

Current HLB Research in Brazil

Silvio Lopes

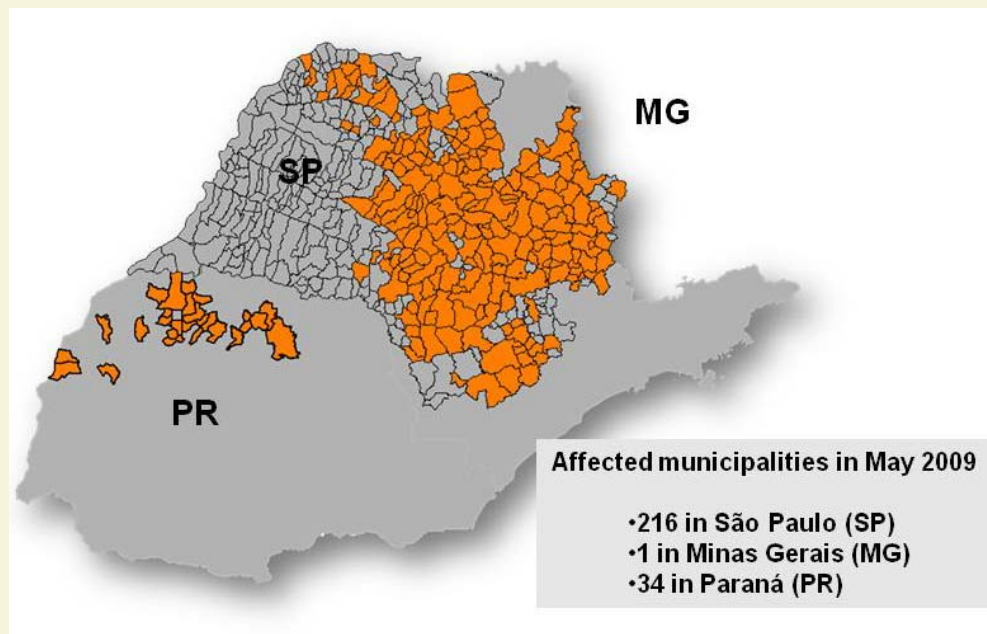
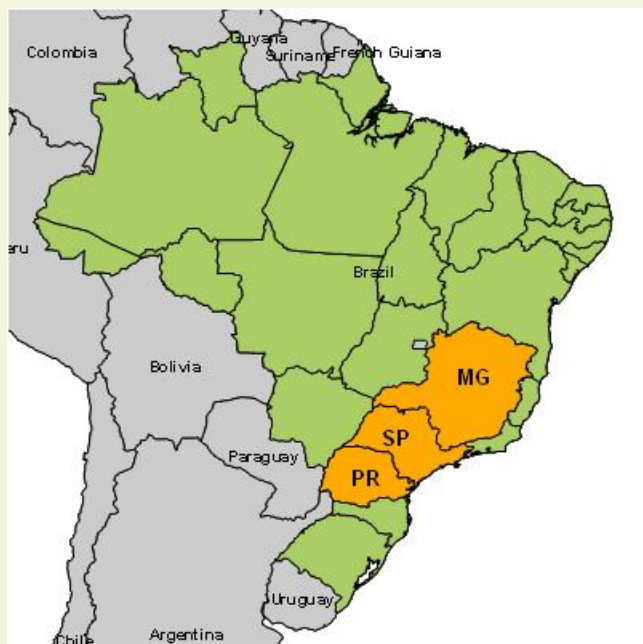
Fundecitrus

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HLB in Brazil

- **What we know about it**
- **What we want to know about it to improve management practices**

HLB is a destructive and fast spreading citrus disease



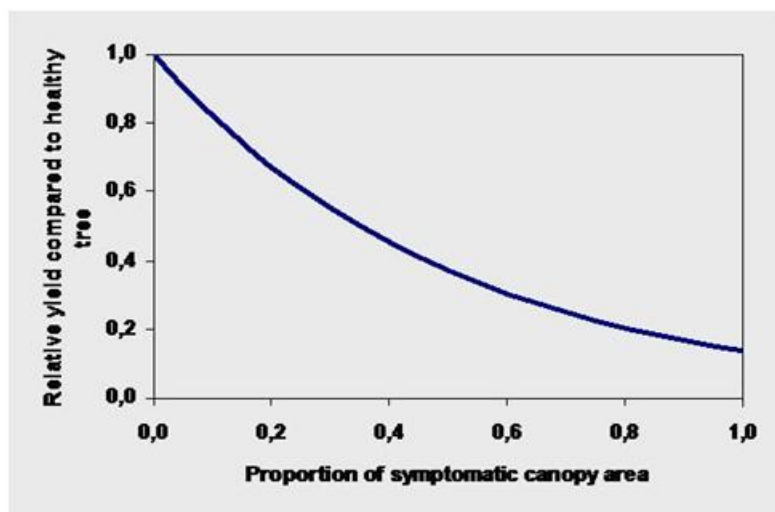
HLB causes severe fruit drop and decrease in fruit quality

Fruit drop



HLB +

HLB -

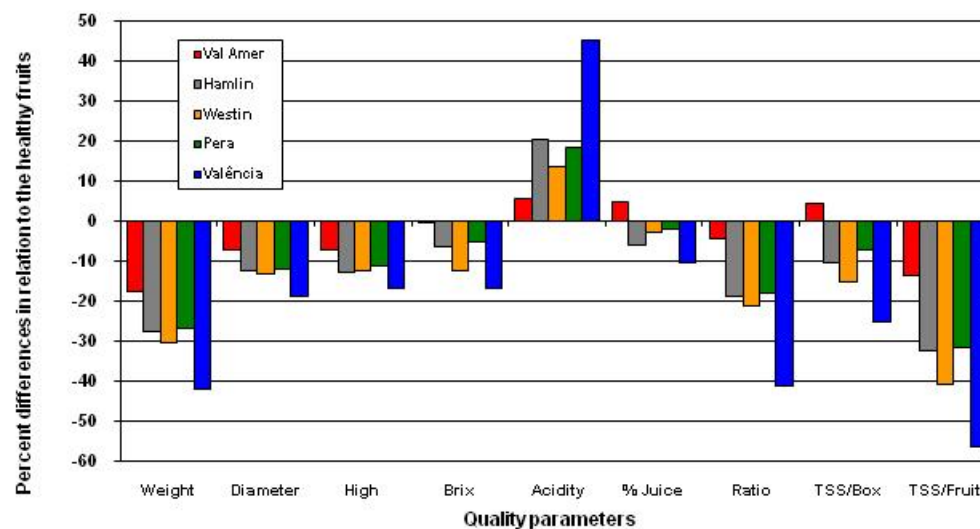


Bassanezi et al, 2006

Fruit quality

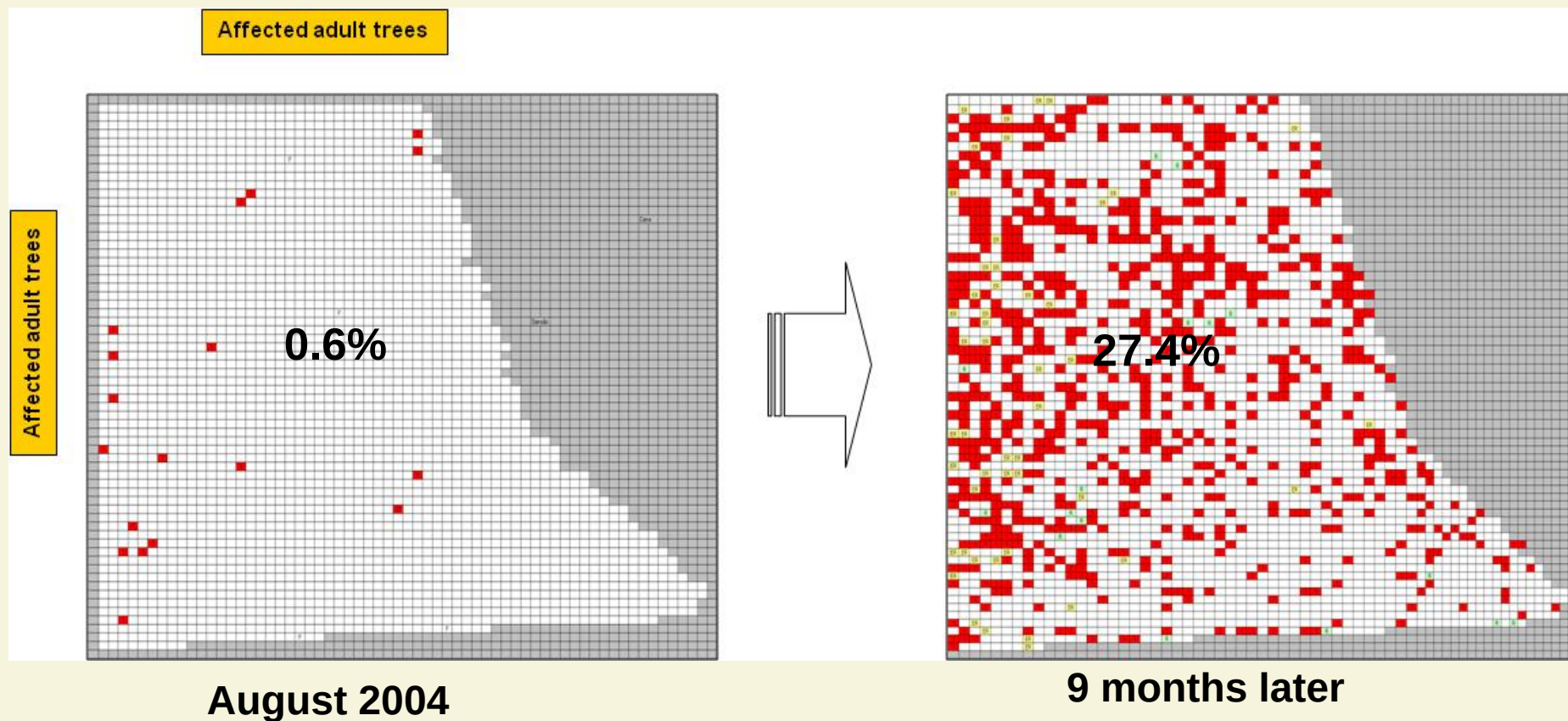


X



The increase in diseased tree incidence can be dramatic

2-y-old Hamlin/Rangpur lime



Bassanezi et al, 2007

HLB is associated to two *Liberibacter* species transmitted by the same insect vector

Candidatus *Liberibacter americanus*
Candidatus *Liberibacter asiaticus*



Ca. *L. asiaticus*

Capoor et al 1967 (India)

Martinez & Wallace 1967 (Philippines)

Ca. *L. americanus*

Yamamoto et al 2006

16S rDNA sequences of *Ca. Liberibacter americanus*, *Ca. Liberibacter asiaticus*, and *Ca. Liberibacter africanus*

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-----G B1-----
          ! ! ! !
C. L. americanus AGGCTTAACACATGCAAGTCGAGCGAGTACGCAAGTACTAGCGGCAGAC
C. L. asiaticus  AGGCCTAACACATGCAAGTCGAGCGCGTATGCAA - TACGAGCGGCAGAC
C. L. africanus  AGGCCTAACACATGCAAGTCGAGCGCGTATTTTA--TACGAGCGGCAGAC
                      ! ! !
                      -----O i1-----
                      -----O a1-----

-----GB3-----
          ! !          ! ! !          ! ! ! ! ! ! ! ! ! !
C. L. americanus CCCCTGCCTATATTTGCCATCA-----TTAA-----GTTGGGA
C. L. asiaticus  CCCCTGCCTCTAGTTGCCATCAAGTTTAGGTTTACCTAGATGTTGGN
C. L. africanus  CCCCTGCCTCTAGTTGCCATCAAGTTTAGGTTTTACCTAGATGTTGGN

          ! !          !
C. L. americanus ACAGAGGGTTGCAAAGTCGCGAGGCGGAGCTAATCCCTAAAAGCCATCTC
C. L. asiaticus  ACAATGGGTTGCGAAGTCGCGAGGCGGAGCTAATCCCCAAAAGCCATCTC
C. L. africanus  ACAATGGGTTGCGAAGTCGCGAGGCGGAGCTAATCCCCAAAGTCCATCTC
                      -----O i2c = O a2c-----
    
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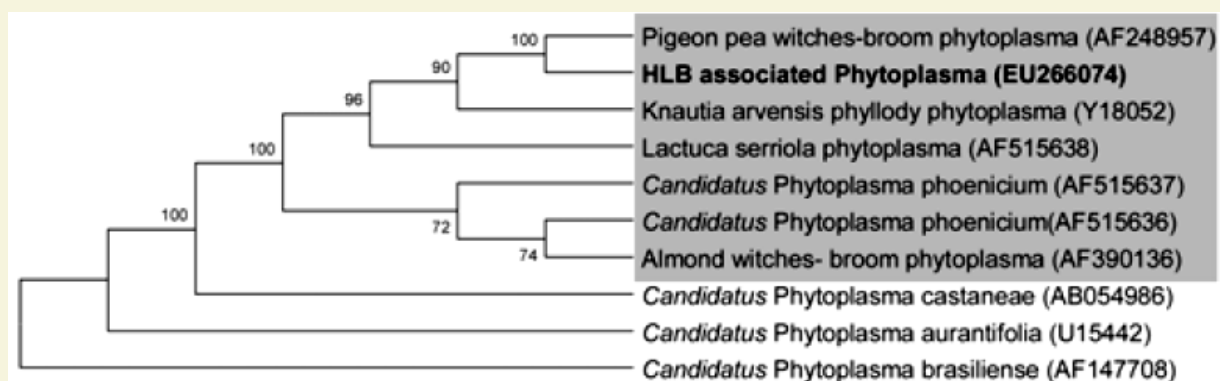
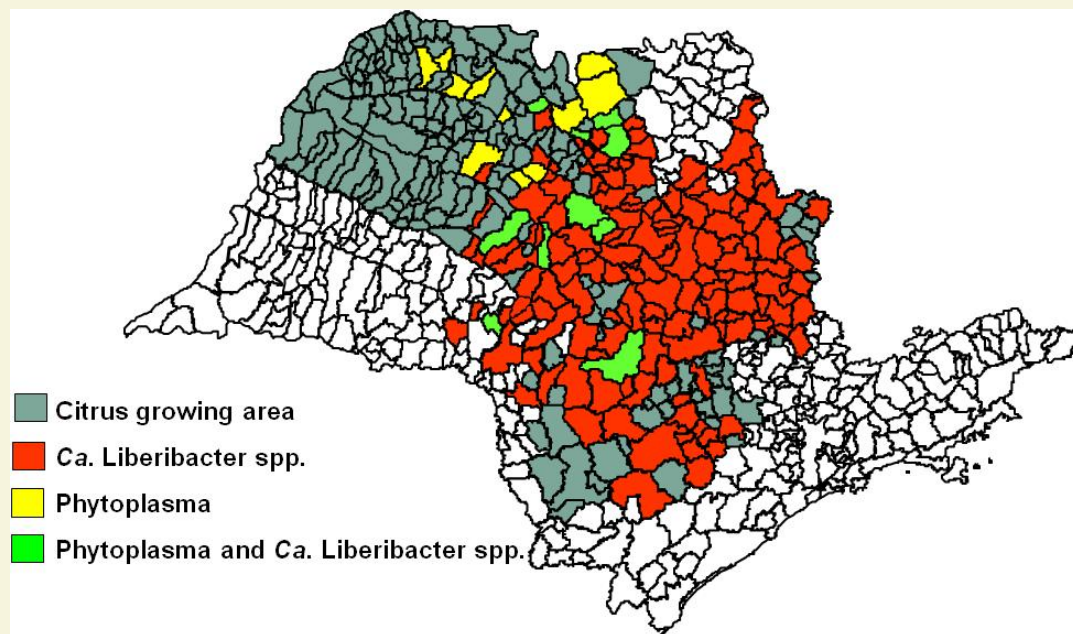
Teixeira et al, 2005

A phytoplasma also was found associated with HLB-like symptoms



PCR + for Phytoplasma;
PCR - for Liberibacter

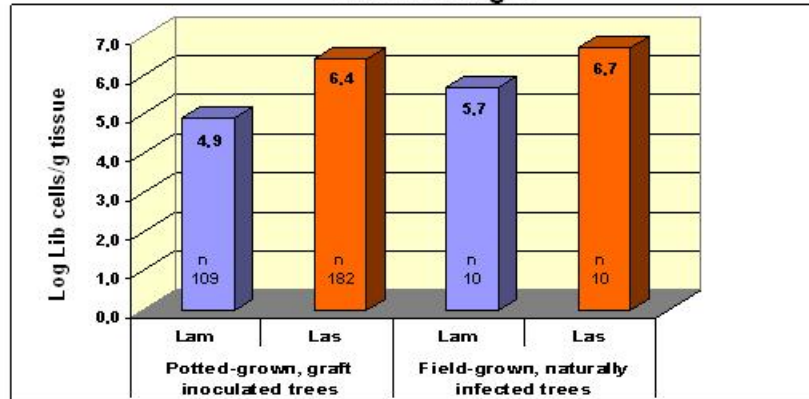
PCR + for Liberibacter
PCR - for Phytoplasma



Teixeira et al, 2005

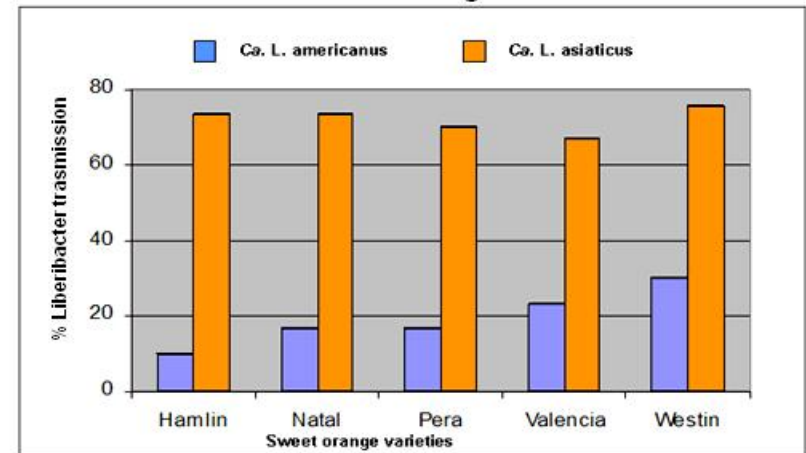
Ca. L. americanus and Ca. L. asiaticus differ in ability to grow in citrus trees

Liberibacter populations in potted and field grown sweet oranges

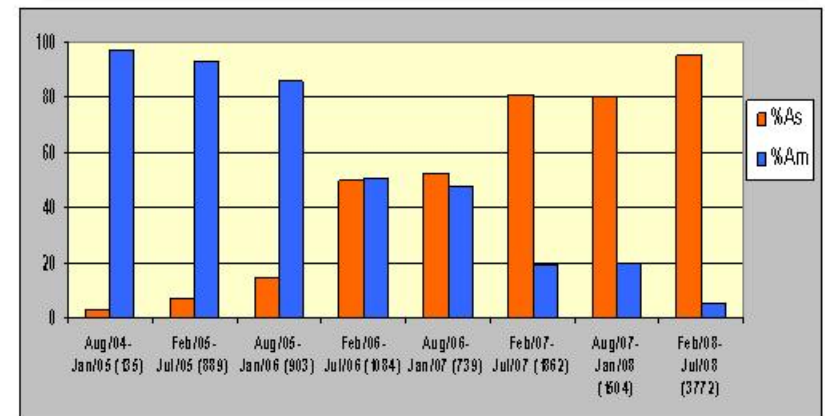


Lopes et al, 2009

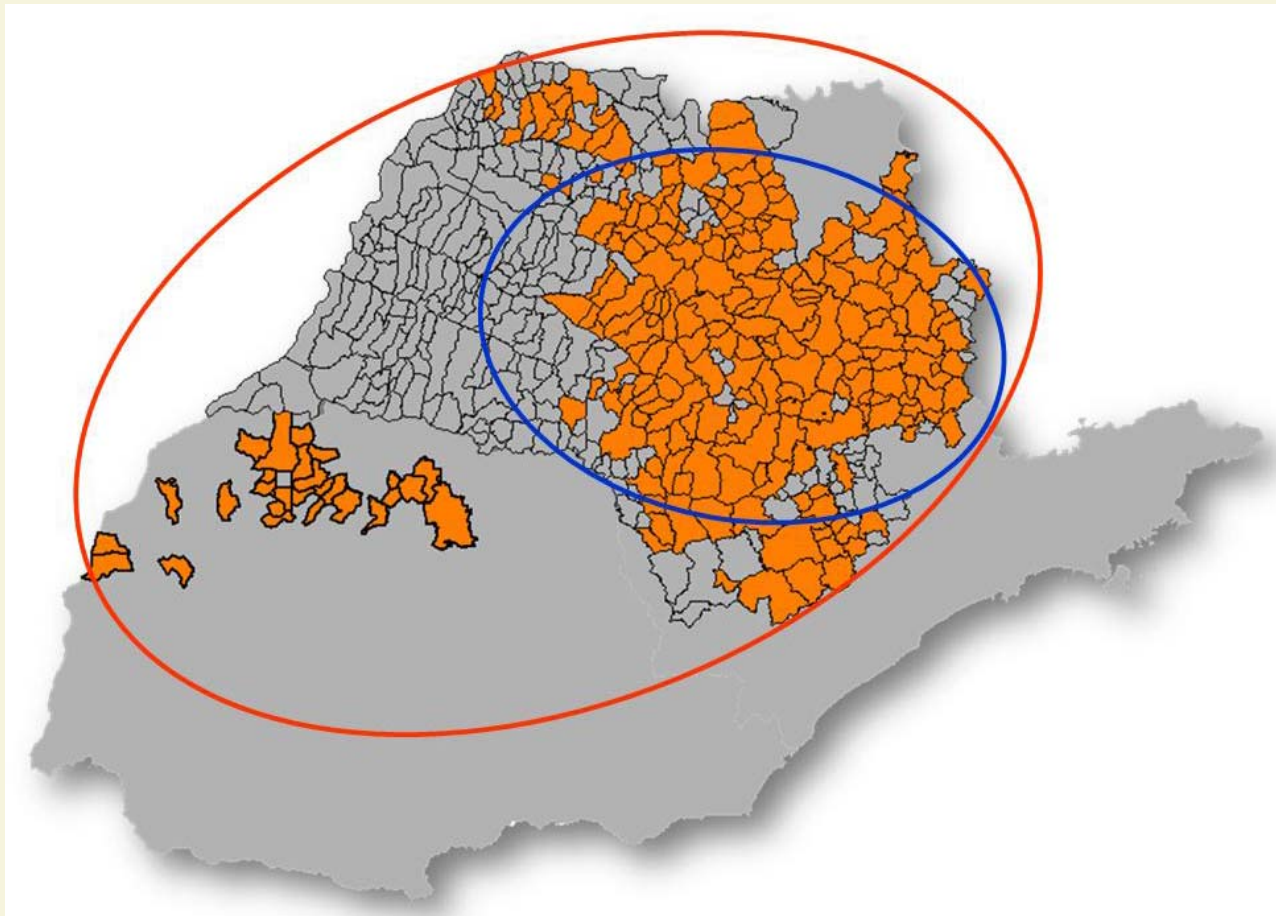
Graft transmission efficiencies of Lam and Las to sweet oranges



Percentages of Lam and Las detections at the Fundecitrus lab from August 2004 to July 2008



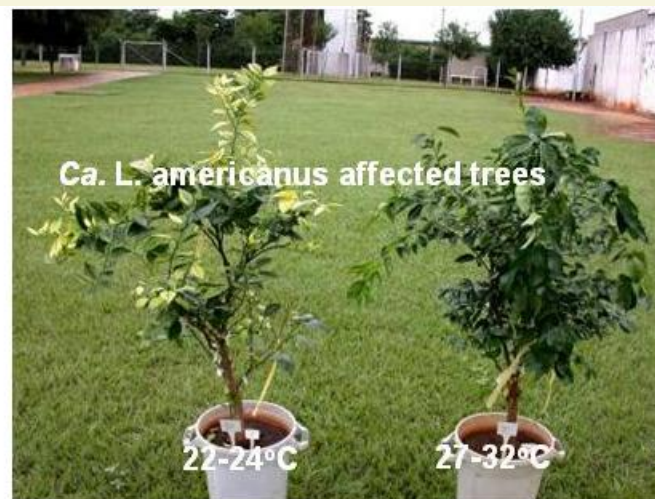
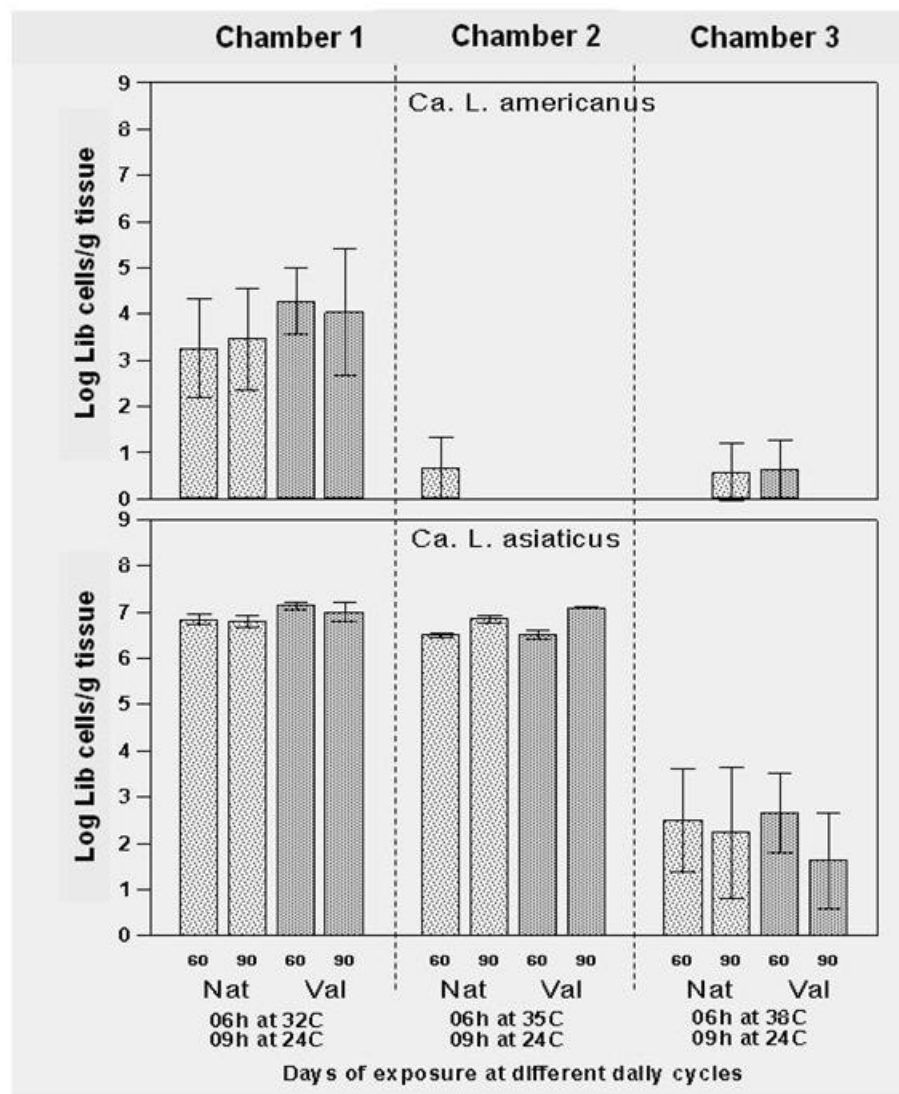
Ca. *L. americanus* and Ca. *L. asiaticus* differ in ability to grow in citrus trees



Ca. *Liberibacter americanus*

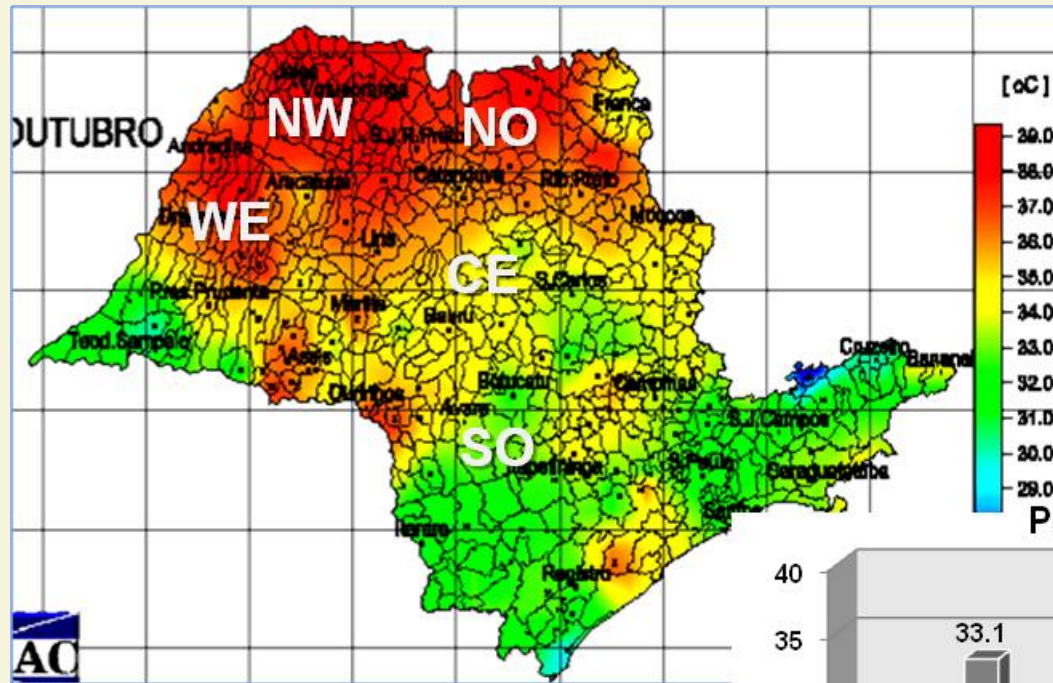
Ca. *Liberibacter asiaticus*

Ca. L. americanus and Ca. L. asiaticus sensitivities do higher temperatures

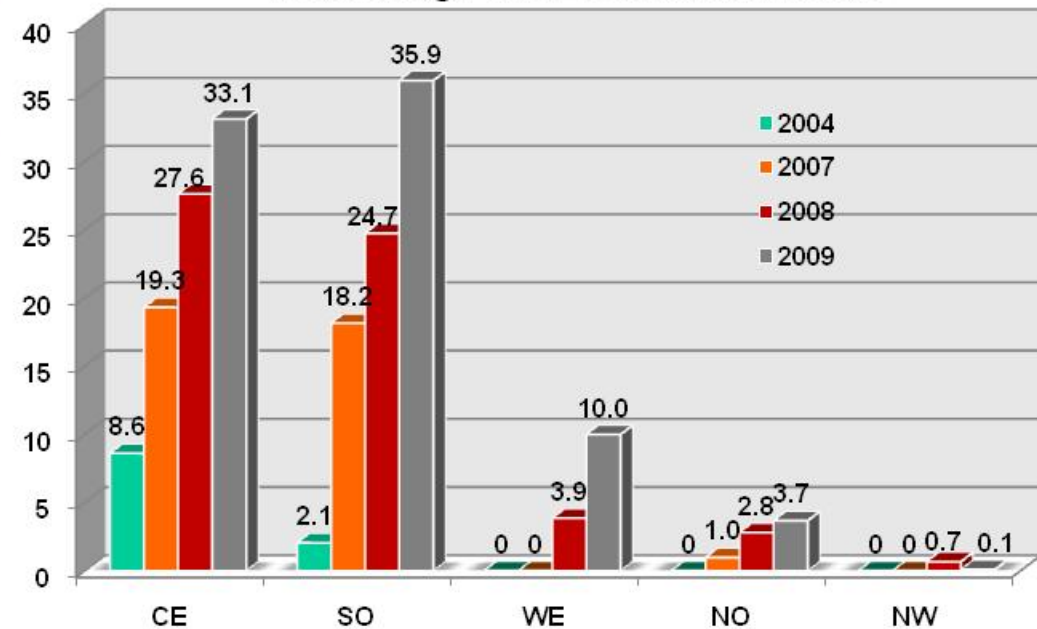


Lopes et al, 2009

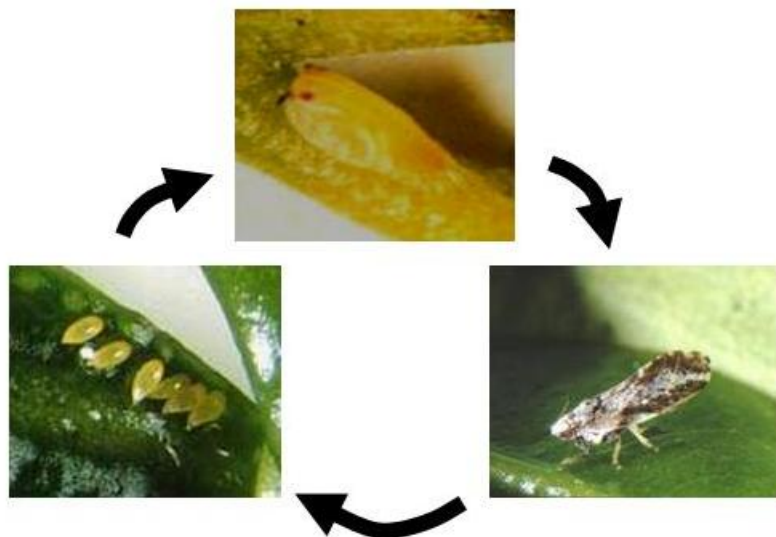
Liberibacter multiplication in citrus trees is affected by high temperatures



Percentage of HLB affected blocks

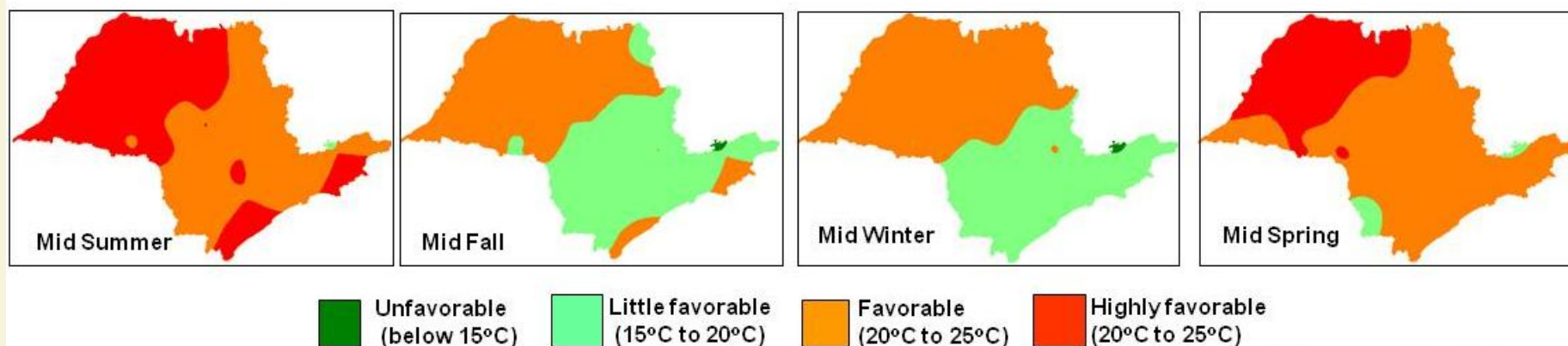


Temperature also influences the length of *D. citri* life cycle



Temperature (°C)	'Pera' sweet orange	
	Egg	Nymph
18	8.2 ±0.08 a	37.6±1.54 a
20	6.9±0.11 b	29.6±1.46 b
22	5.7±0.07 c	23.4±0.25 c
25	4.6±0.18 d	13.2±0.47 d
28	3.6±0.14 e	12.4±0.26 d
30	2.9±0.06 f	11.8±0.47 d
32	3.0±0.09 f	

Parra et al, 2008



Morandini et al. 2005

The Liberibacters also affect orange jasmine trees



Sampled 550 symptomatic trees in 17 municipalities

- 11.4% positive for Lam
- 0.5% positive for Las
- 88.1% negative



Lopes et al, 2005 and 2006

Pruning is not effective in removing all infected tissues

Trees affected by *Ca. L. americanus*



Disease reappeared in 58.3%
of 216 pruned trees



Disease reappeared in 62.5%
of 376 pruned trees

Lopes et al, 2008

The effectiveness of symptomatic tree elimination and insecticide applications is limited in areas of high inoculum pressure



Continuous elimination of symptomatic trees

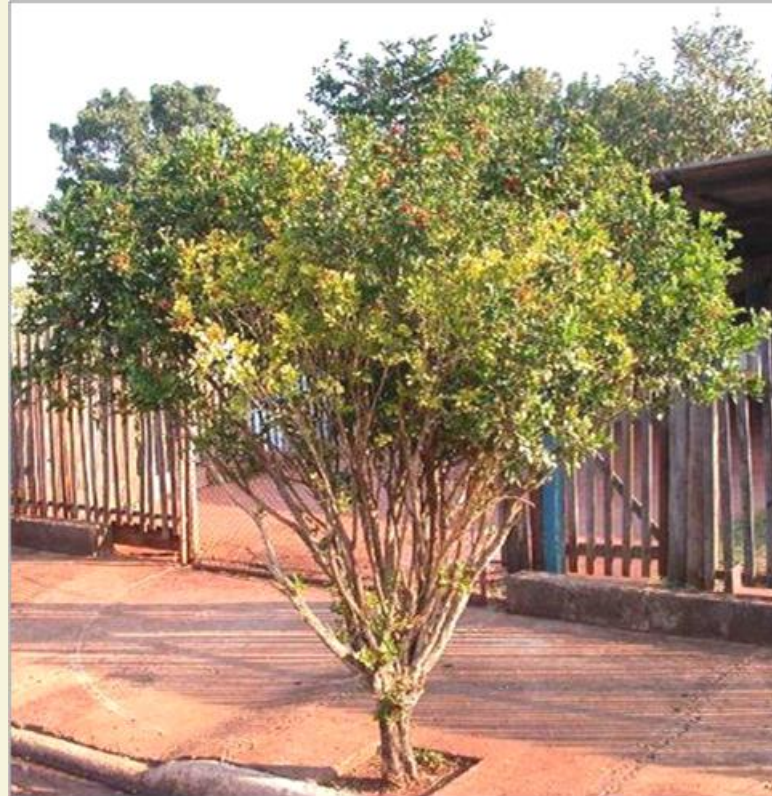


Repeated applications of insecticides

HLB in Brazil

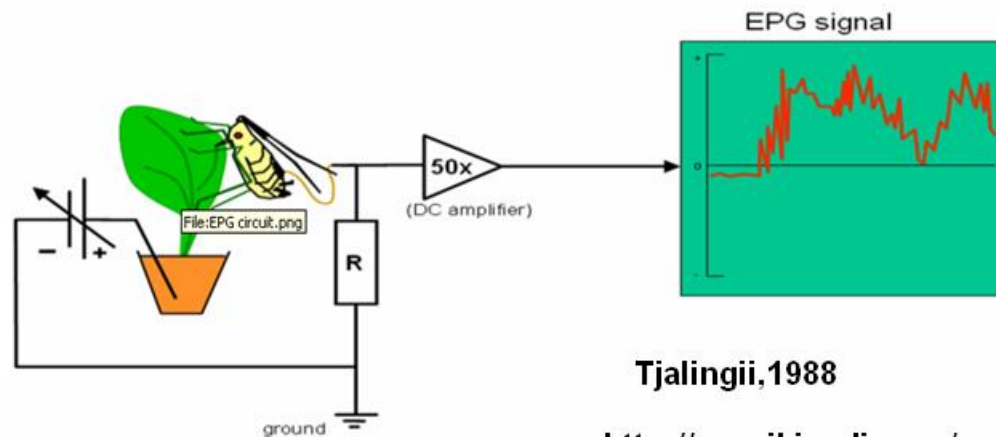
- What we know about it
- What we want to know about it to improve management practices

The role of asymptomatic citrus and of *M. paniculata* as source of inoculum to citrus trees



Efficacy of insecticide application in preventing *Liberibacter* transmission

The electrical penetration graph (EPG) technique



Tjalingii, 1988

<http://en.wikipedia.org/>



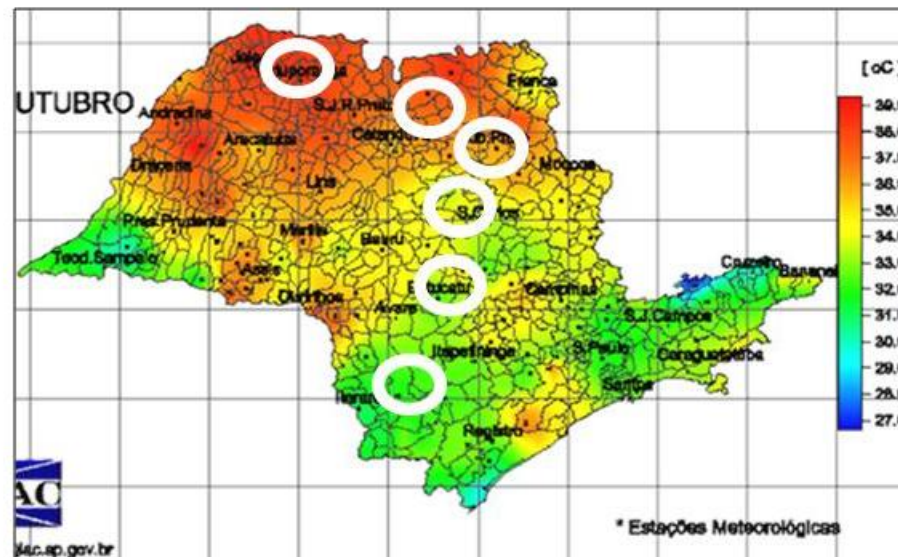
- How long does it take for the insect to reach the phloem?
- How vulnerable it is to insecticide during this process?
- Can it acquire the bacteria from or transmit it to an insecticide treated tree?

Pedreira et al, underway

The relative importance of tree elimination and insecticide application in disease suppression



The influence of temperature seasonal changes on *Liberibacter* multiplication in citrus and in *D. citri*





Thank you