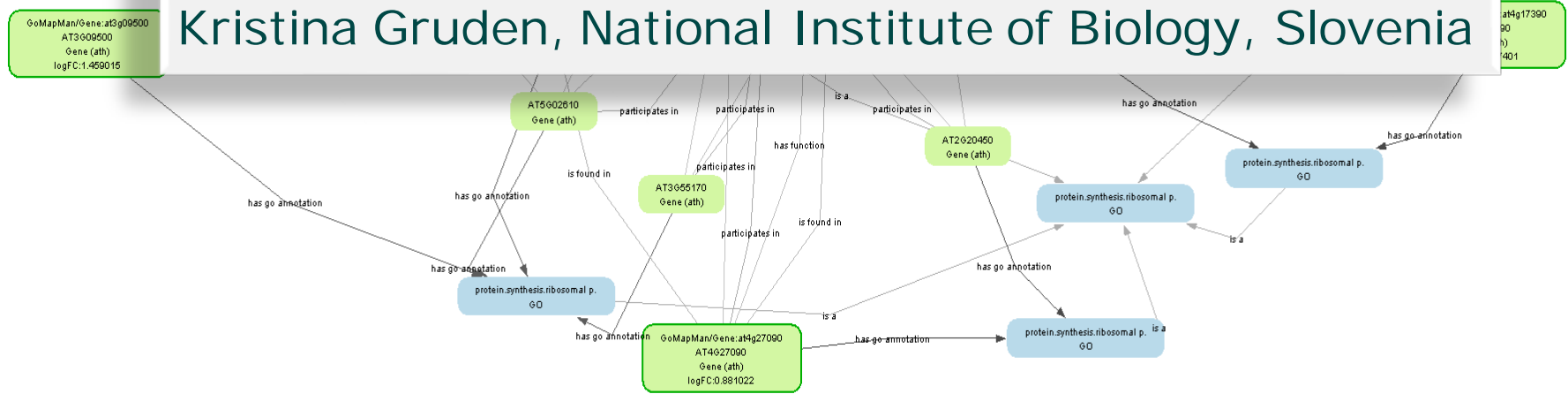


## Potato Virus Y infection hinders potato defence response and renders plants more vulnerable to Colorado potato beetle attack

Kristina Gruden, National Institute of Biology, Slovenia



# Experimental system

- Potato



## Experimental system

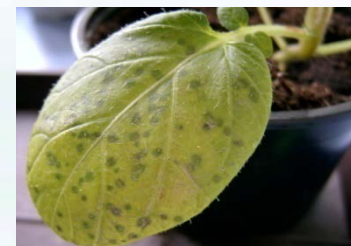
- Potato



- *Phytophthora infestans*



- PVY



- Colorado potato beetle



## Experimental system

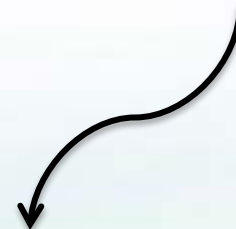
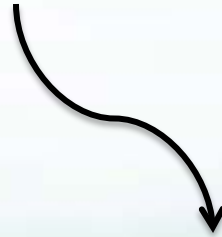


## Experimental system



- SA, JA
- ROS
- PR-proteins
- Callose accumulation

## Experimental system



- JA, ET
- ROS
- protease inhibitors (PI)
- Antinutritive compounds
- alkaloids



- SA, JA
- ROS
- PR-proteins
- Callose accumulation



## Experimental system

Larvae adapt

- Induction of alternative set of digestive proteases,.....



- JA, ET
- ROS
- protease inhibitors (PI)
- Antinutritive compounds
- alkaloids



- SA, JA
- ROS
- PR-proteins
- Callose accumulation

## Experimental system

Larvae adapt

- Induction of alternative set of digestive proteases,.....



?



- JA, ET
- ROS
- protease inhibitors (PI)
- Antinutritive compounds
- alkaloids

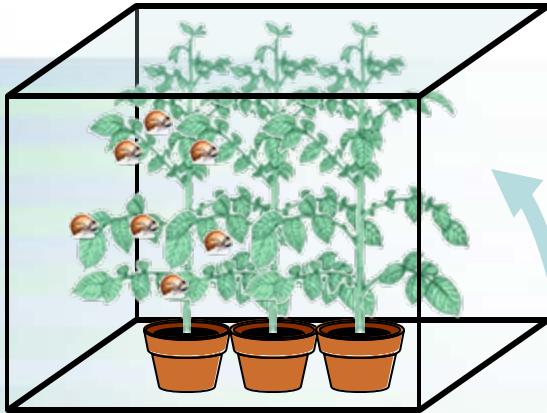
- SA, JA
- ROS
- PR-proteins
- Callose accumulation



# Aim

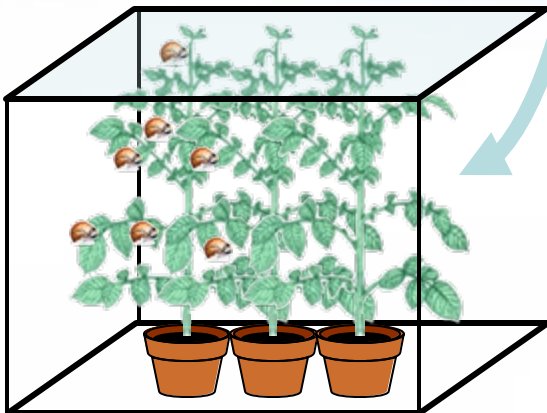
- To understand the system in more realistic setup – **potato+PVY+beetle larvae**
  - Understand molecular signalling in response
  - The effects on priming of neighbouring plants

## Feeding assays



Healthy (cv. Igor )

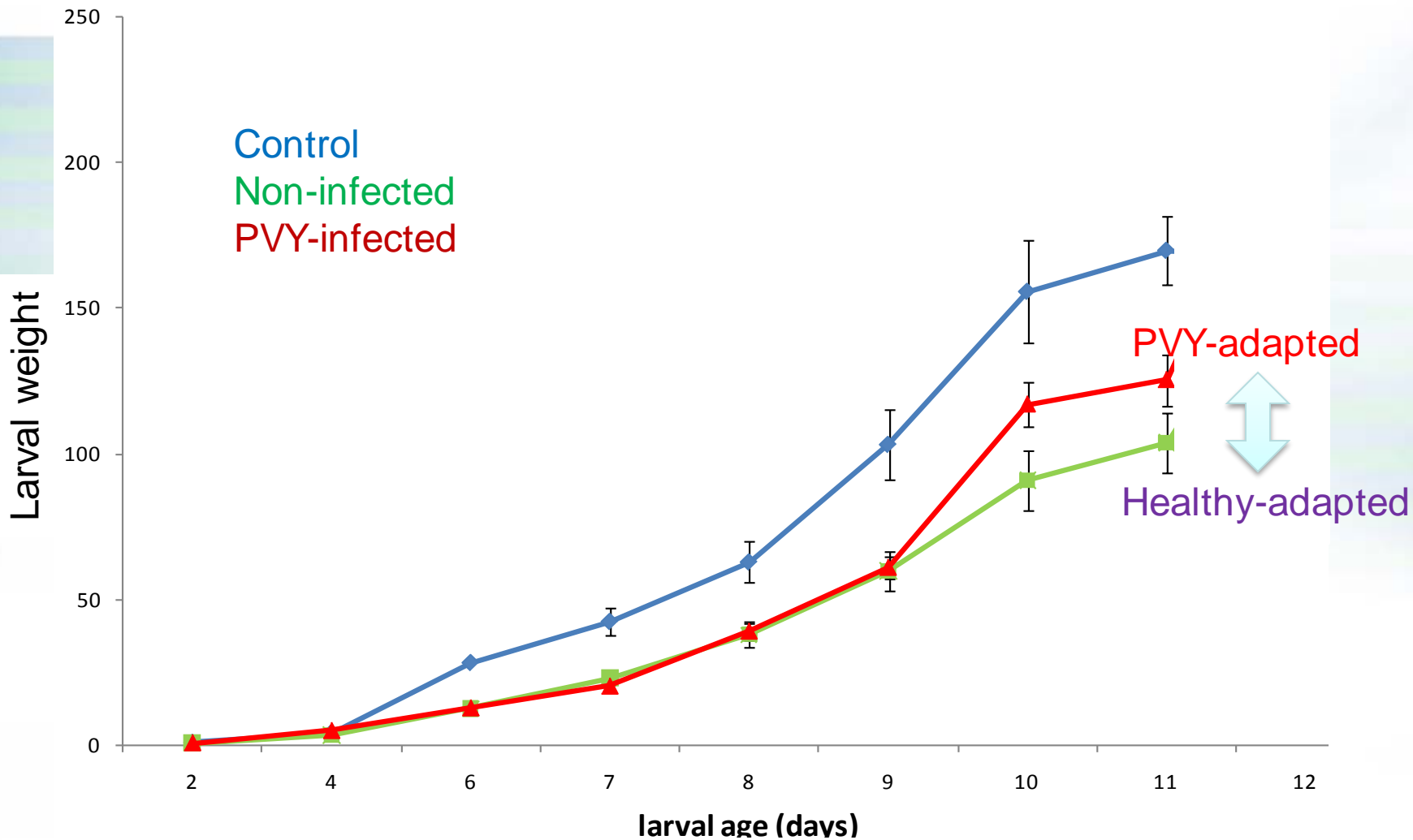
**sec. PVY<sup>NTN</sup>-inf** (cv. Igor )



Weighing every day



## Feeding assays



## Does PVY suppresses JA signalling?



JA



COI1



Potato defense  
molecules

## Does PVY suppresses JA signalling?



JA



COI1

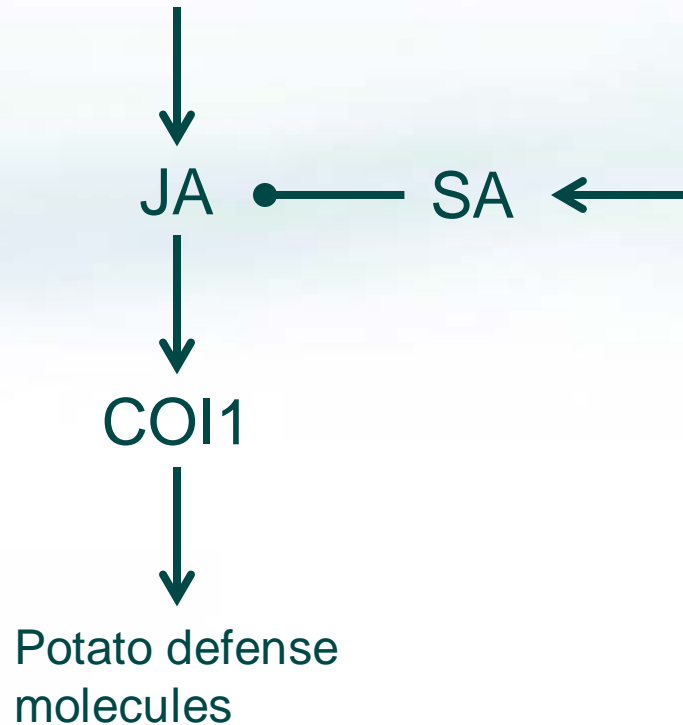


Potato defense molecules

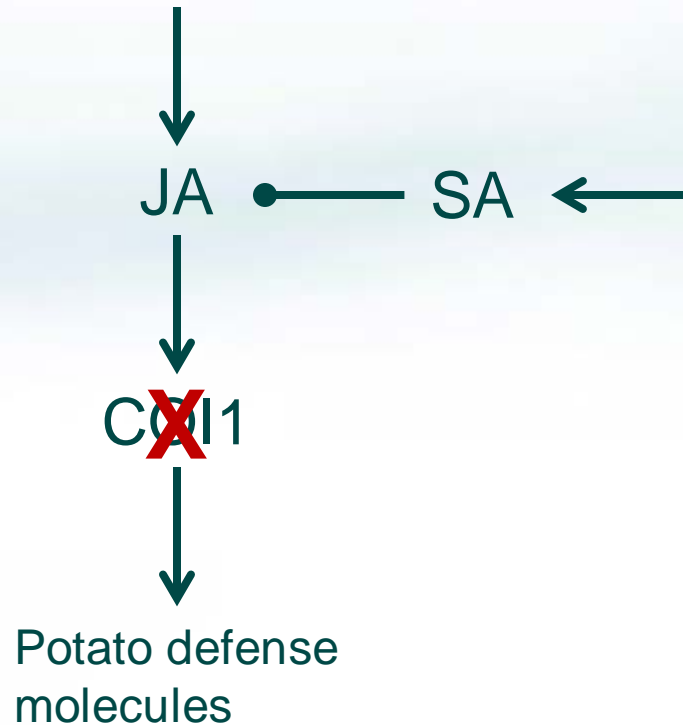
SA



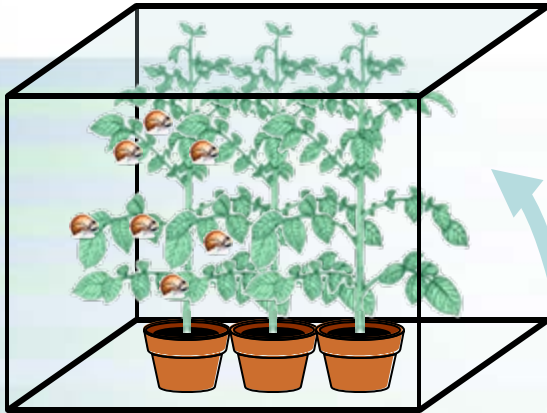
## Does PVY suppresses JA signalling?



## Does PVY suppresses JA signalling?

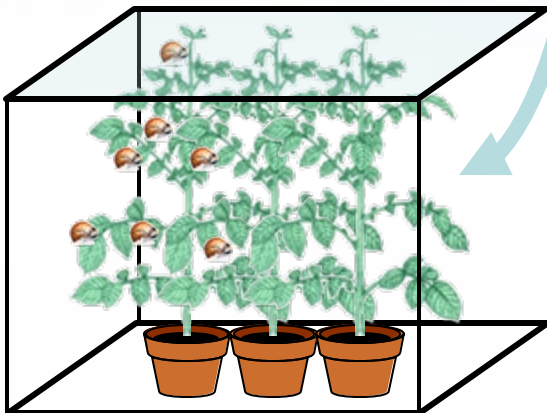


## Feeding assays

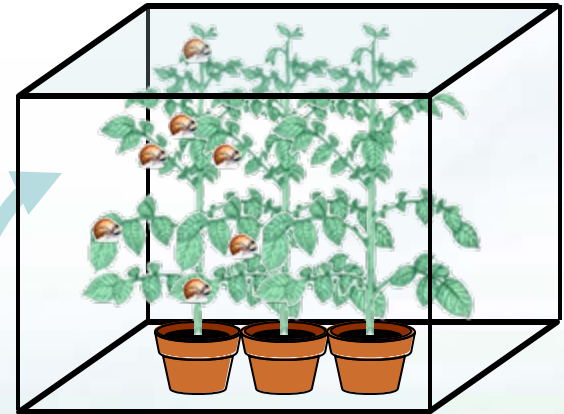


Healthy (cv. Igor )

**sec. PVY<sup>NTN</sup>-inf** (cv. Igor )

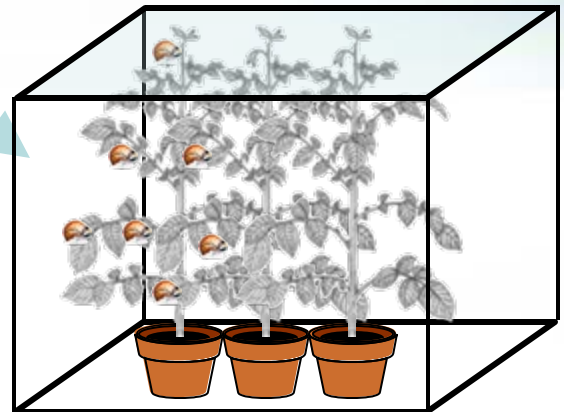


Weighing every day



NT (cv. Désirée )

**coi1-silenced** (cv. Désirée )





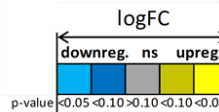
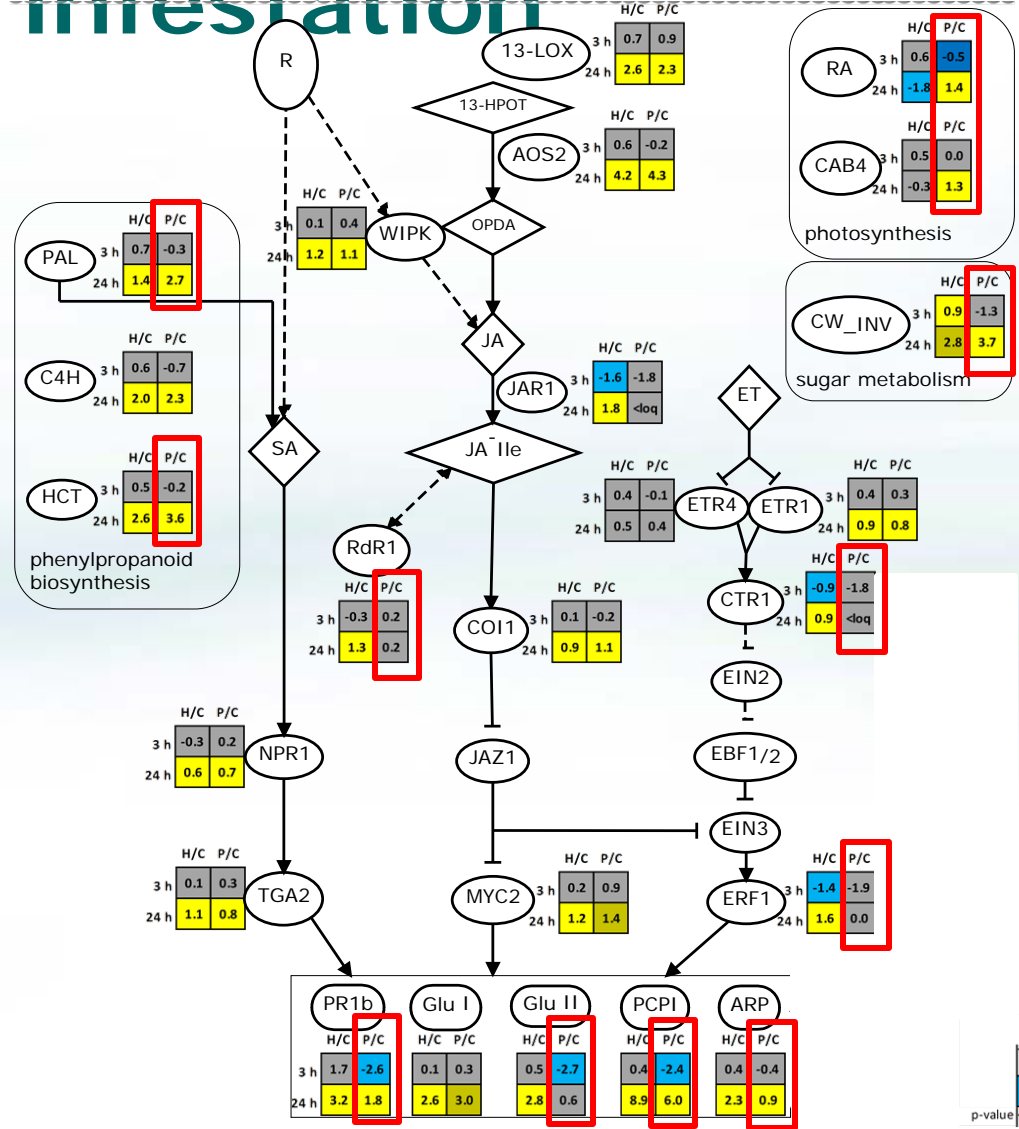
# Potato transcriptome

- qPCR analysis for markers of:
  - JA signalling
  - SA signalling
  - Ethylen signaling
  - Auxin signalling
  - PR proteins
- 3h, 24h after infestation

## PVY<sup>NTN</sup> + CPB infestation

↓ ET pathway  
 ↓ JAR1, PCPI  
 ↓ ARP  
 ↓ PR1b, Glu II,  
 ↓ RdR1

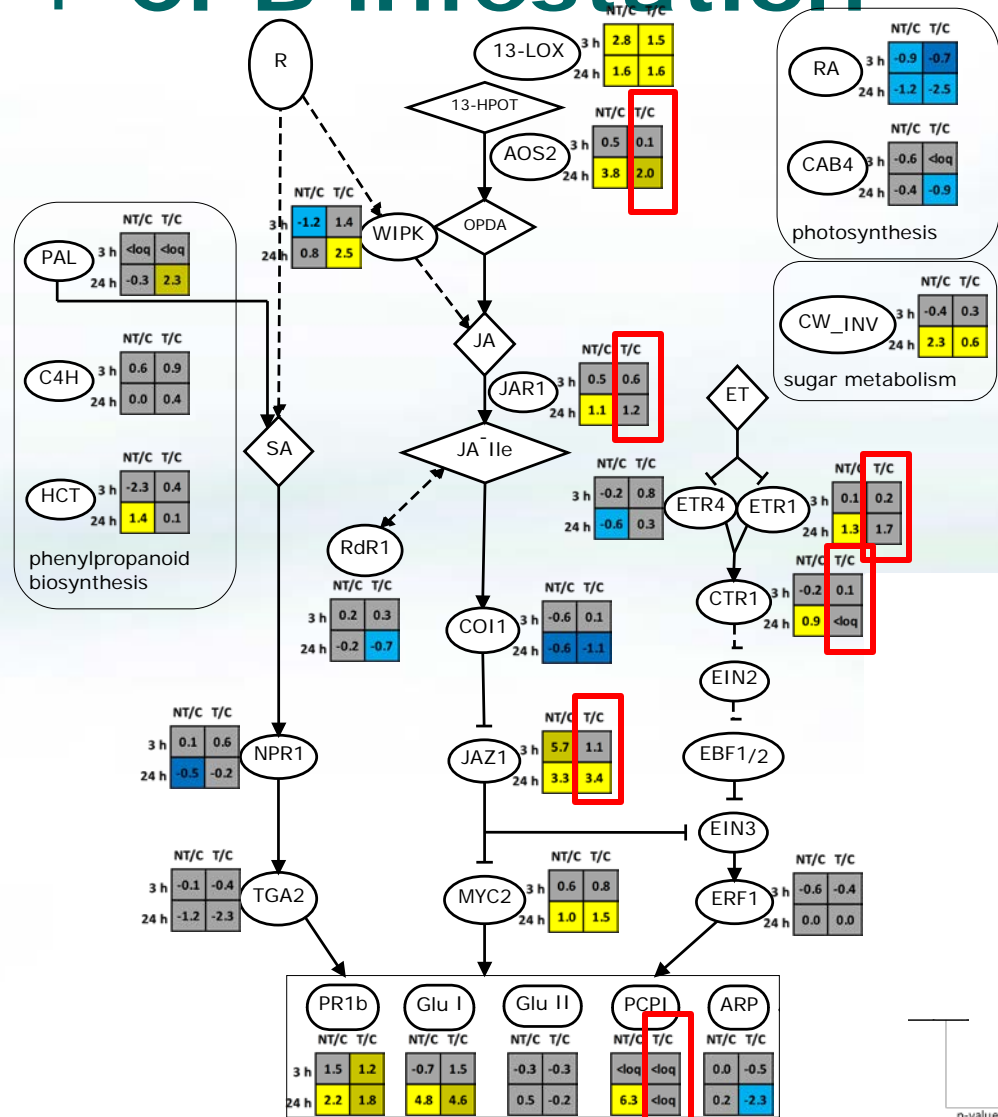
↑ PS and CW\_INV  
 ↑ PAL, HCT



## *coi1* silencing + CPB infestation

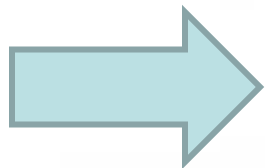
As expected  
 ↓ JA synth. & sign.  
 ↓ ET signalling

↓ PCPI gene family—  
 influences larval adaptation



## Complex interconnection between signalling pathways

- Simple SA-JA antagonism hypothesis does not explain the results
- Ethylene and auxin signalling also important – only limited number of relevant genes in our dataset



**Nontargeted analysis performed: RNASeq**

# RNASeq analysis of potato transcriptome

- Geneset enrichment analysis

MapMan bin description	Elements in bin	Igor Healthy	Igor PVY	Desiree NT	Desiree coil
Photosynthesis	247	-	+	-	-
Amino acid synthesis/aromatic	47		+		
Cell wall	364		+		
Phenylpropanoids/lignin biosynthesis	73	+	+		
Gibberelin-regulated genes	14		+		
Proteinase inhibitors	57	+	+	+	
Auxin response transcription factors	21		-		

- Importance of **ethylene** signalling also confirmed
- Lower induction of genes related to antinutrition (α-amylase inhibitors, arginase, terpene synthase and polyphenol oxidases )

# Adaptation of CPB in multitrophic setting



- The set of genes previously found to be part of adaptation not changed
- RNASeq analysis showed:
  - Another set of digestive enzymes is induced: besides novel cysteine proteases also some aspartic and serine proteases
  - Set of potential regulatory proteins coding genes identified

# Conclusions

- CPB larval growth was enhanced when reared on secondary PVY<sup>NTN</sup>-infected plants can be explained by decreased accumulation of **antinutritional compounds**
- Not only SA and JA signalling is important: **ERFs/ARFs** seem to be hubs in defense signalling network
- PVY infection modulates volatiles emission and **priming** of defense in neighbouring plants
- Energy trade-offs in defense against several biotic stressors?

# Acknowledgements

- NIB, Department for Biotechnology and Systems Biology:

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A. Blejec, A. Rotter

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