

# Risks of aphid adaptation to caffeic acid derivatives used as bioinsecticides

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Resistance'19 Rothamsted, Harpenden, UK - 16-18 sept 2019

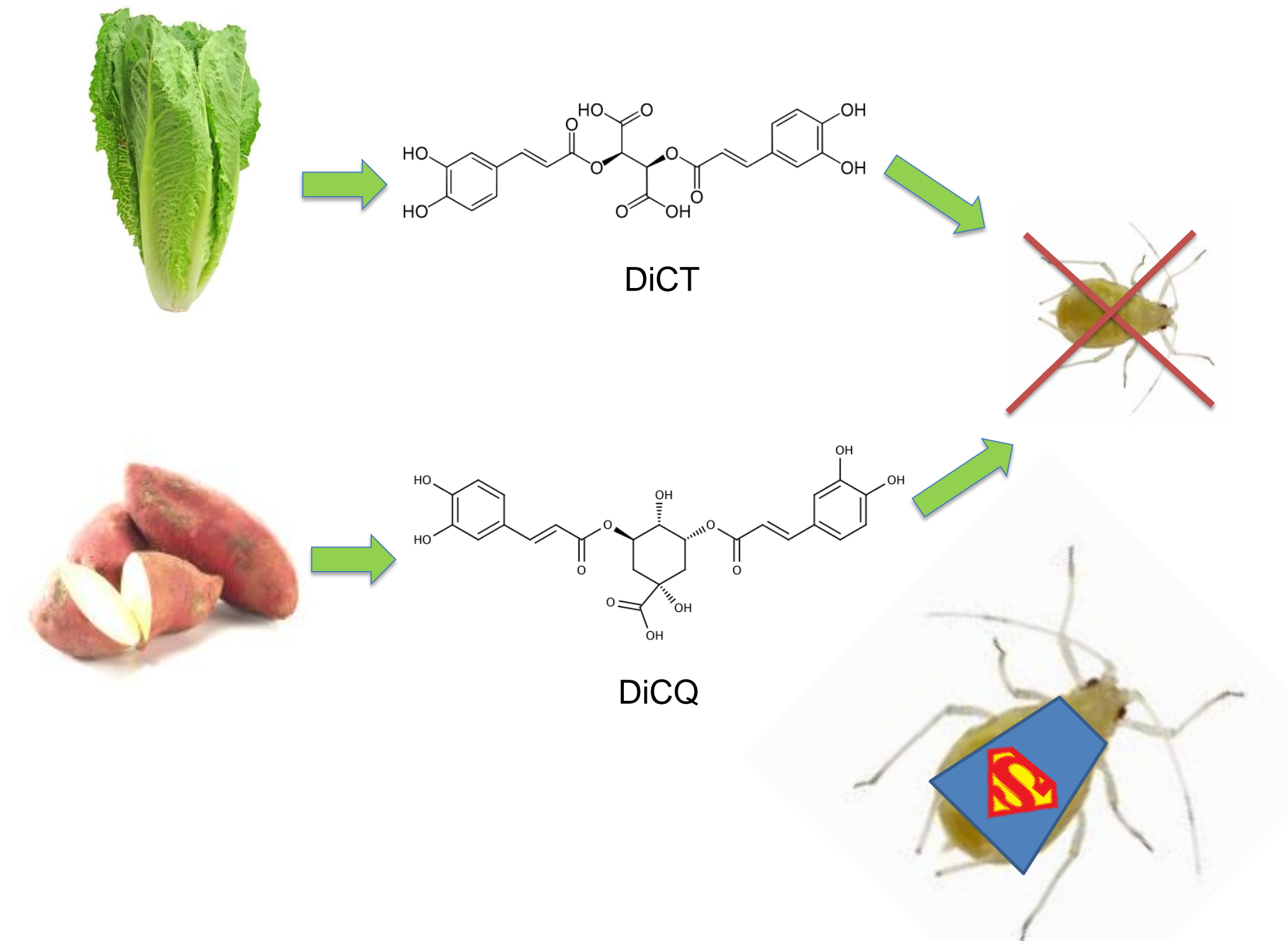
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## Introduction

In Dicabio project we are looking if Dicafeoylquinic (DiCQ) and Dicafeoyltartaric (DiCT, chicoric acid) acids, natural substances toxic for aphids, can be used for their biocontrol. However, aphids are well known for quickly developing resistances to different insecticides. Bioinsecticides have a reputation of better sustainability, but several have already been bypassed. Mechanisms of resistance developed by pests for natural substances are often those used to resist chemical insecticides.

## Goal

- Estimate the sustainability of these two molecules
- If we find resistant aphids, determine their resistance mechanisms
- Compare the mechanisms between biocontrol agent and chemical insecticides? Cross-resistances?

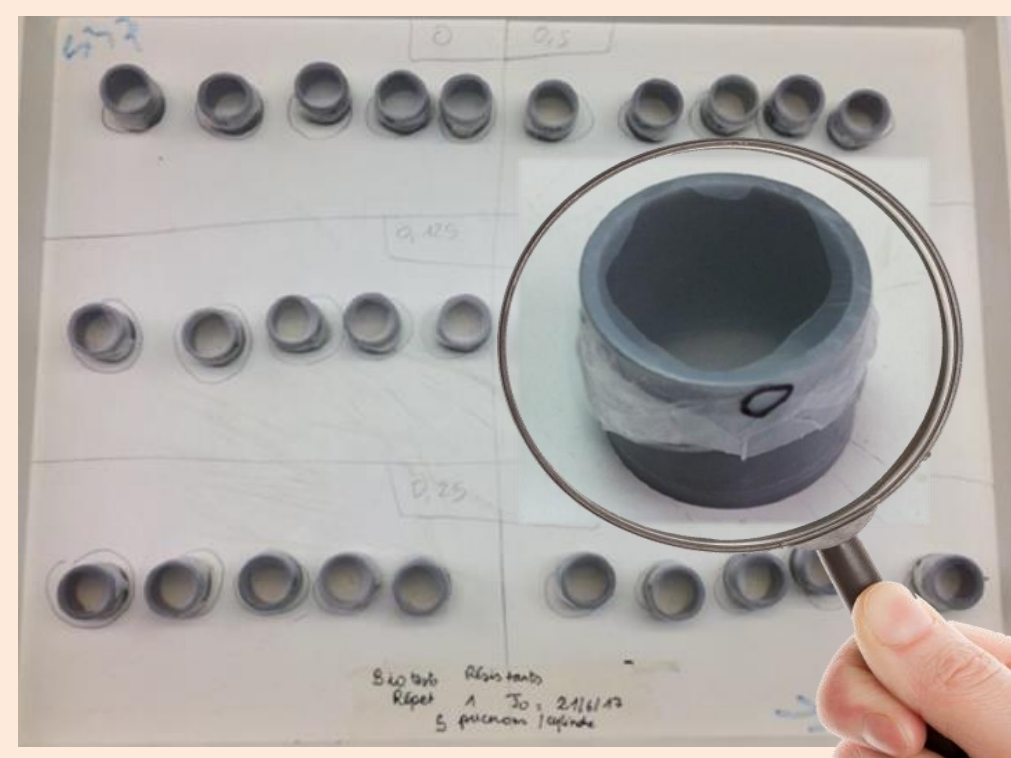


### 1. Resistant individuals in commercial orchard ?



10 wild populations of *Myzus persicae* including 3 populations resistant to pyrethroids and neonicotinoids + 2 laboratory strains : one susceptible (S) one resistant (R) to OPs

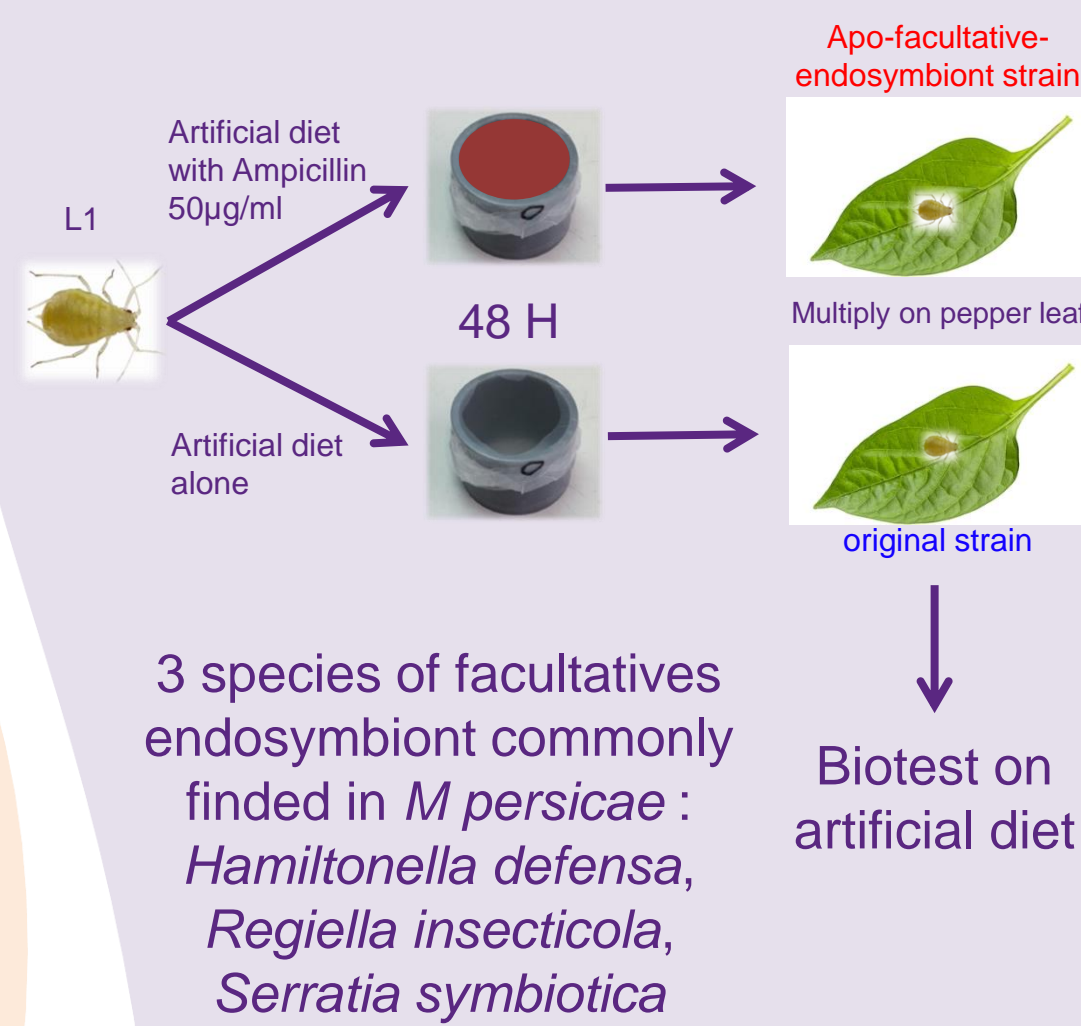
Biotests on artificial diet (Ap3) with DiCT



Mortality after 48h feeding

See protocol 3. for biochemical tests

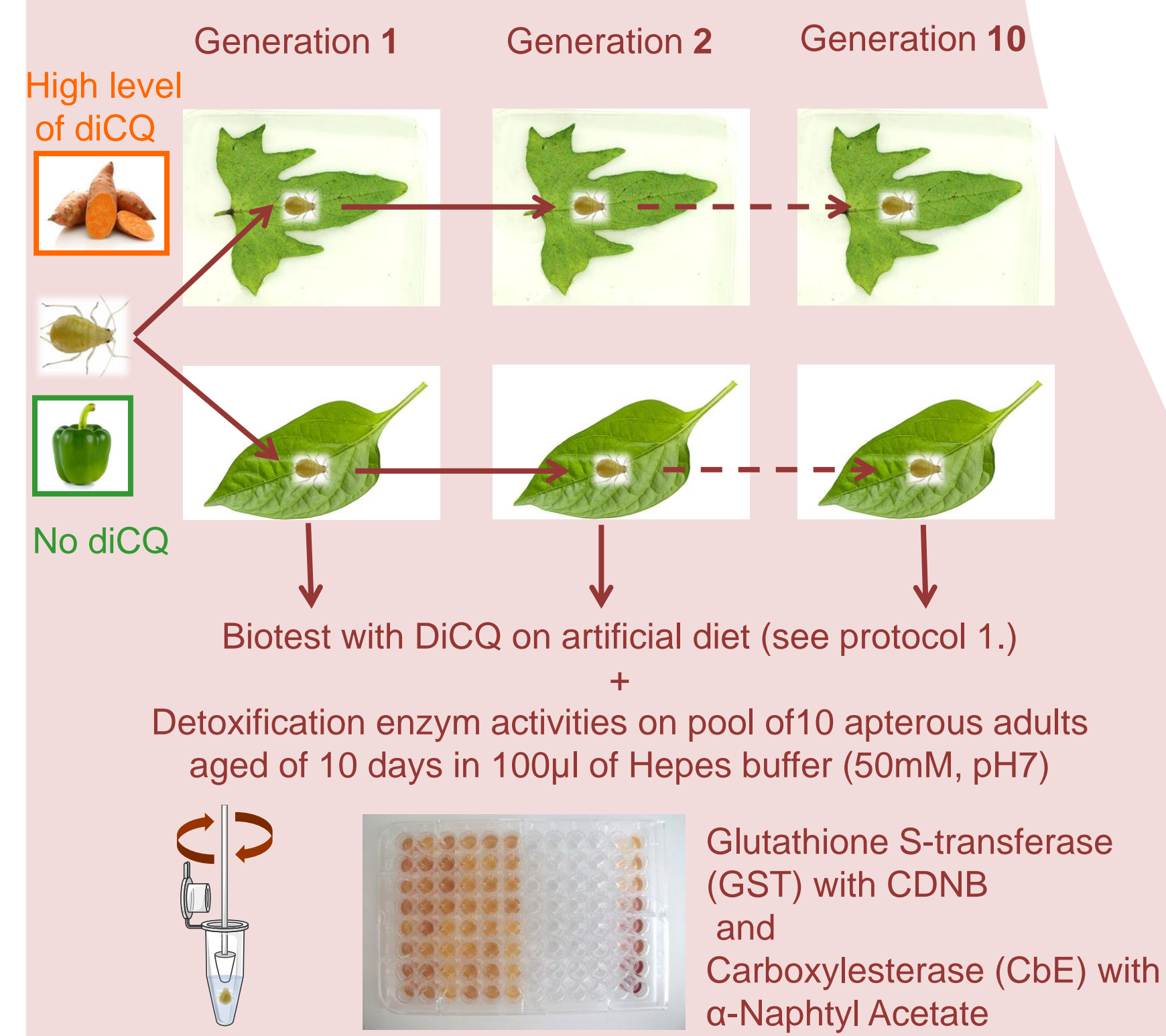
### 2. May facultative endosymbiont influence sensibility to DiCT ?



3 species of facultative endosymbiont commonly found in *M. persicae* : *Hamiltonella defensa*, *Regiella insecticola*, *Serratia symbiotica*

Same protocol with Rifampicin to kill Buchnera did't gave any offspring

### 3. Can aphids evolve on plants rich in DiCQ ?

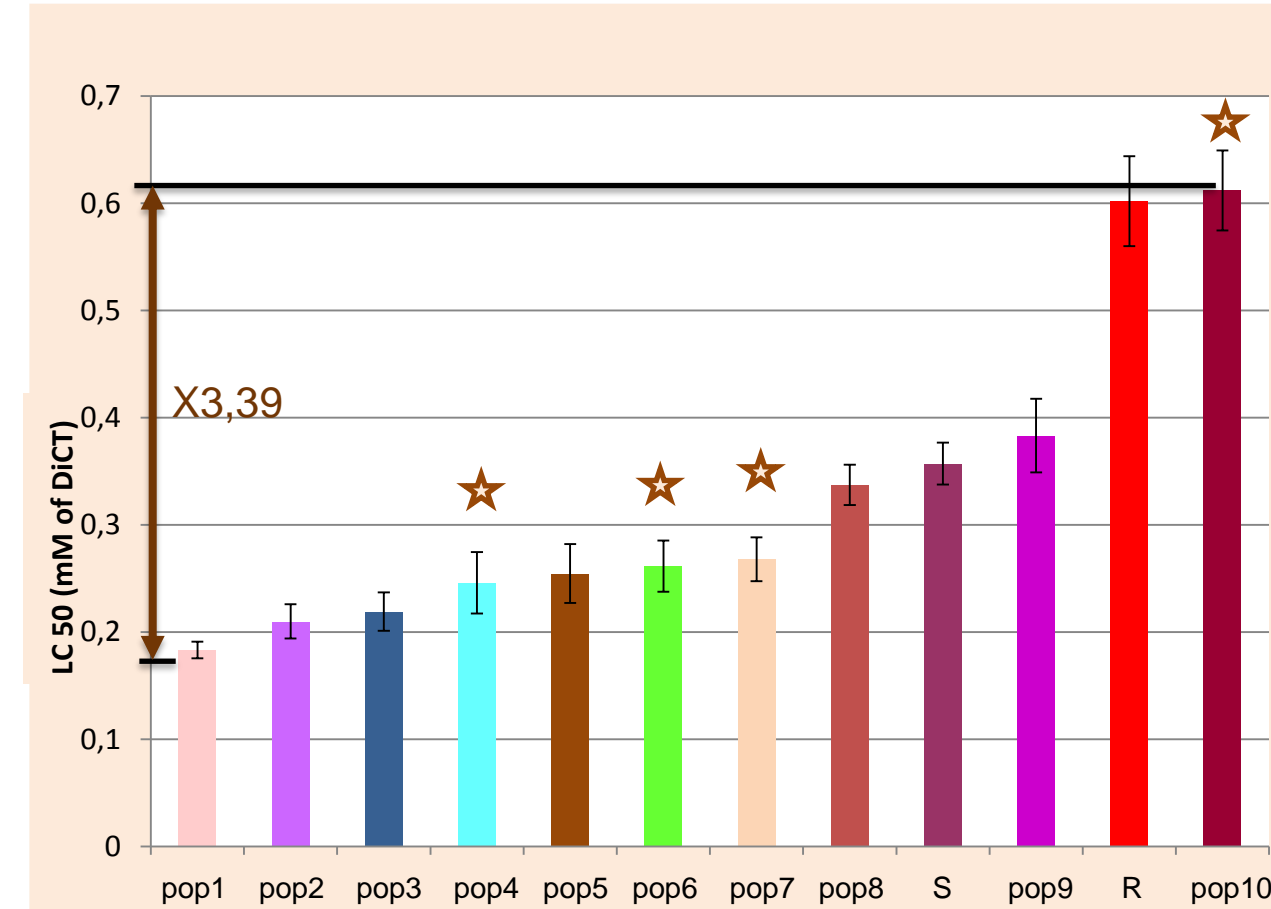
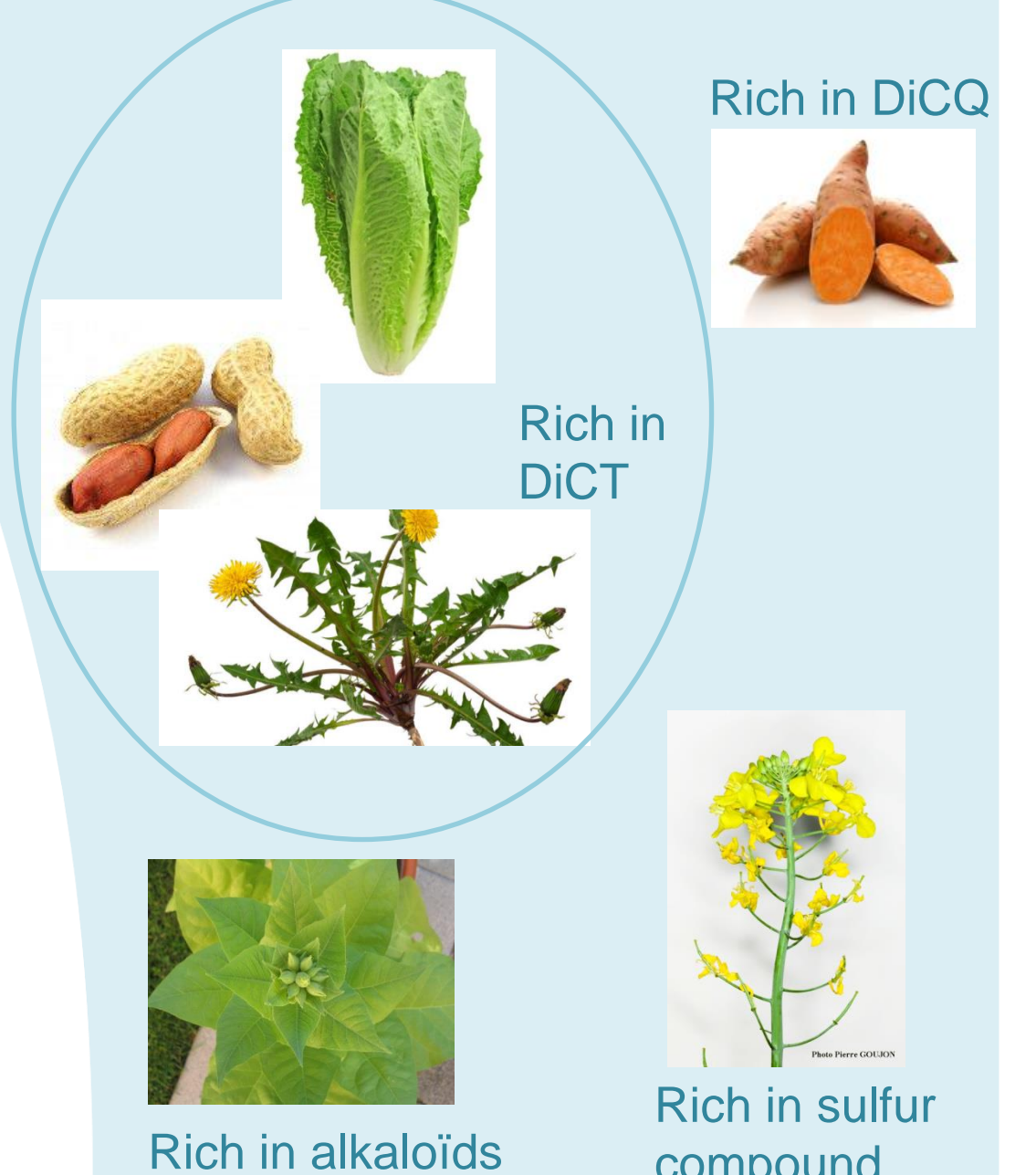


Biotest with DiCQ on artificial diet (see protocol 1.) + Detoxification enzyme activities on pool of 10 apterous adults aged of 10 days in 100µl of Hepes buffer (50mM, pH7)

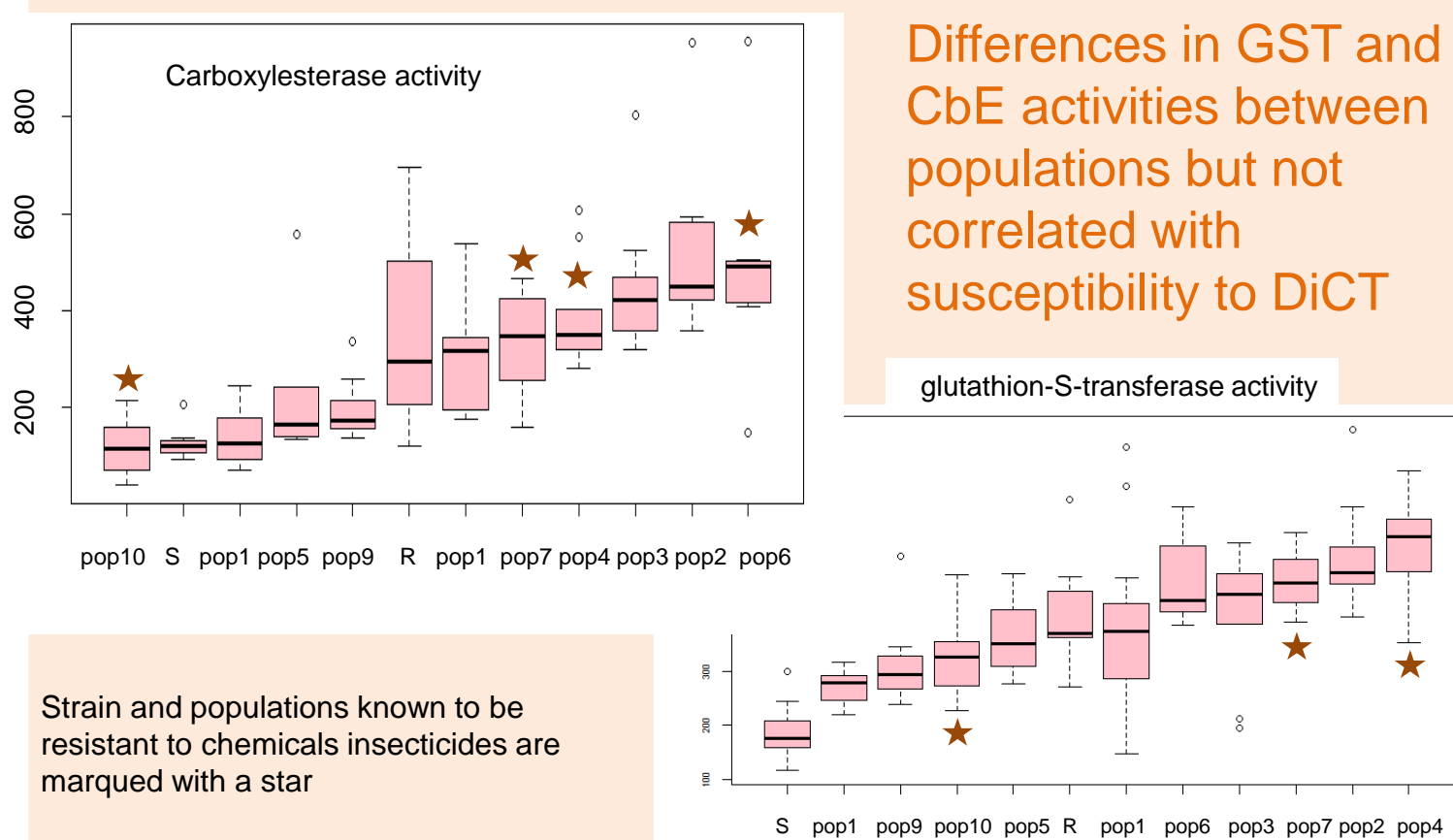
Glutathione S-transferase (GST) with CDNB and Carboxylesterase (CbE) with α-Naphthyl Acetate

### 4. Are there species or host races less sensitive ?

Find natural aphids populations on plants accumulating DiCQ or DiCT or others secondary compounds and test their susceptibility to these molecules in biotests

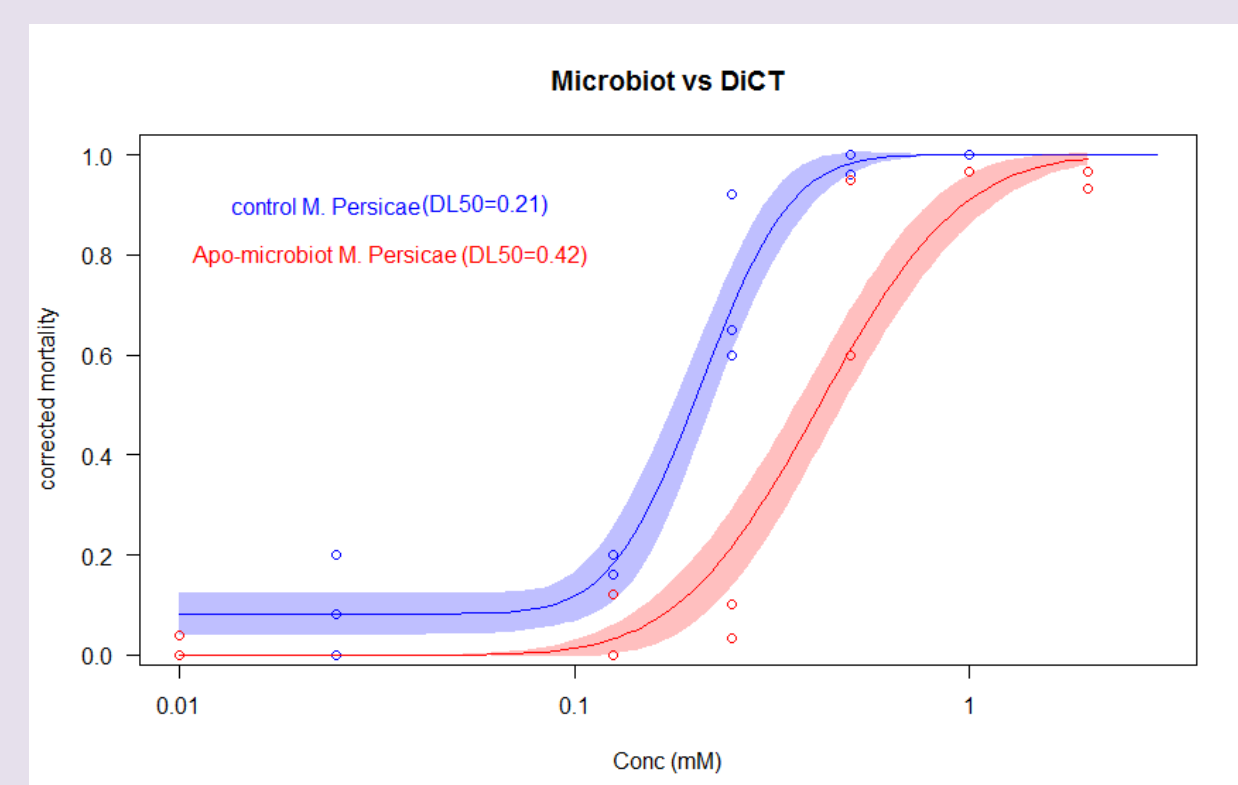


These differences illustrate genotype diversity but the less susceptible populations cannot be considered as resistant



Differences in GST and CbE activities between populations but not correlated with susceptibility to DiCT

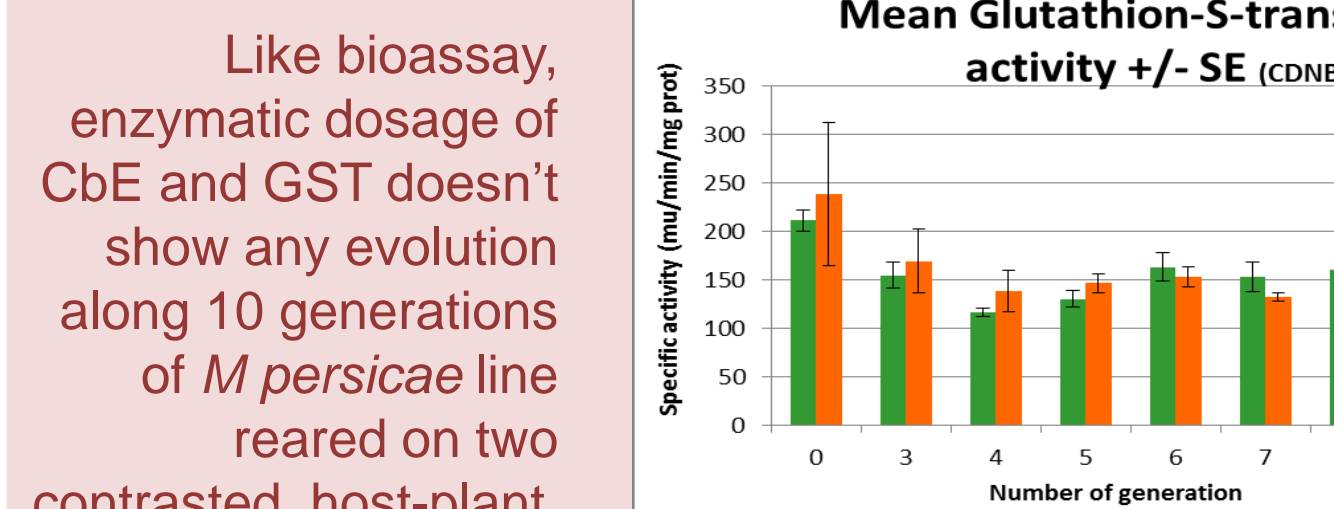
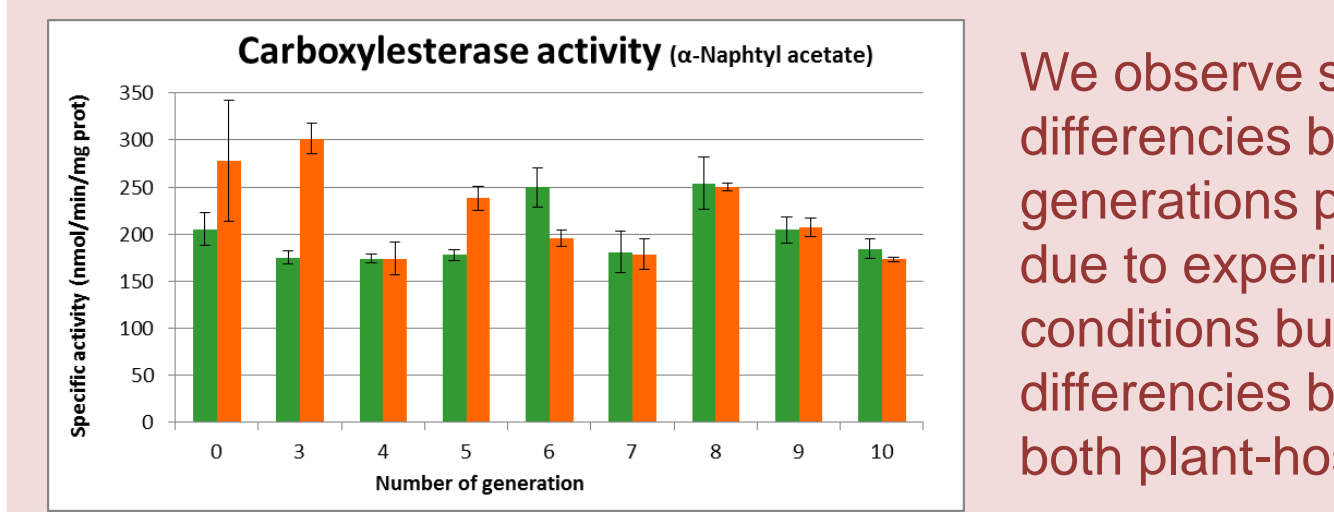
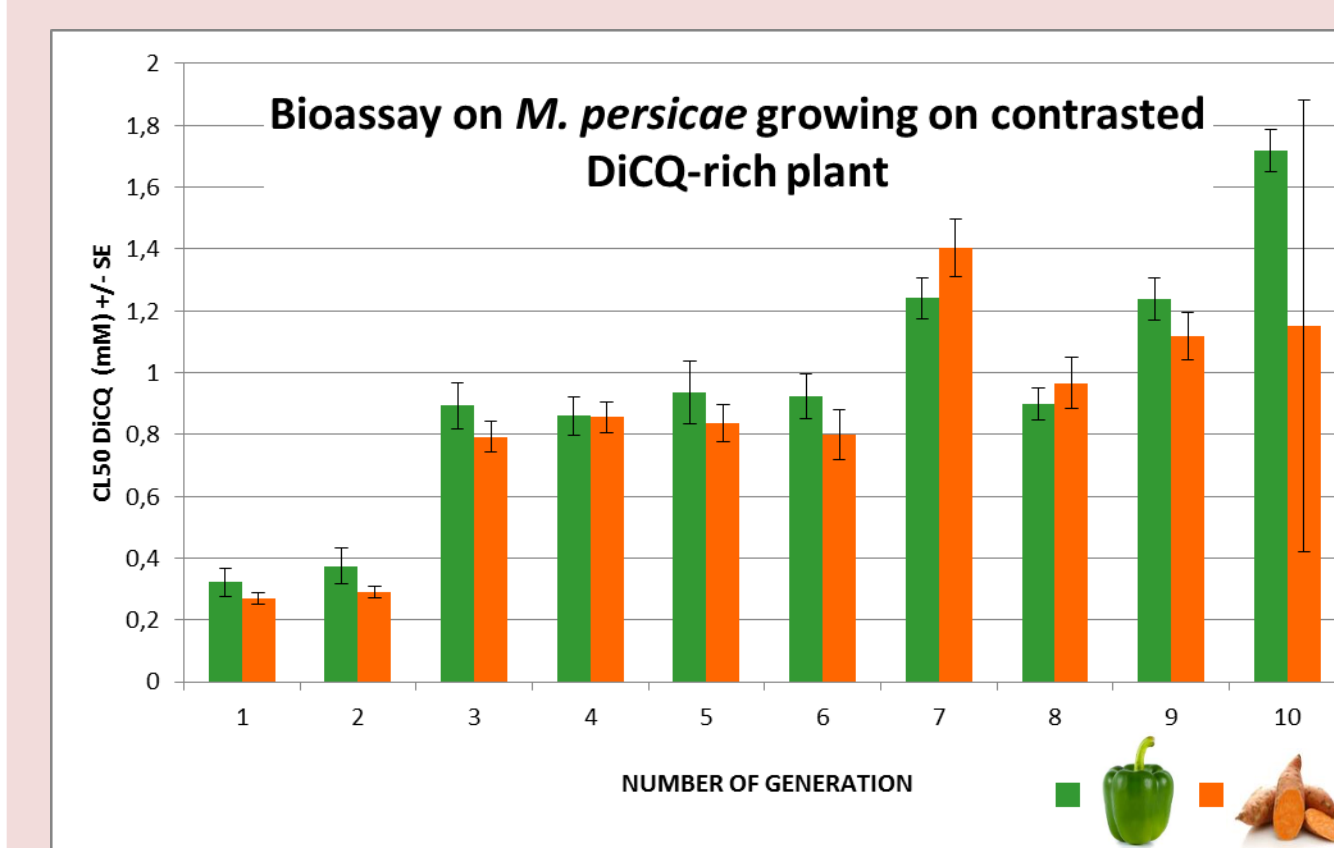
Strain and populations known to be resistant to chemicals insecticides are marked with a star



Removing facultative endosymbiont of *M. persicae* strain make it significantly less susceptible to DiCT

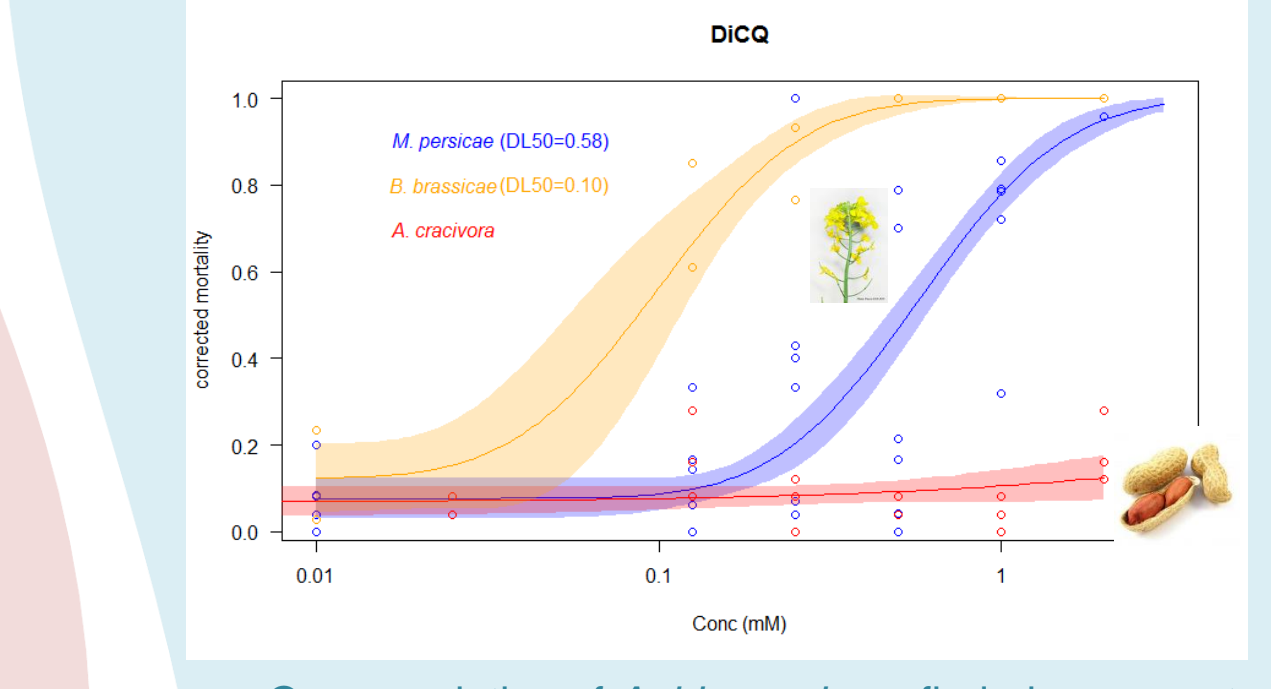
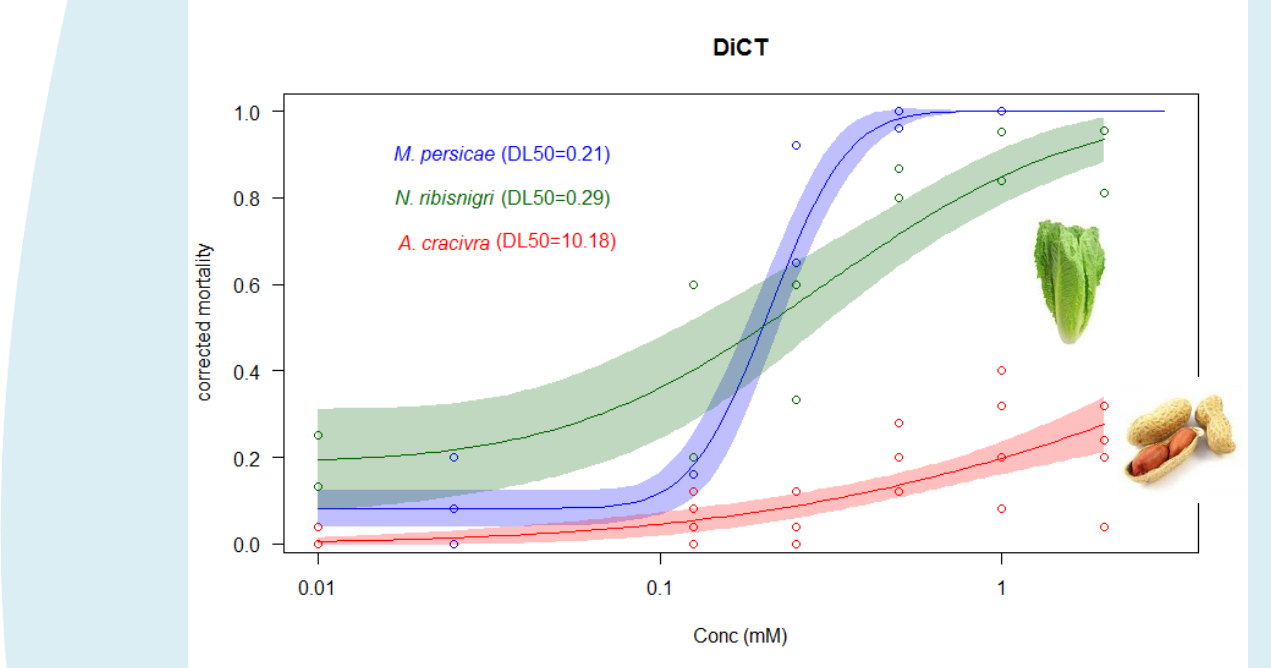
The ratio between both strain is weak

More tests are needed to evaluate the involvement of Buchnera in susceptibility to those two molecules



We observe some differences between generations probably due to experimental conditions but no differences between both plant-host lines

Like bioassay, enzymatic dosage of CbE and GST doesn't show any evolution along 10 generations of *M. persicae* line reared on two contrasted host-plant.



One population of *Aphis cracivora* found on peanut plant is more resistant to both DiCT and DiCQ, but the population of *Nasonovia ribisnigri* tested is equivalent compared to *M. persicae* susceptibility to DiCT unlike the *Brevichorina brassicae* population tested which is more susceptible to DiCQ.

Other populations of *M. persicae* found on tobacco have similar susceptibilities to DiCT and DiCQ as our reference strain

3 *Aphis taraxacicola* additional populations were not tested because of their inability to feed on Ap3 diet

## Conclusions

- Wild sampled populations of *M. persicae*, resistant or not to synthetic insecticides, are susceptible to DiCT. Their CbE and GST activities, which are classically involved in detoxification mechanisms, are not correlated with variation of susceptibility to DiCT
- Removing facultative endosymbiont made our reference strain of *M. persicae* less susceptible to DiCT
- Experimental evolution during 10 generations of a *M. persicae* strain on a plant naturally rich in DiCQ did not change its susceptibility to the purified molecule in biotests
- We found one population of *A. cracivora* resistant to DiCT and DiCQ proving that adaptation to these molecules already exists in nature.

## Take home message

We found a small evidence of the ability of aphids to bypass the toxicity of DiCT and DiCQ. Good hope for the sustainability of these natural compounds as biopesticides