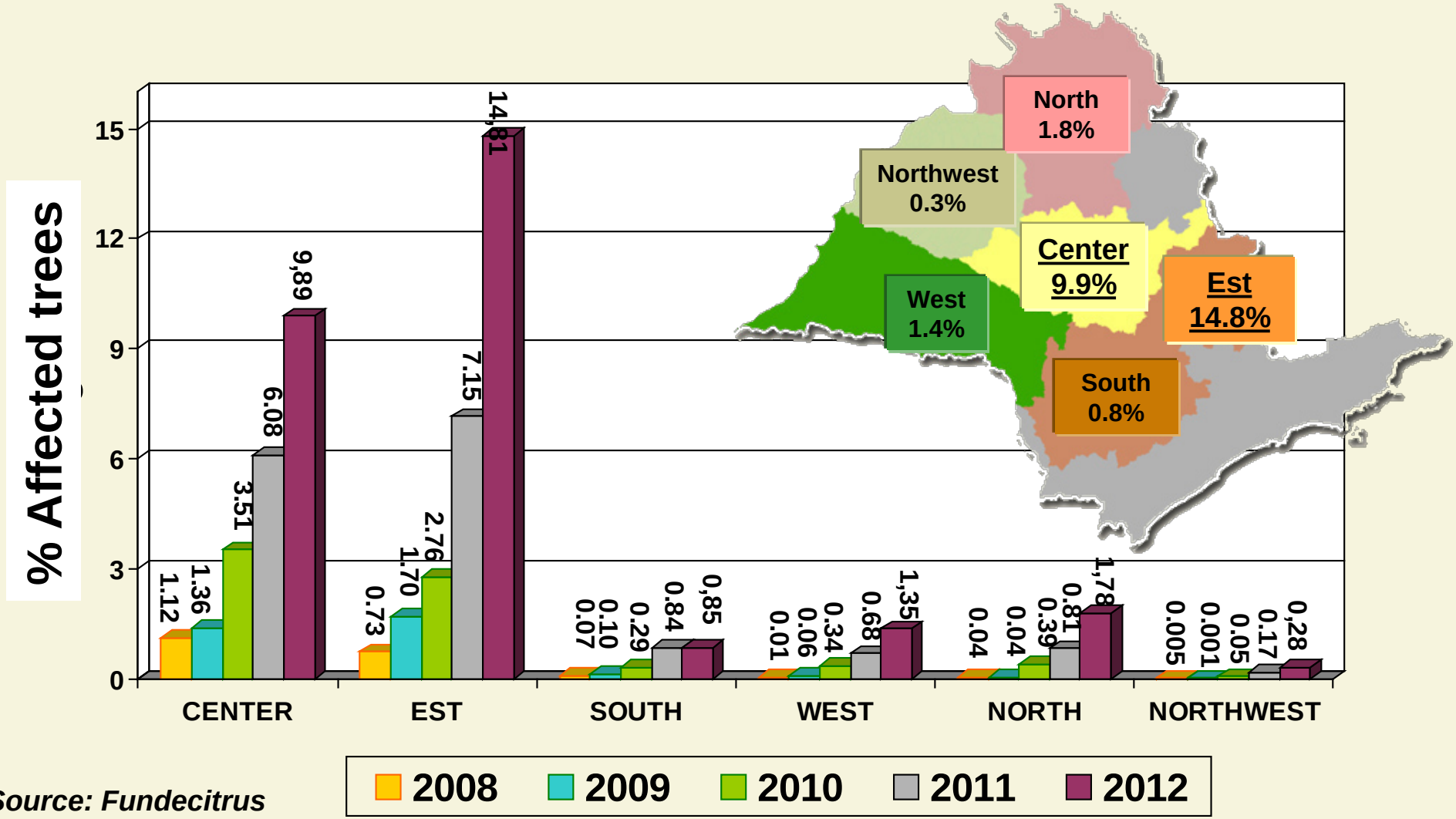
Source: Fundecitrus

HLB progress in Sao Paulo
- % symptomatic trees -



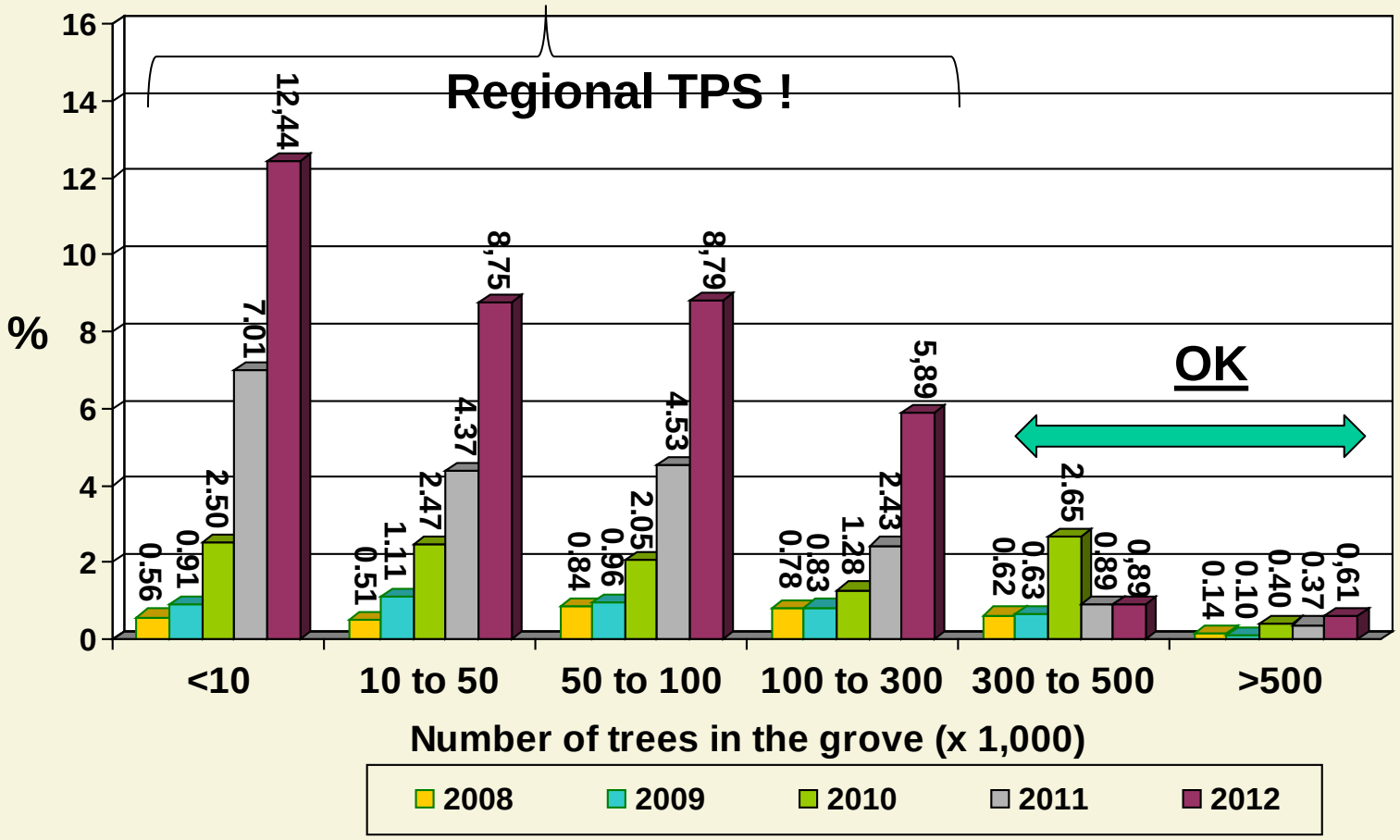
Fonte: Fundecitrus

HLB incidence by region in Sao Paulo State

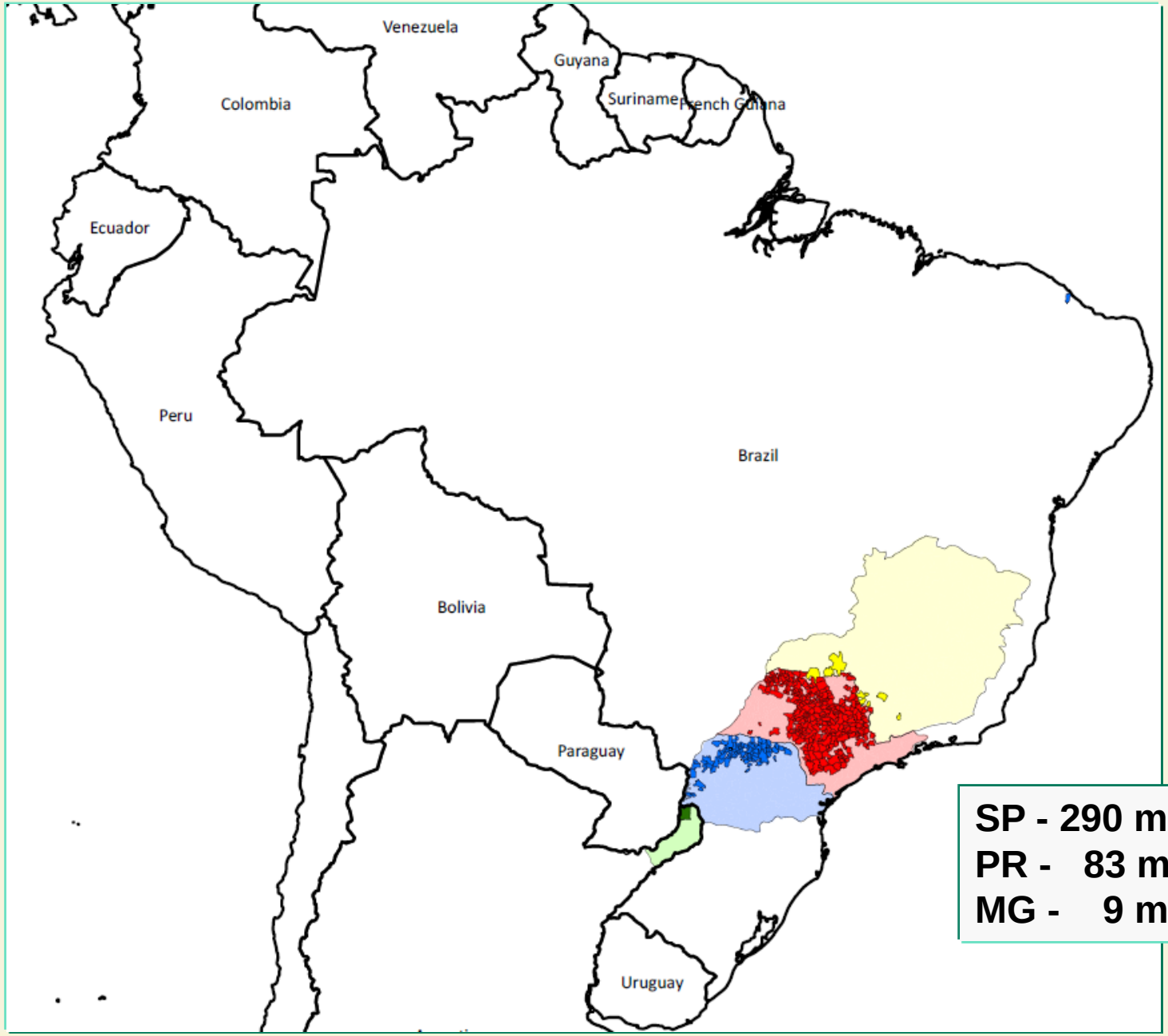


Source: Fundecitrus

Incidence of HLB-affected trees by grove size



Source: Fundecitrus



SP - 290 municipalities
PR - 83 municipalities
MG - 9 municipalities

Healthy young trees from covered, insect-free nurseries

Elimination of symptomatic trees

HLB Management

Insecticide treatments

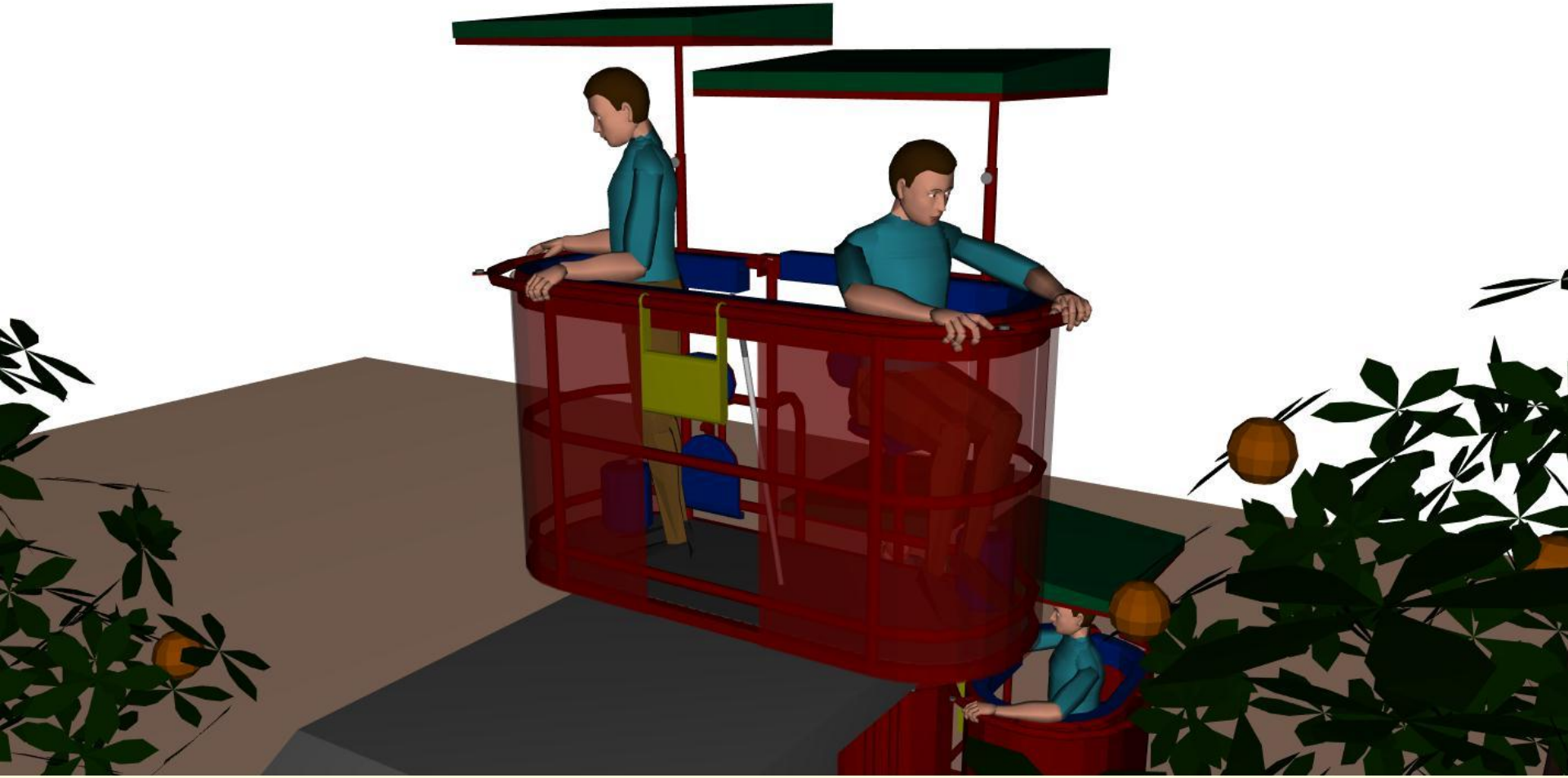
Mandatory <u>covered</u> Nurseries since 2003

150 million young trees produced in the last 10 years in Brazil

Platform Inspection

New Platform:
Better view and labor conditions

Research Project: UFSCAR, Citrosuco e Fundecitrus



Insecticide applications

Psyllid population monitoring

Before leaving the nursery

Systemic insecticide

Before starting fruit production

Rainy period: Systemic

Dry and rainy periods: Contact

After starting fruit production

Contact

Positive factors that support HLB control

- **Covered nurseries since 2003**
- **Experience with CVC management and canker “eradication”**
- **Low HLB incidence: > 93% trees are healthy**
- **Lessons on HLB management from many growers**

Journal of Plant Pathology (2010), **92** (2), 285-302 *Edizioni ETS Pisa, 2010*

LETTER TO THE EDITOR

LESSONS FROM HUANGLONGBING MANAGEMENT IN SÃO PAULO STATE, BRAZIL

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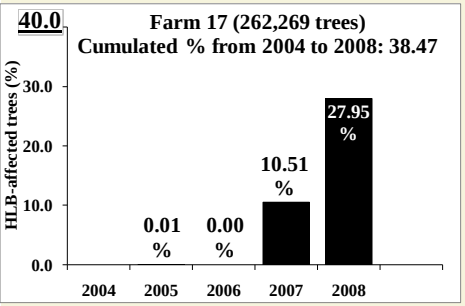
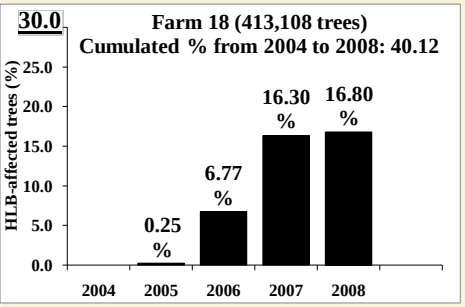
SUMMARY

Huanglongbing (HLB) was first identified near Araraquara in the central region of São Paulo State (SPS), Brazil, in March 2004. As of November 2009, HLB was present in 242 of the 425 citrus-growing municipalities of SPS. In April 2009, the current total num- aged farms, their psyllids invariably invade and contaminate the latter farms. SPS has legal tools, which make possible the removal of contaminating groves, but the laws are not strictly enforced. Costs of HLB management vary considerably, but inspections range from $4 to 17 $US each per ha, and insecticide treatments from about $US 240 to > $1,000 per ha annually, depending

Study of cases

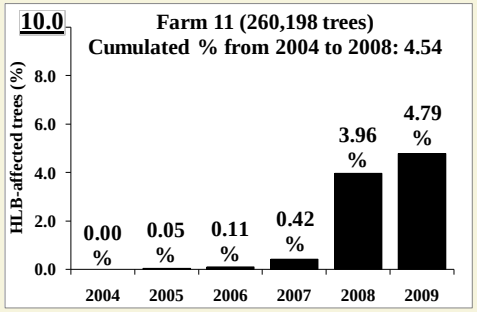
Farms without HLB management located near farms without HLB management

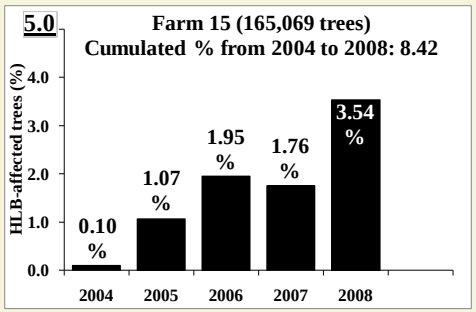




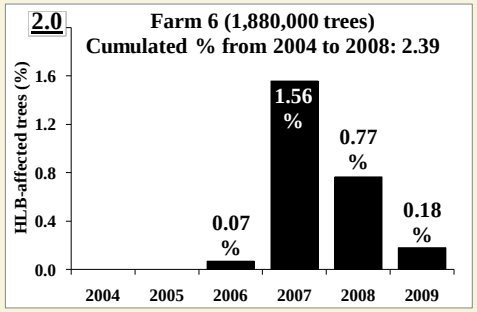
Farms with HLB management near farm without HLB management

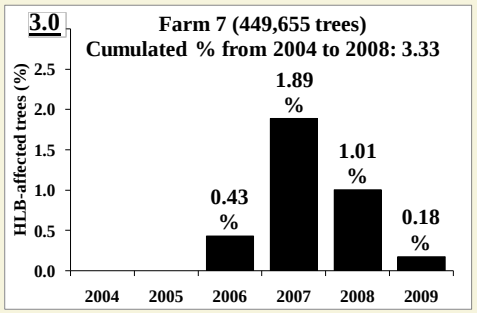
Small farm and/or Young trees



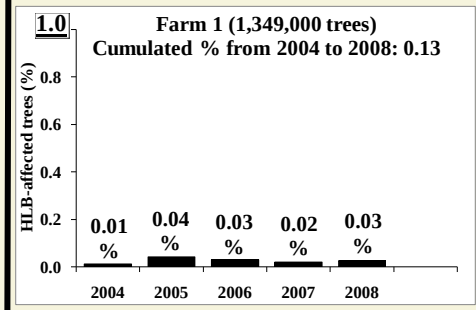


Large farm and/or Adult trees





Farm with HLB management far from farm without HLB management



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Main factors associated with the success of HLB management by the TPS

Main factors for the success of the HLB management

1) Incidence of the disease at the moment when management was initiated

2) Age of the trees

3) Period of time during which the control measures have been applied

4) Size of the grove

5) Distance from groves without control measures

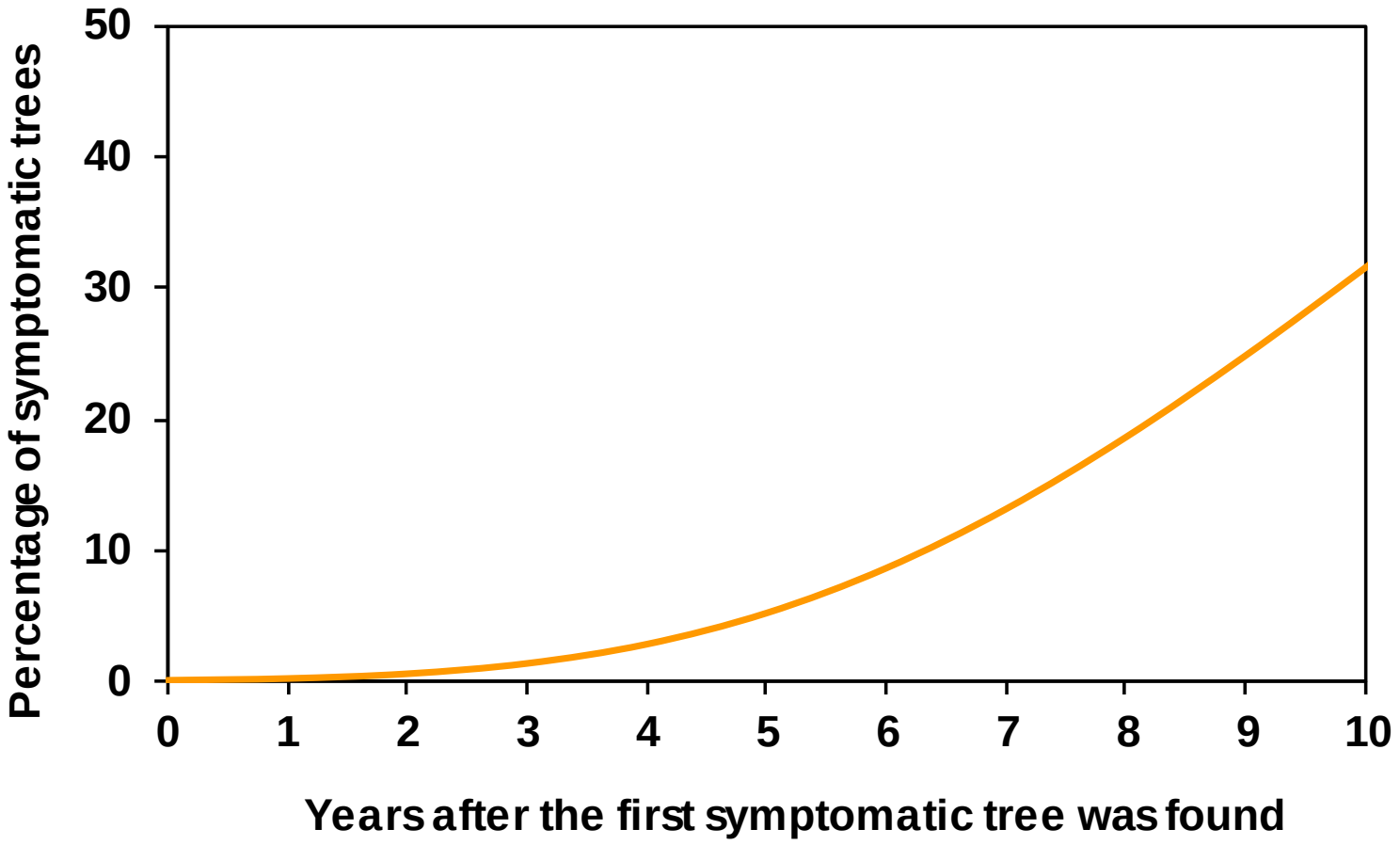
6) Number of sprays per year

7) Number of inspection per year

Incidence of HLB in the first year of control

Range: 0 to 17.6%

HLB incidence at the moment management was started



Size of the grove

Range: 240 to 10,000 ha

72,000 a 3,000,000 trees

Distance from neighboring groves without HLB management

Range: 0 to 5 km

Costs of management programs

Yearly HLB control program	Inspection	Spray	Drench	Soil	Airplane	Total cost
	US$/ha					
4 inspections 5 ground sprays 1 systemic	32.21	165.64	-	40.33	-	238.17
6 inspections 10 ground sprays 2 systemic 1 airplane	48.31	331.28	26.52	40.33	113.06	559.48
12 inspections 15 ground sprays 3 systemic 2 airplanes	96.61	496.92	26.52	80.65	339.17	1,039.86

Strategies to maintain high productivity inspite of HLB

- **Establishment of groves on large surfaces with high tree density**
- **Appropriate nutritional and irrigation practices**
- **More intense efforts on grove borders for psyllid control**
- **Regional HLB management, in particular for the smaller farms**

Establishment of groves on large surfaces with high tree densities


Removal of blocks
highly affected by HLB
Renovation on large surfaces
NEVER BLOCK BY BLOCK !!!

More intense efforts for psyllid control on the grove borders

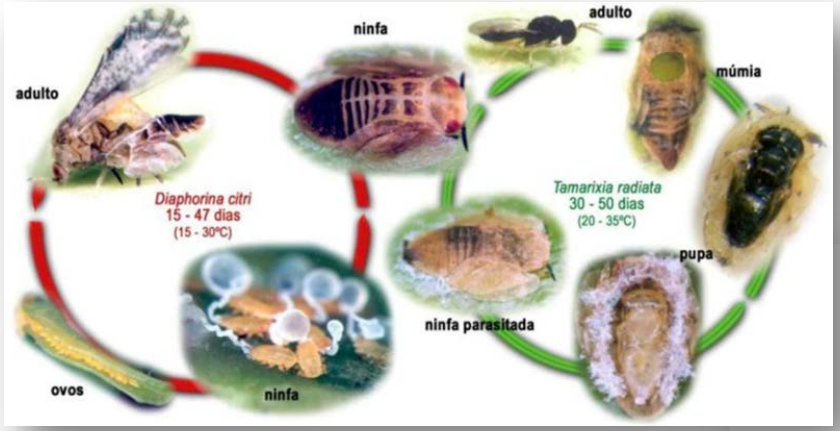
More intense effort in the borders of the groves

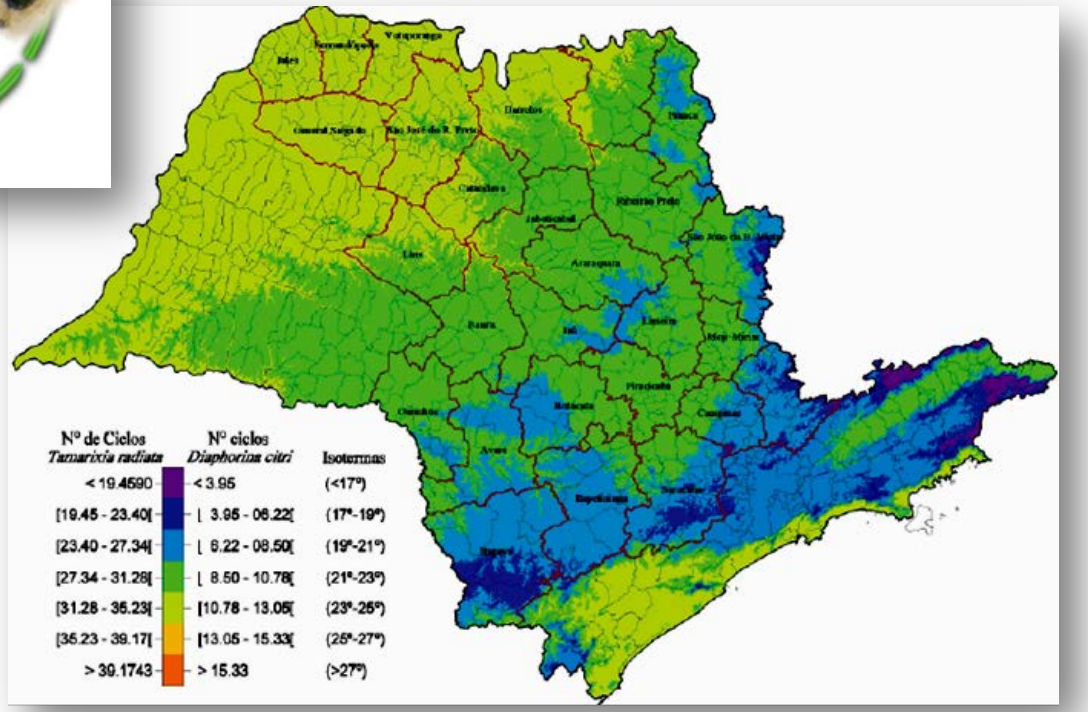
D. citri distribution in groves

HLB Management

Wide-area application at the key moment.

Psyllid bio-control:
in urban area
and/or abandoned groves?





Colaboration
ESALQ - FUNDECITRUS

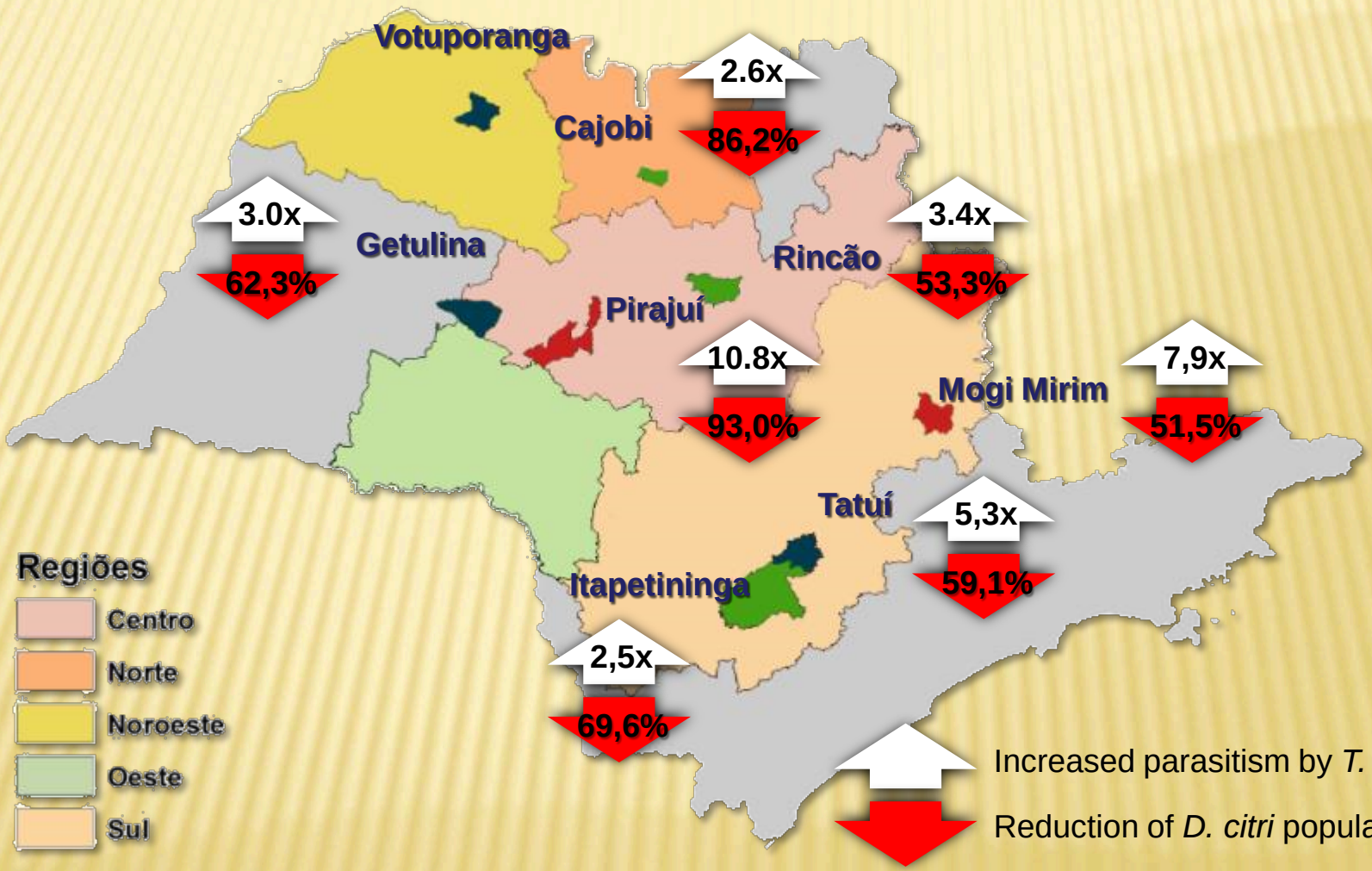
Greenhouse for multiplication of D. citri

Laboratory for multiplication of *T. radiata*

Release in the Field

400 parasitoids/ha in 4 different sites

Release areas of *T. radiata*



Source: Parra

Nutritional Treatments in an HLB-affected grove

Scientific Team: D. Mattos Jr., J. A. Quaggio (IAC)
J. M. Bové (INRA)
R. Bassanezi, A. J. Ayres (Fundecitrus)

Nutritional Treatments in an HLB-affected grove

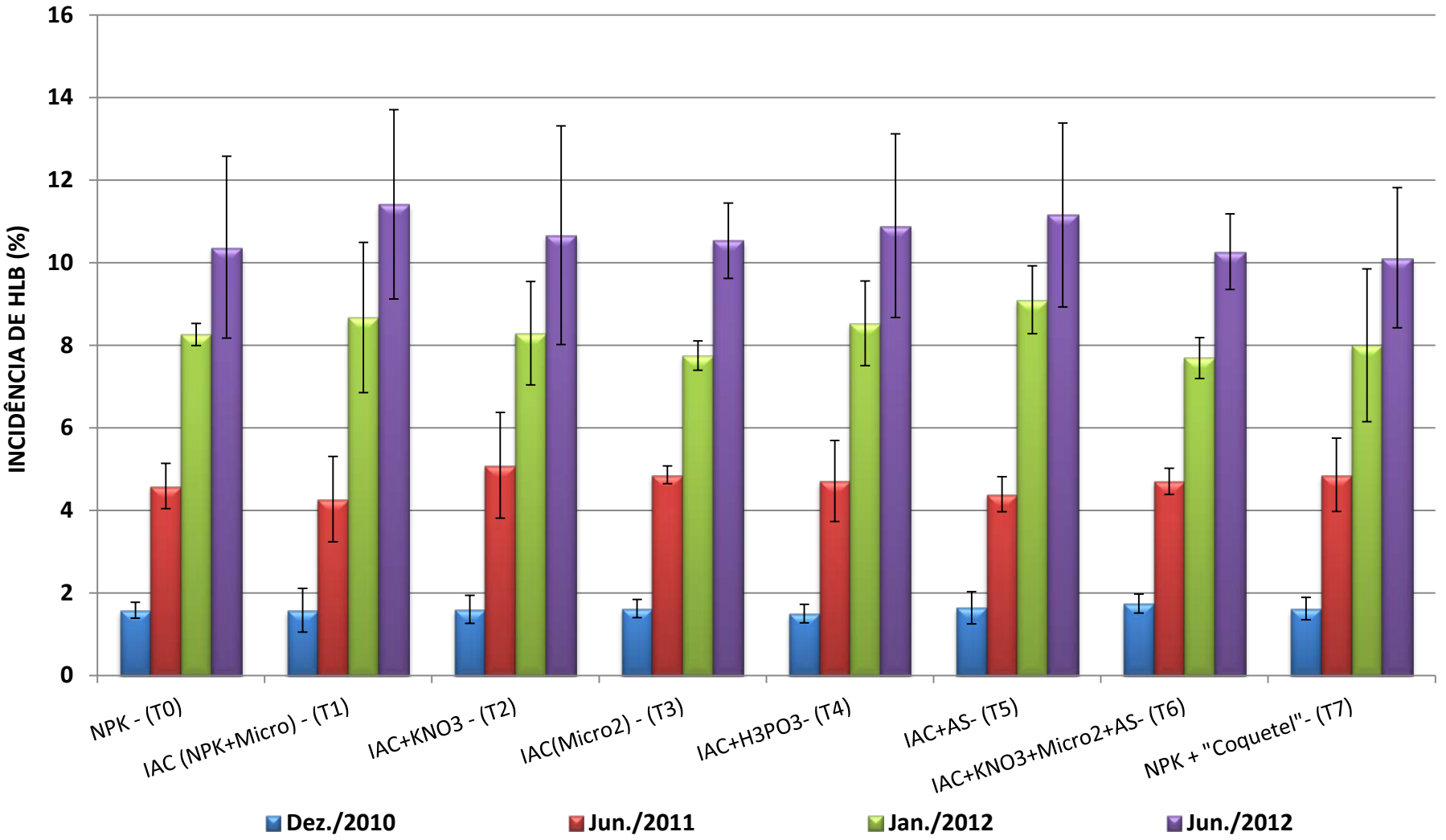
- Valencia/Rangpur planted in 2002. No Irrigation.
- HLB incidence at start of experiment : 1.8 % (Dec. 2010)

- 4 Randomized Blocks, 3 with psyllid control and 1 without
- 8 Treatments:

T0 = NPK	T4 = T1+H_3PO_3
T1 = NPK+Micro(IAC)	T5 = T1+AS
T2 = T1+KNO_3	T6 = T1+KNO_3+Micro2+H_3PO_3+AS
T3 = T1+Micro2	T7 = NPK + “Cocktail”

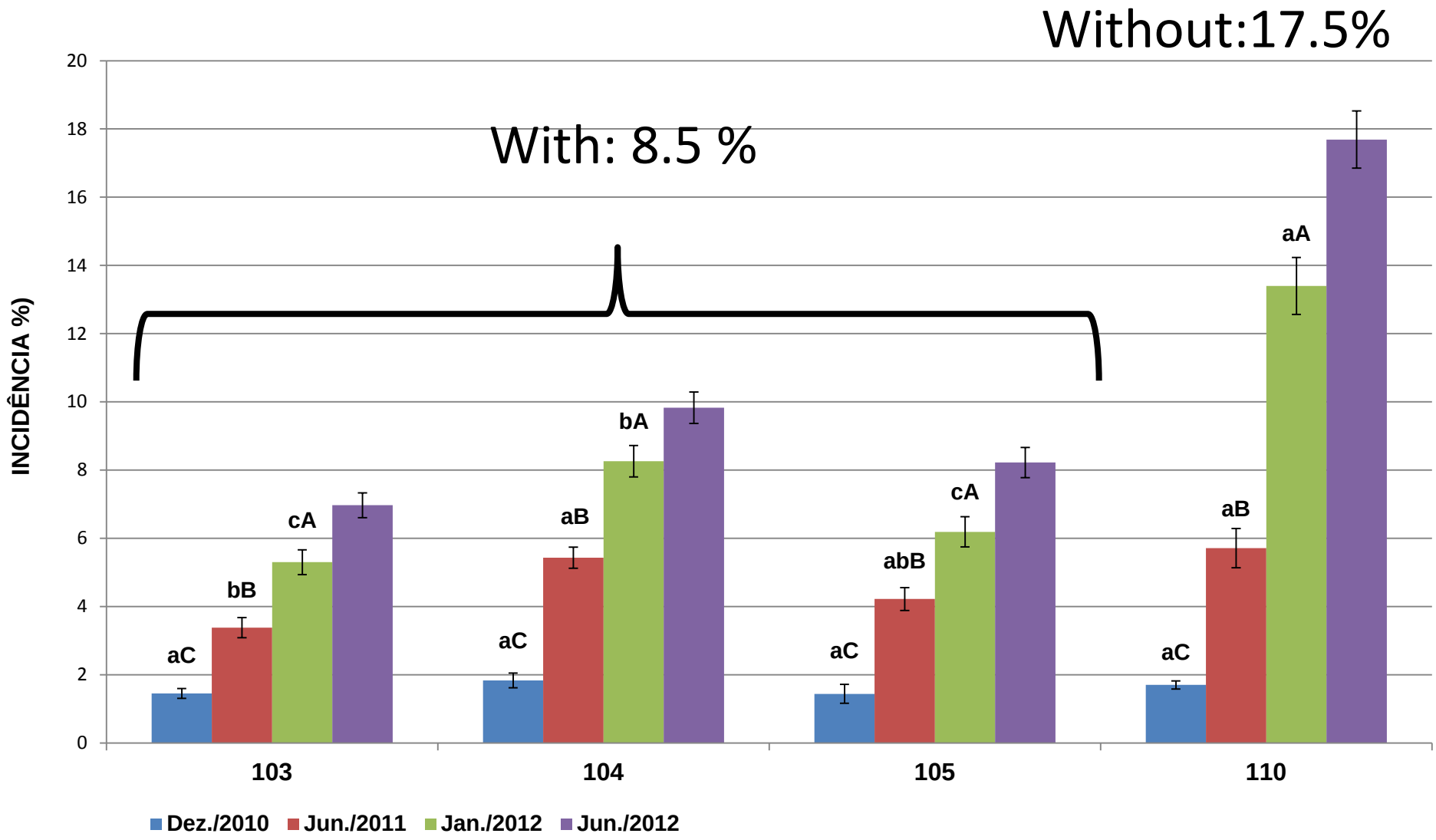
- Plots: 8 rows x 160 plants = 1280 pl./plot
- Nutritional sprays(4 times per year):
  - 1st Year: Dec/10, Jan/11, Mar/11 and Apr/11
  - 2nd Year: Nov/11, Dec/11, Jan/12 and Feb/12

Progress of HLB Incidence from 1.8 % in Dec. 2010 to 10.5 % in June 2012 !



Test-F were not significant for treatments

HLB incidence with and without psyllid control



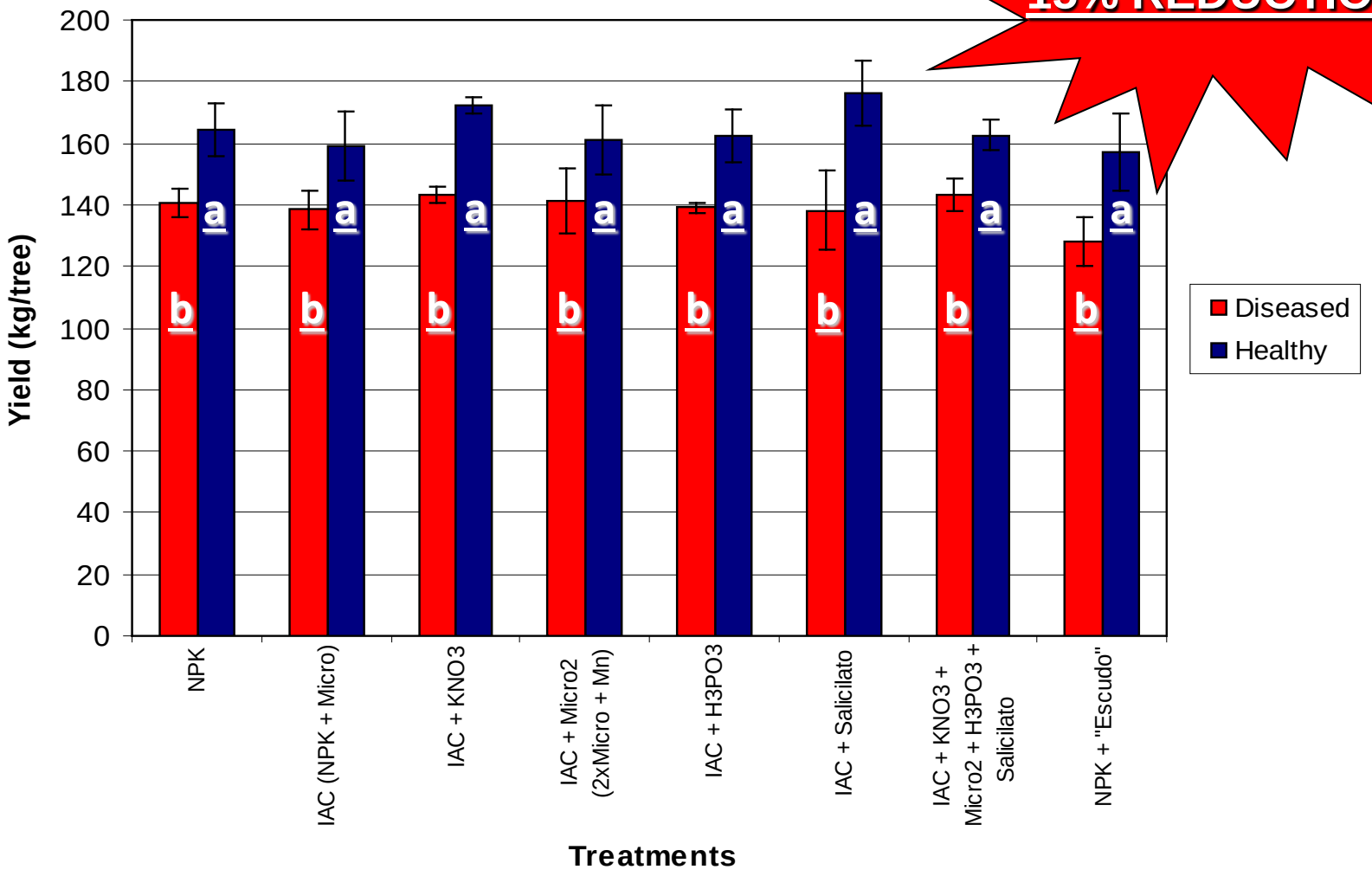

Healthy Tree
with the Complete Nutritional
Treatment: Oct. 2012


HLB Symptomatic Tree
with the Complete Nutritional
Treatment: Oct. 2012

1st year yield - 2011 (kg/tree)

Mean of 4 plots (20 symptomatic and 20 asymptomatic trees per plot)

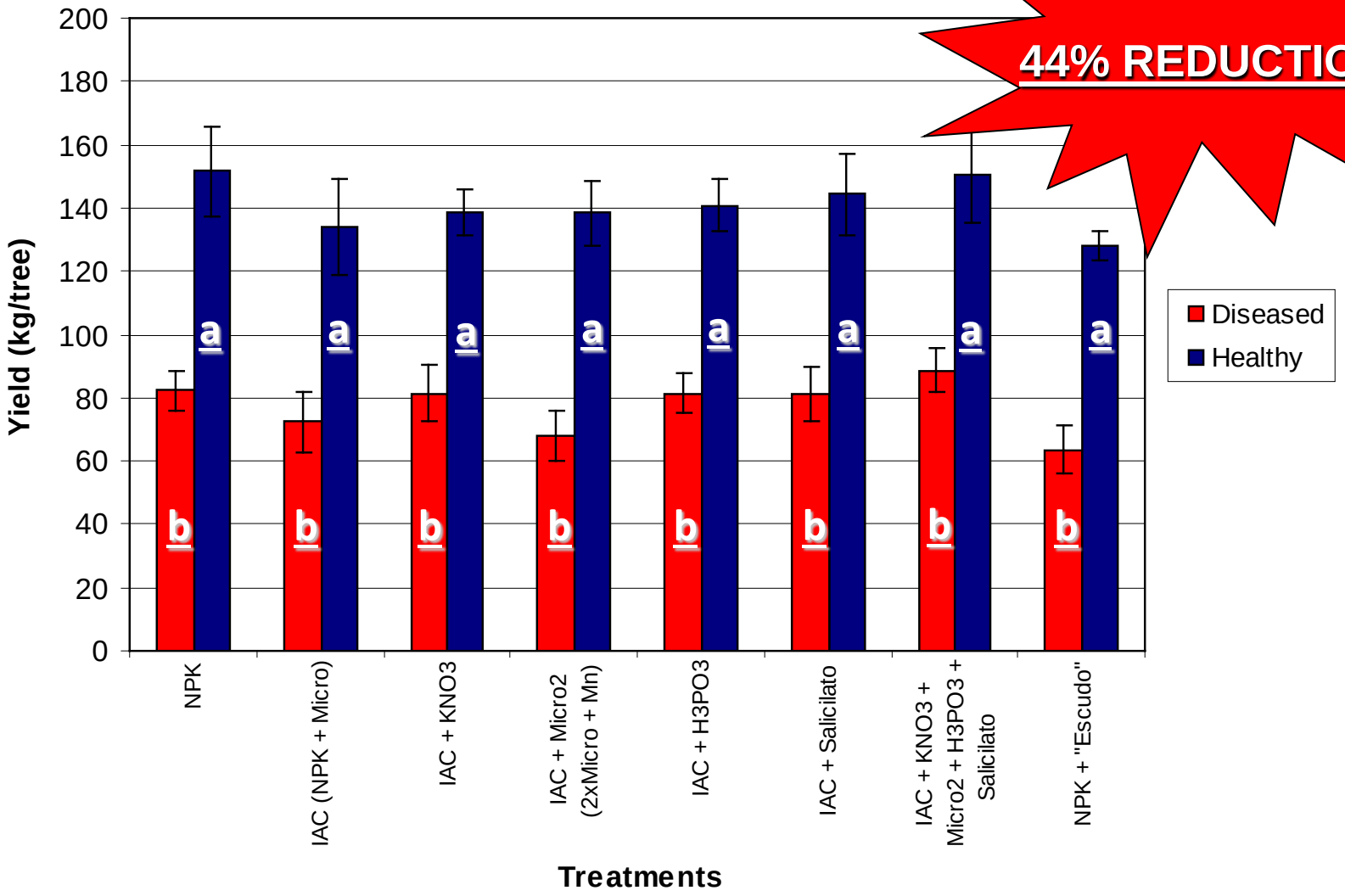
15% REDUCTION



Different letters differed by Tukey test (P<0.01)

2nd Year Yield - 2012 (kg/tree)

Mean of 4 plots (20 symptomatic and 20 asymptomatic trees per plot)



Different letters differed by Tukey test (P<0.01)

Research Priorities

- Inspection Improvement
- Systemic insecticides
- Low-volume applications
- Entomopathogenic fungi
- Pheromones
- Towards Genetically Modified Citrus Trees Resistant to HLB

Controled Greenhouse

Biotecnology Lab

Laboratory for Volatiles Studies

Perspectives for the São Paulo State Citriculture

- North, Northwest, West and South regions are less affected regions and are eligible for HLB management by the TPS
- Regional HLB managment by the TPS should be extended

On the long term, the Paulista citrus industry will depend not only on genetically modified citrus (GMC) trees, but also on regular, non-GMC trees from large areas where HLB is well under control !


THANK YOU