

# Metabolic profiling of shoot apices infested by the peach-potato aphid in susceptible and resistant peach cultivars

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## Context

### *Prunus persica* / *Myzus persicae* a model system to study plant resistance to phloem feeding insects

- Peach**
  - primary host for *M. persicae*
  - model species for Rosaceae with genomic resources (Genome Database for Rosaceae (GDR))
  - different sources of resistance available
- Peach-potato aphid**
  - phloem feeding insect belonging to Hemiptera order (aphids, whiteflies, planthoppers)
  - most studied aphid species
- Plant/aphid relationships**
  - a specialized, long lasting interaction, intermediate between plant/herbivore and plant/pathogen systems
  - several targeted biochemical studies of plant response (Kaloshian and Walling 2005)
  - emerging of transcriptomics of plant defense induction (Thompson and Goggin 2006)

### *Myzus persicae* Sulzer peach-potato aphid

- a main threat for peach (*Prunus persica*) (primary host)
- and for many other crops as solanaceous vegetables (secondary hosts)
- observed resistances to all pesticides
- vector of viruses such as Plum Pox Virus (Sharka, quarantine disease)
- Objective**
  - Development of durable-resistant cultivars to control aphids and reduce the use of pesticides through a better knowledge of peach/aphid relationships

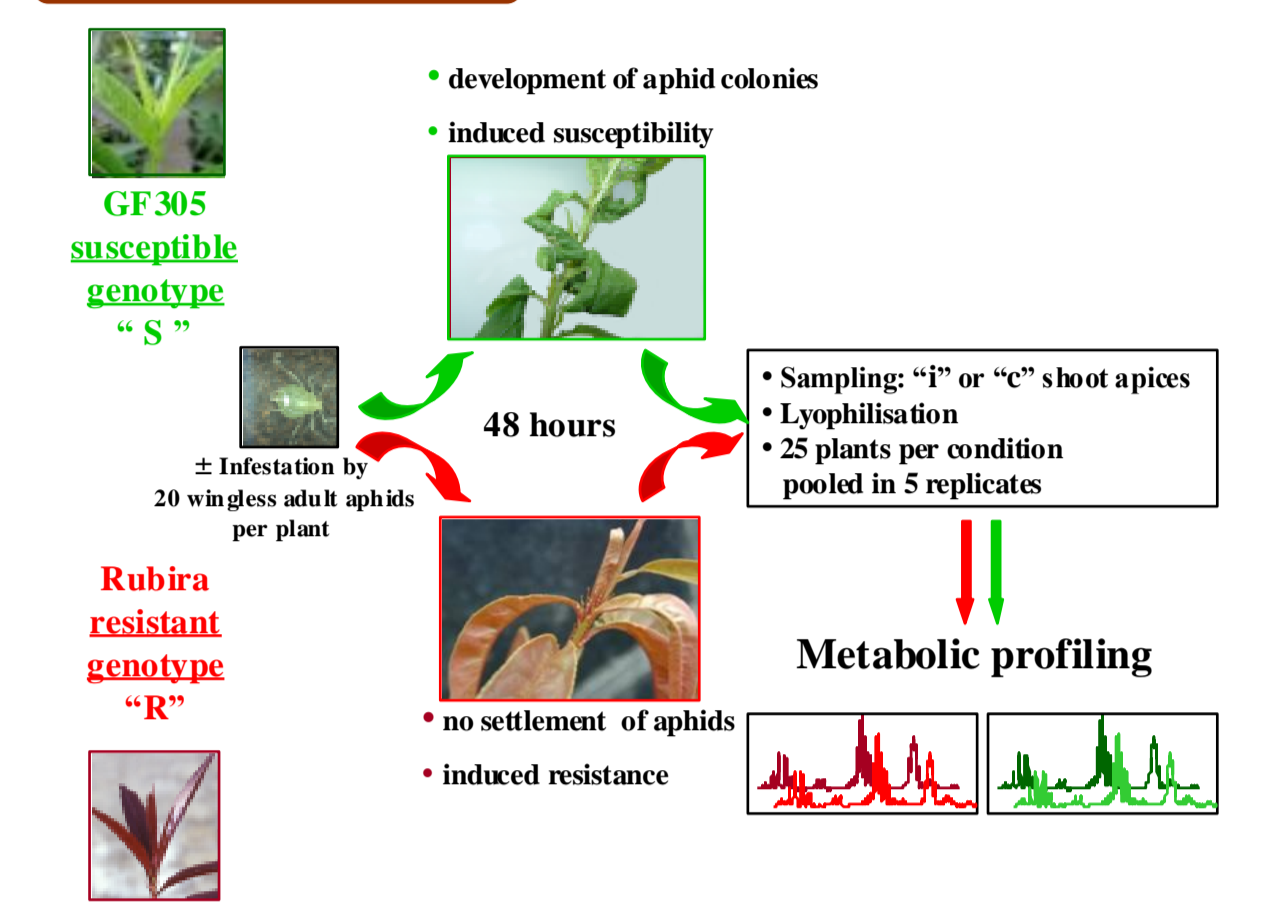
### Rubira: a peach cultivar resistant to *Myzus persicae*

- Rubira: a red leaf peach cultivar
  - used as rootstock
  - bearing a dominant gene of resistance to *Myzus persicae* (Pascal et al., 2002)
- Induced resistance occurring two days after infestation (Sauge et al. 2002, 2006)
  - Running away of aphids from Rubira resistant plants within few days (antixenosis)
  - Local reaction around feeding sites on Rubira on a green-leaf resistant Rubira hybrid

Comparative metabolomics of resistant / susceptible cvs after infestation

## Material and methods

### Experiment design



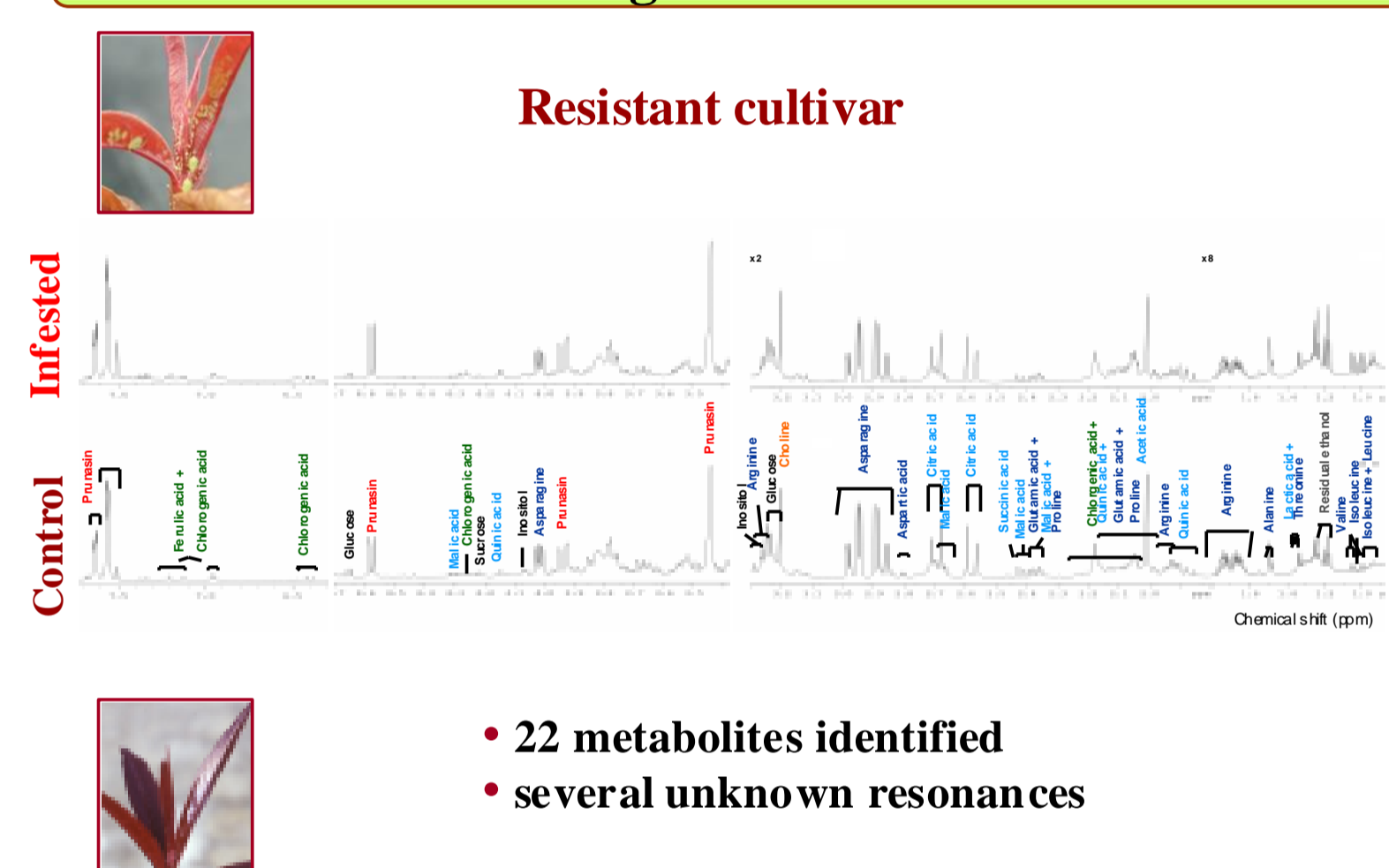
### Analytical strategy of shoot apices profiling

- ID <sup>1</sup>H NMR non-targeted profiling of polar metabolites
  - HPLC targeted analyses
- | Metabolites           | Extraction                            | Separation     | Detection     |
|-----------------------|---------------------------------------|----------------|---------------|
| Primary metabolites   | Ethanol/H <sub>2</sub> O serie, 80° C | anion exchange | PAD           |
| Secondary metabolites | Ethanol/H <sub>2</sub> O 70/30, 4° C  | anion exchange | conductivity  |
| amino acids           | Ethanol/H <sub>2</sub> O 70/30, 4° C  | reverse phase  | fluorescence  |
| cyano-genic compounds | Ethanol/H <sub>2</sub> O 70/30, 4° C  | reverse phase  | UV absorbance |
| phenolic compounds    | Ethanol/H <sub>2</sub> O 70/30, 4° C  | reverse phase  | UV absorbance |

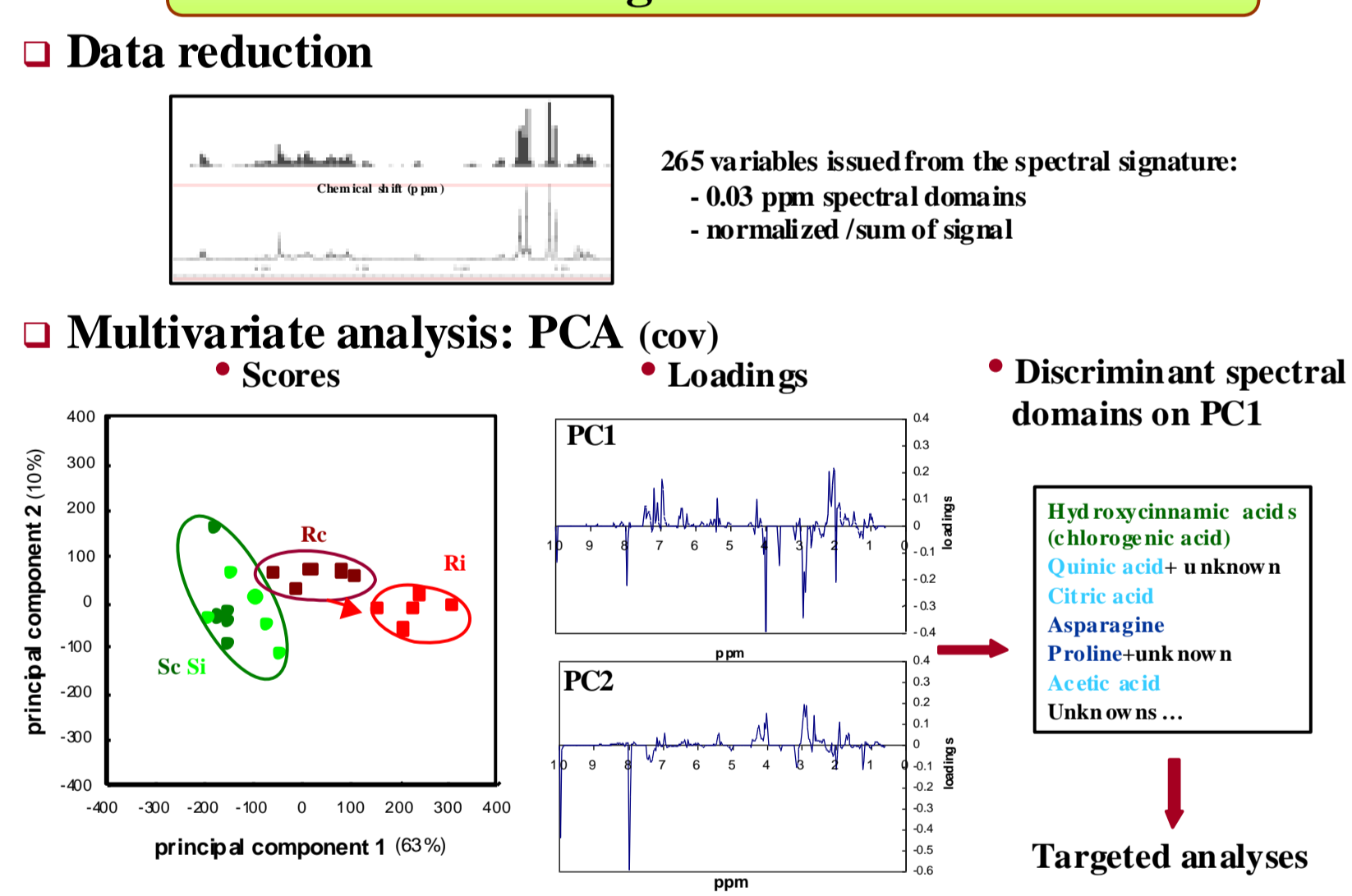
## Results

### <sup>1</sup>H NMR

#### Representative <sup>1</sup>H-NMR spectra of polar extracts and assigned resonances

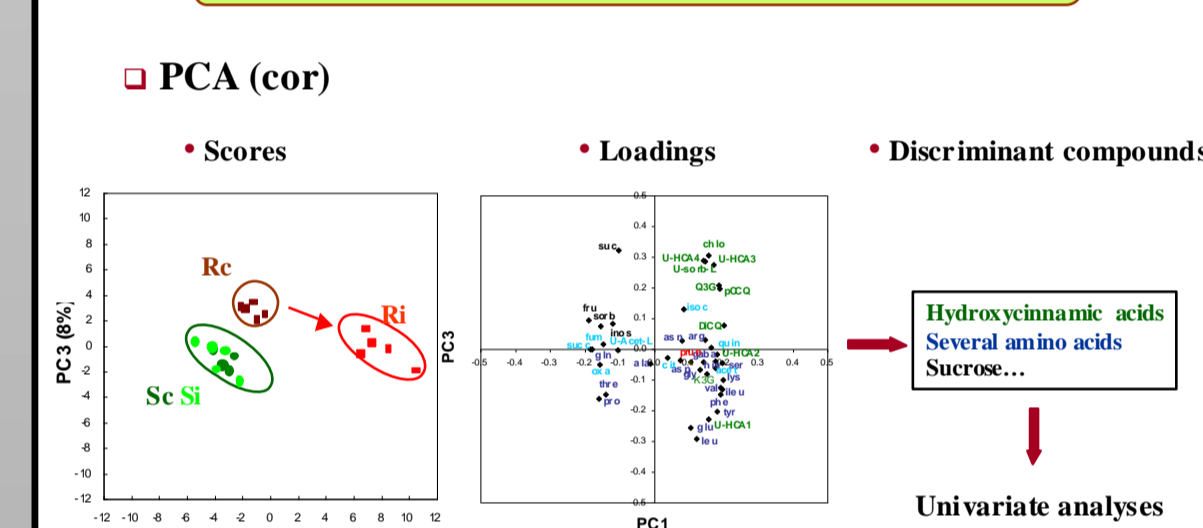


#### Analyses of the <sup>1</sup>H-NMR spectral signatures

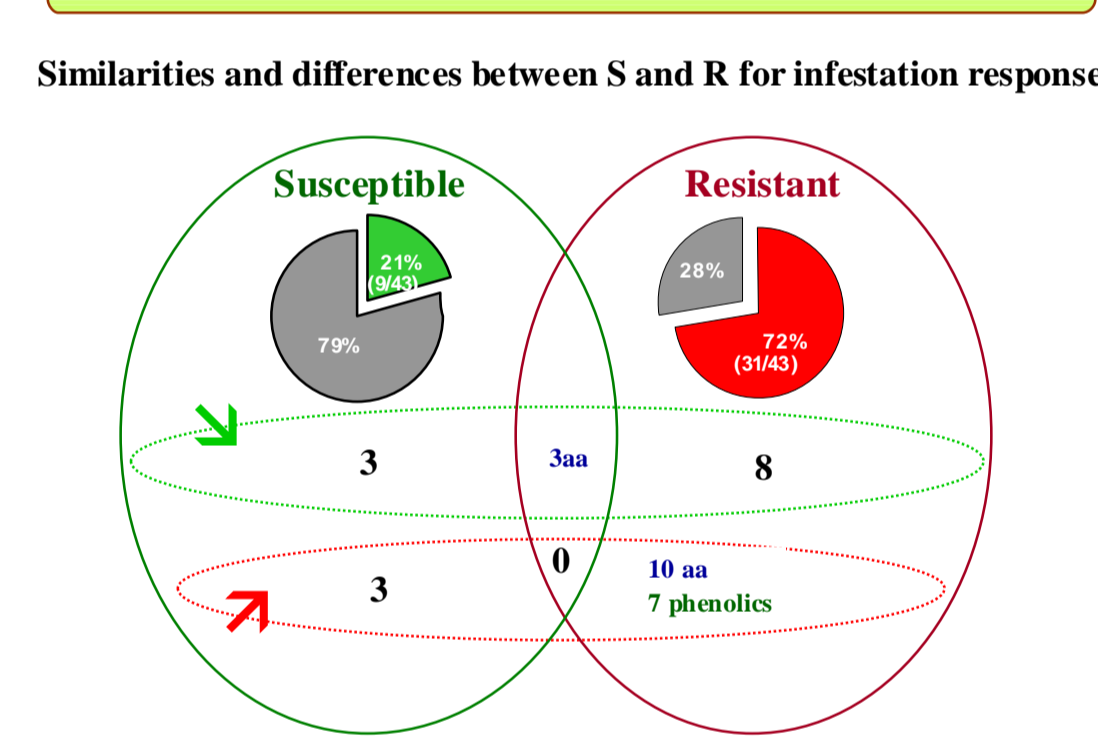


### HPLC

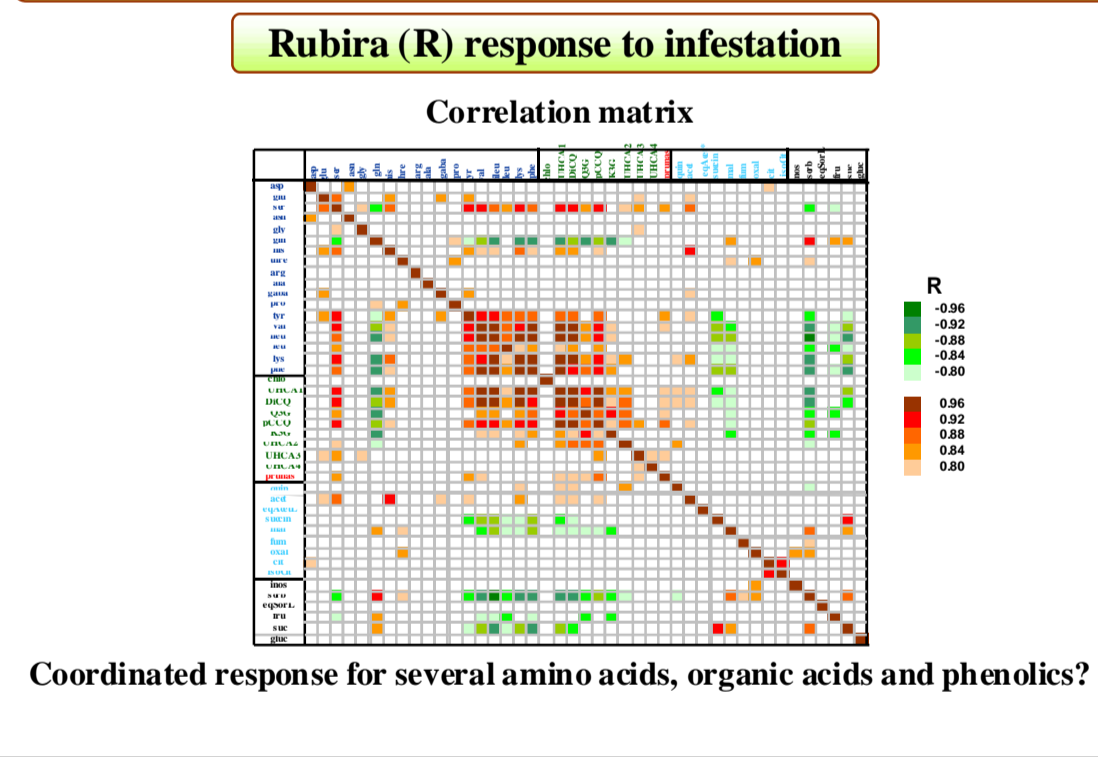
#### Targeted HPLC analyses Multivariate analysis on 43 metabolites



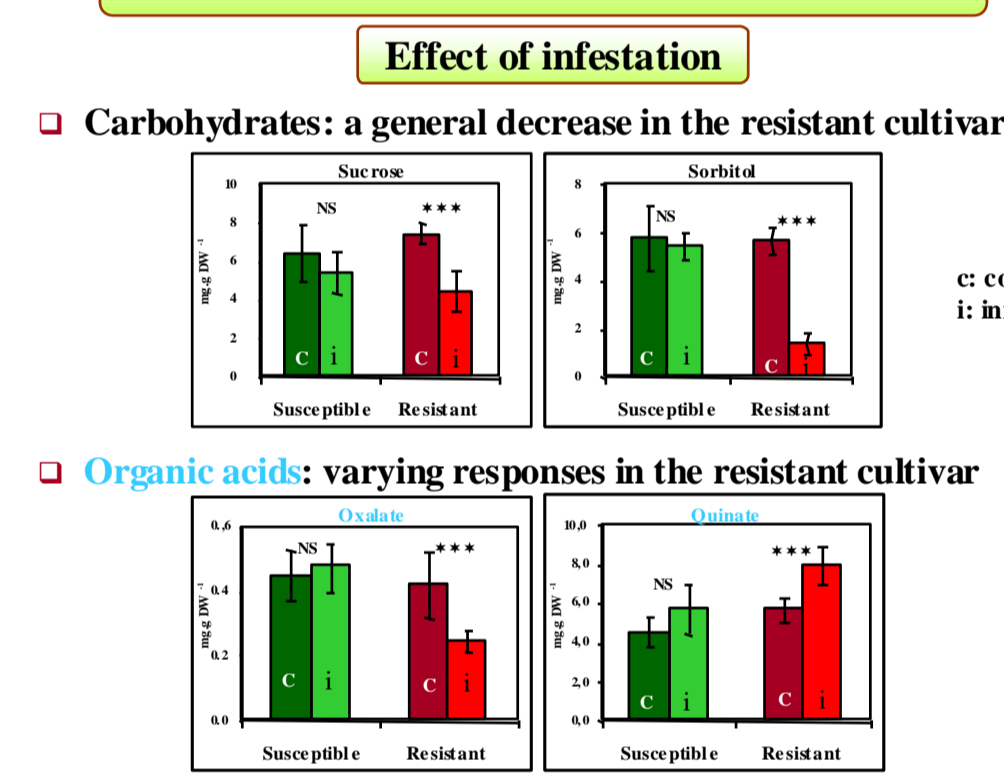
#### Targeted HPLC: overview on 43 metabolites



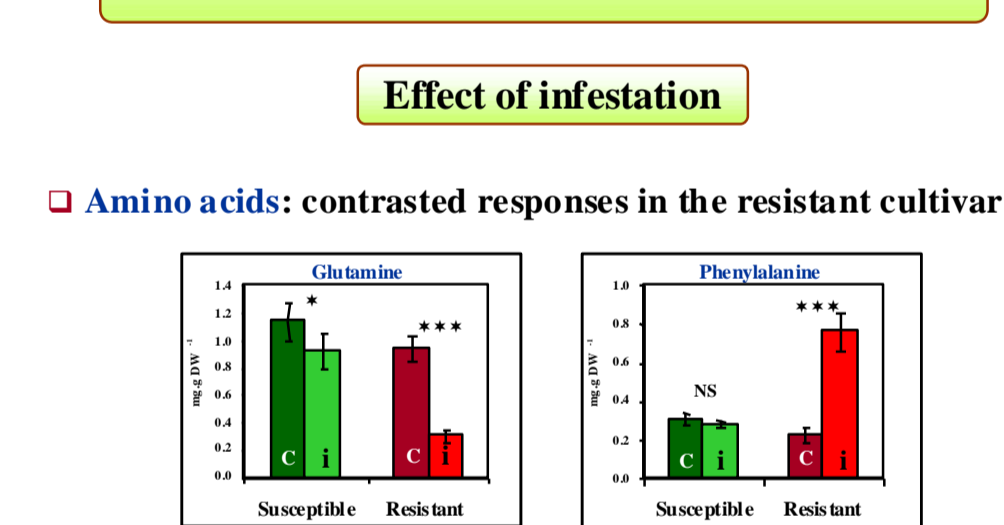
#### Targeted HPLC: correlations between 43 metabolites



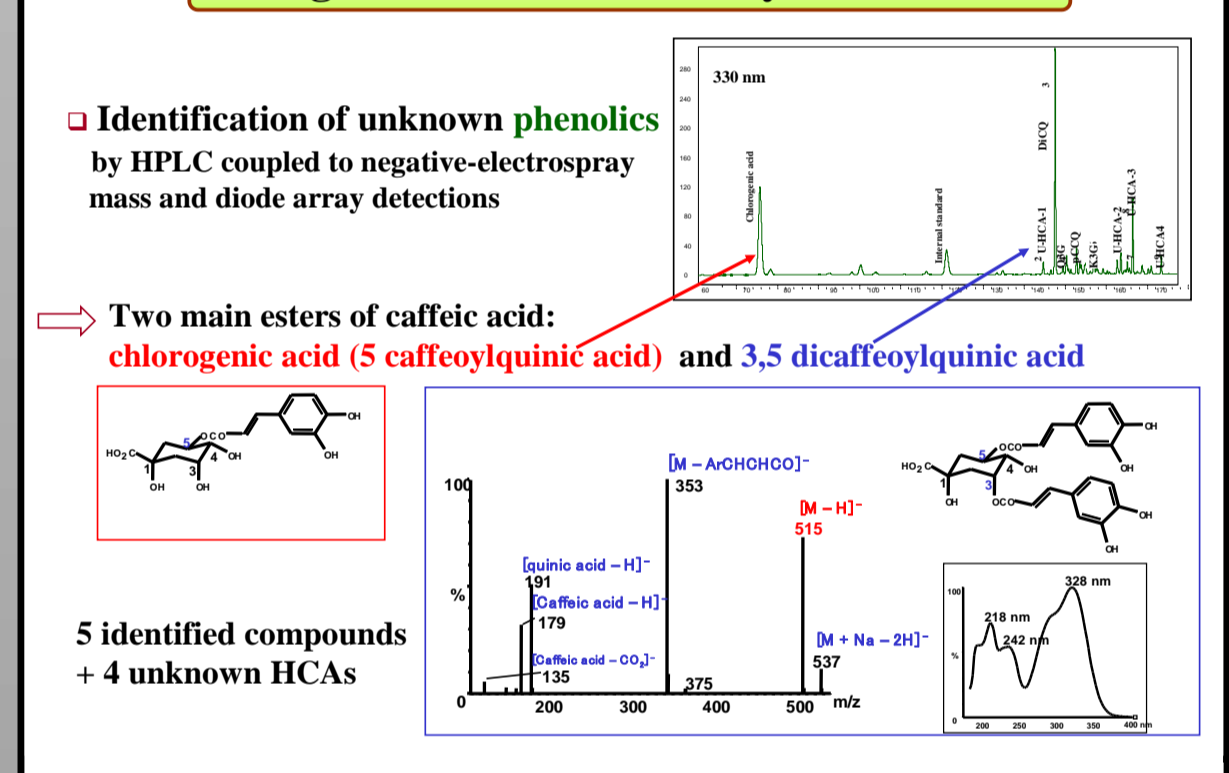
#### Targeted HPLC: primary metabolites



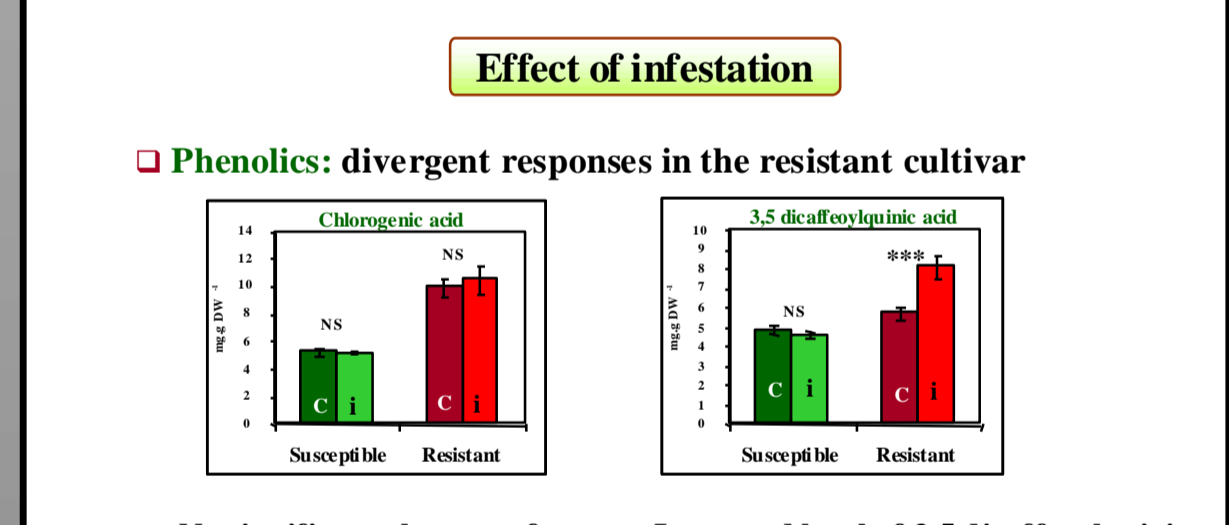
#### Targeted HPLC: primary metabolites



#### Targeted HPLC: secondary metabolites

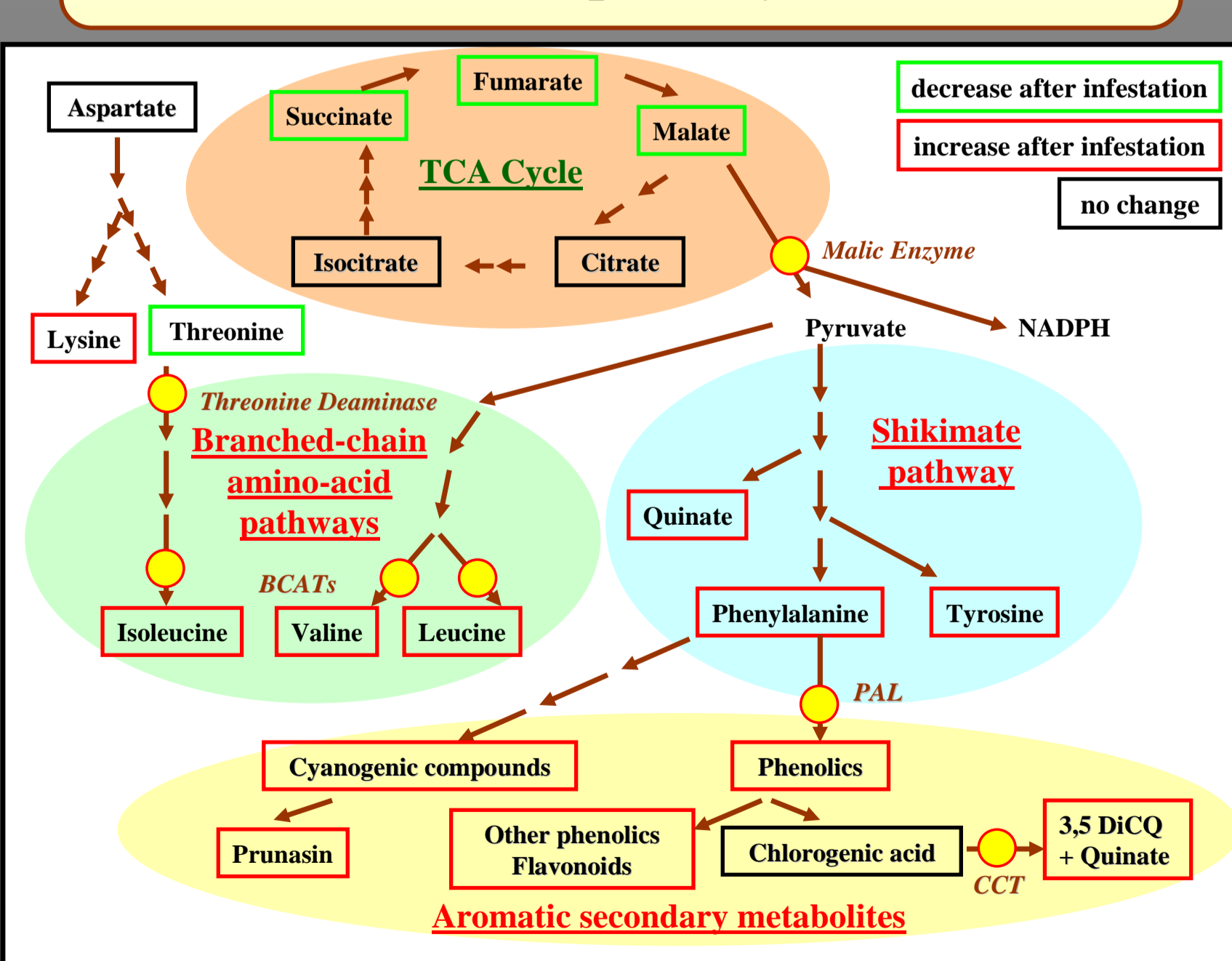


#### Targeted HPLC: secondary metabolites

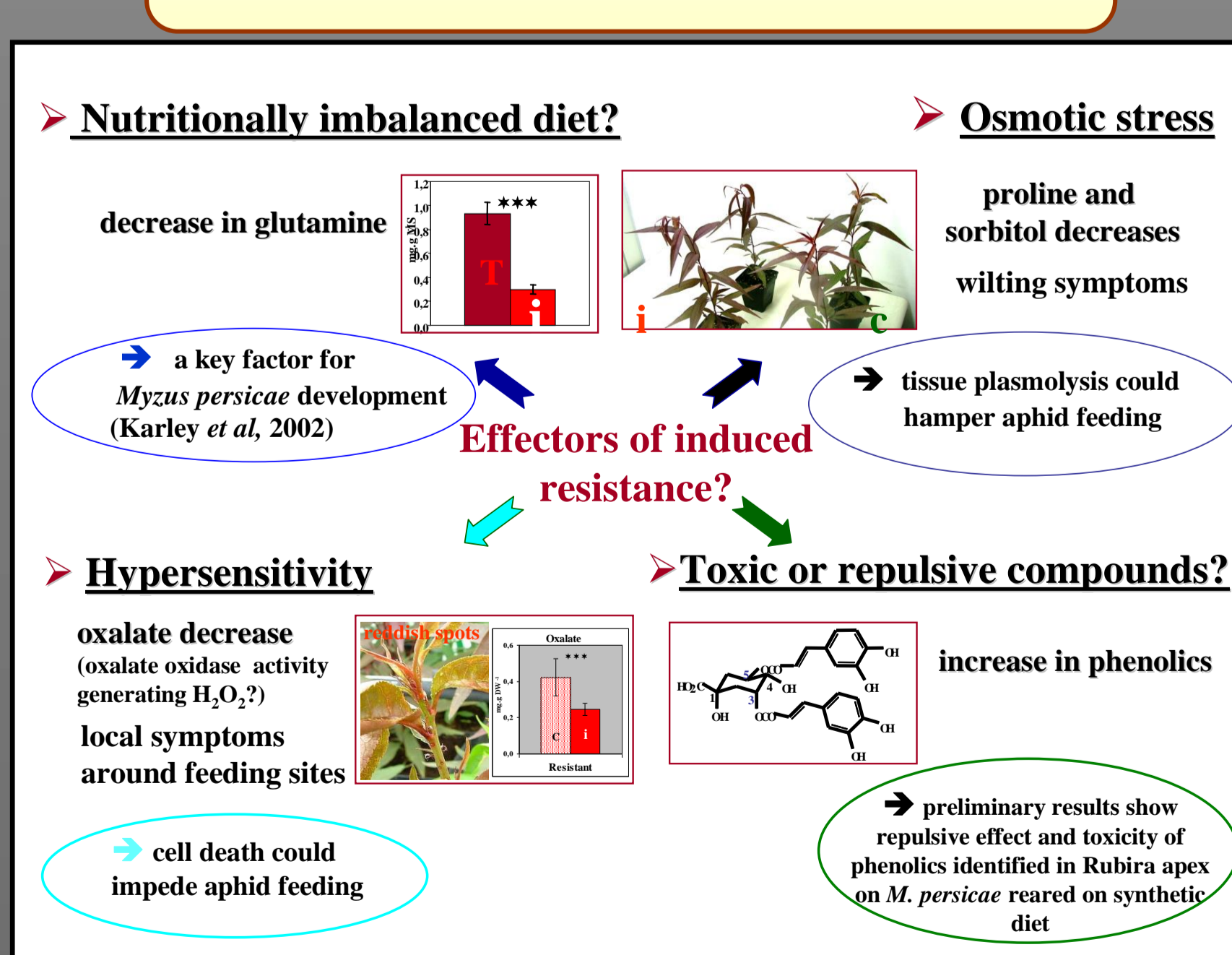


## Discussion

### Rubira (R) response to infestation: which metabolic pathways involved?



### Some hypotheses on mechanisms involved in resistance...



## Conclusions and perspectives

- Conclusions
- First metabolomic approach of plant / phloem feeding insect interactions
    - towards system biology approach
  - Contrasted responses in susceptible and resistant genotypes
    - high metabolic changes associated with induced resistance
  - Several metabolite families and metabolic pathways involved
    - primary and secondary metabolites

### Perspectives

- Metabolomics
  - Analyses of non-polar compounds
  - Analyses of volatiles (M Sautet, CNRS, Montpellier)
  - Time course and tissue localisation of infestation responses
- Phenolics
  - Isolation of candidate compounds for toxicity or repulsive effects on *M. persicae*
  - Metabolism and regulation of candidate compounds
- Transcriptomics
  - Comparison with metabolite responses

## References

- Kaloshian I, Walling LL. 2005. Hemipterans as plant pathogens. *Annual Review of Phytopathology* 43: 491-521.  
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