

Understanding the genetic mechanism of *Brassica napus* resistance against CSFB





Breeding resistance to cabbage stem flea beetle



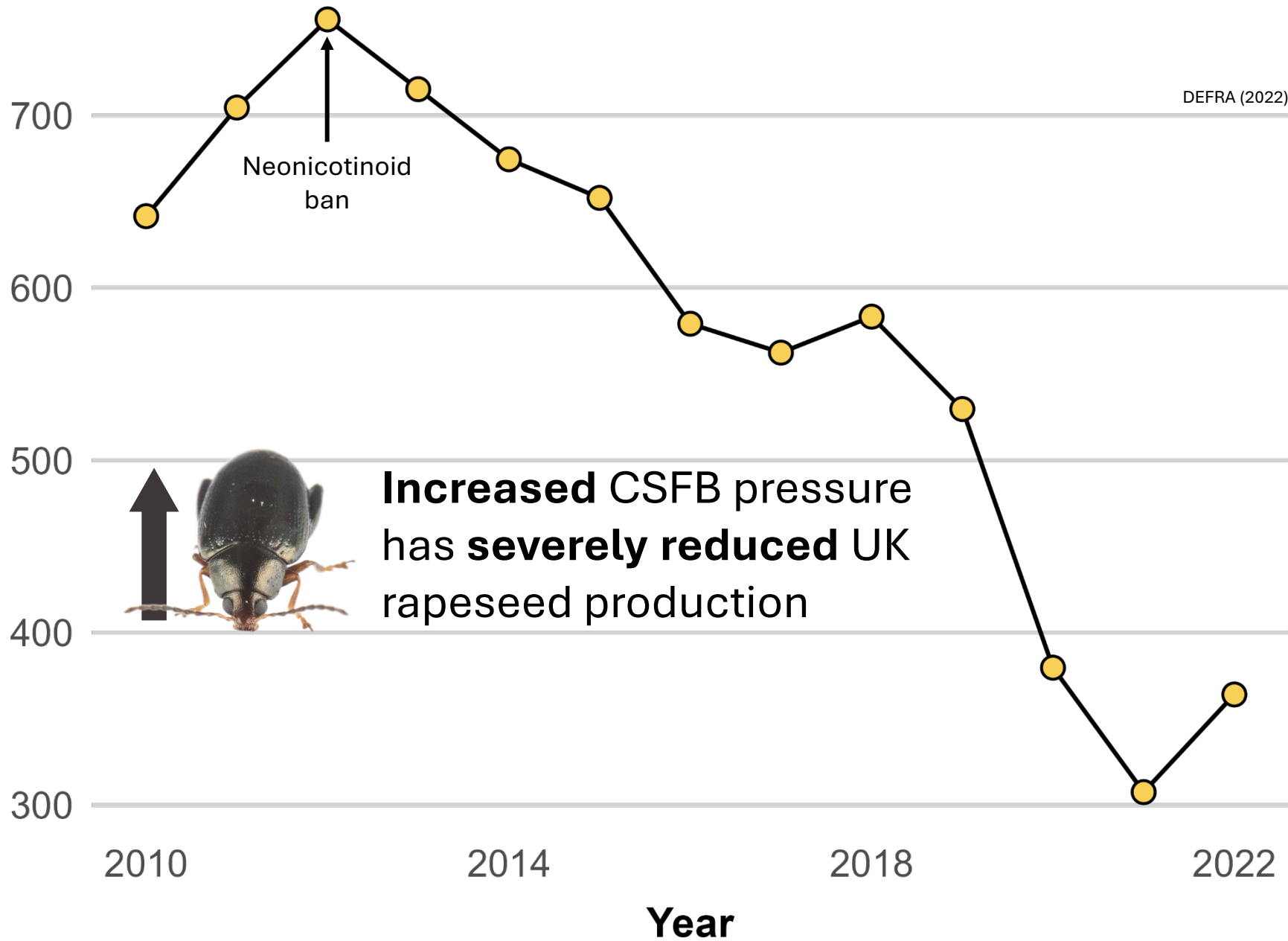
Oilseed rape (OSR; *Brassica napus*) is the third most widely grown crop

Cabbage stem flea beetle (CSFB) is the main pest of winter OSR in UK and Europe

CSFB management is based on the use of chemical insecticides



UK rapeseed area (1000 ha)

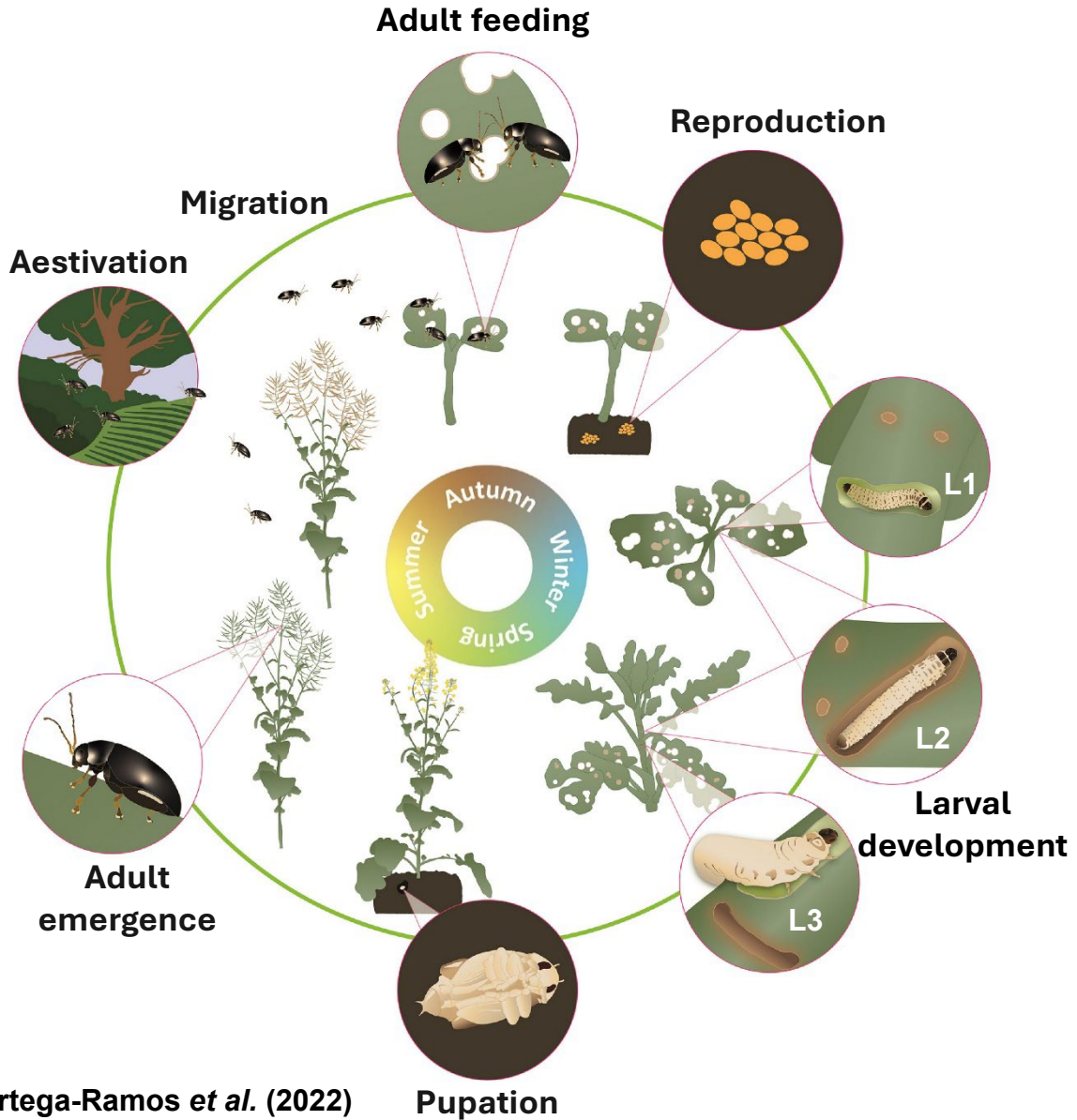


Rapeseed

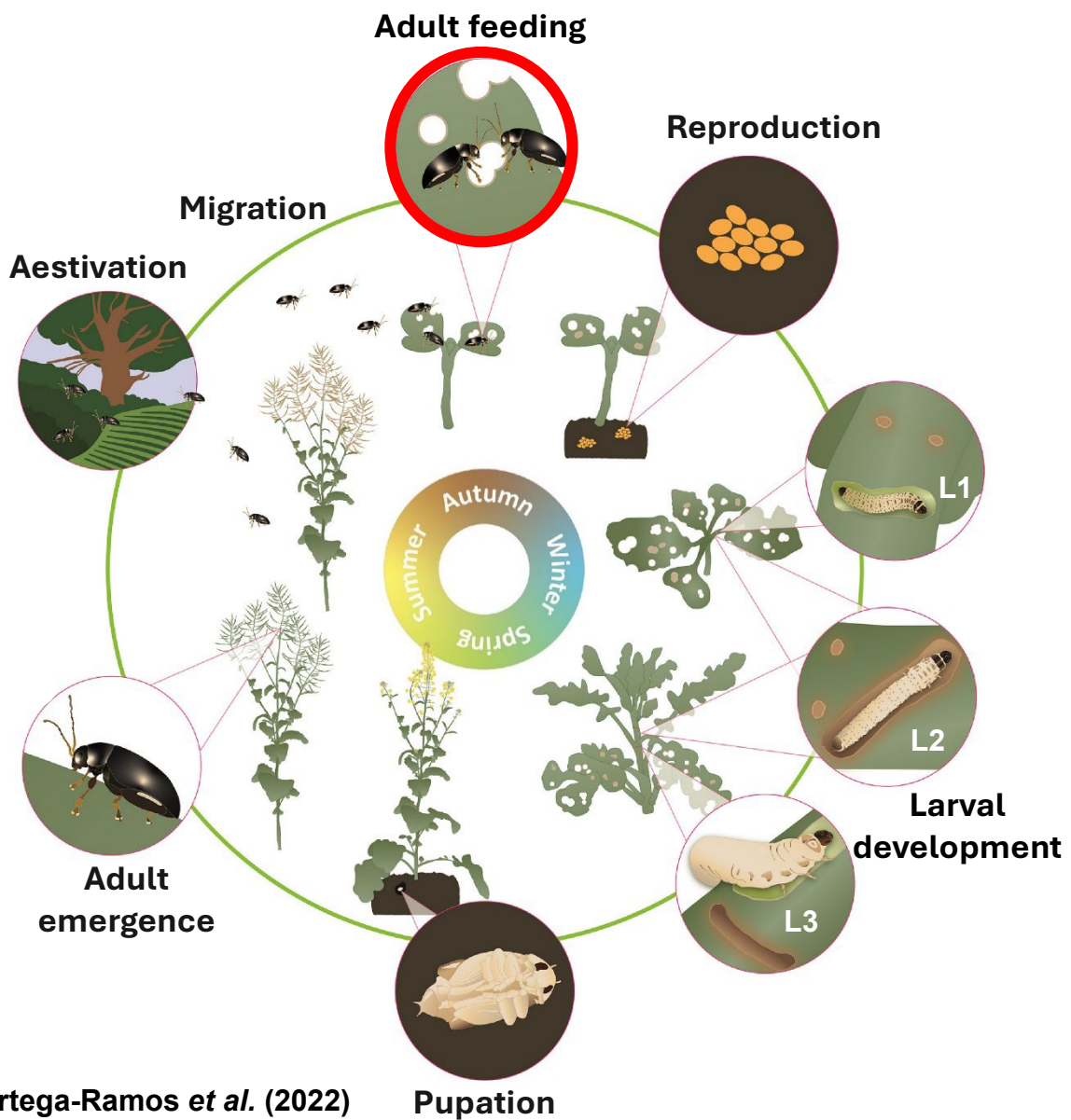
Brassica napus



Cabbage stem flea beetle



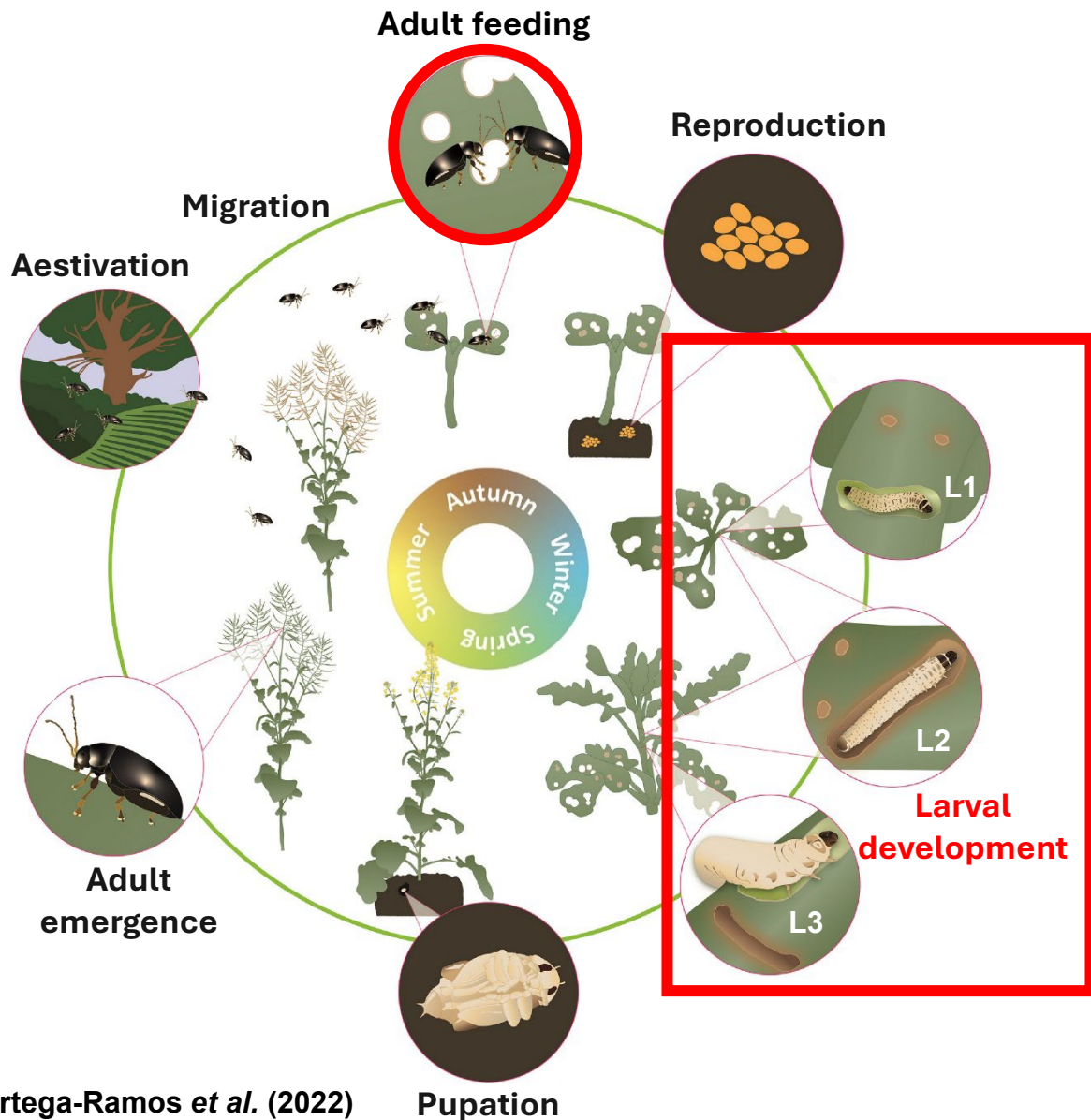
Cabbage stem flea beetle



Adult feeding



Cabbage stem flea beetle



Research Questions



Are there *B. napus* varieties that are resistant to CSFB?



Can we screen for CSFB resistance and/or susceptible in *B. napus* varieties ?

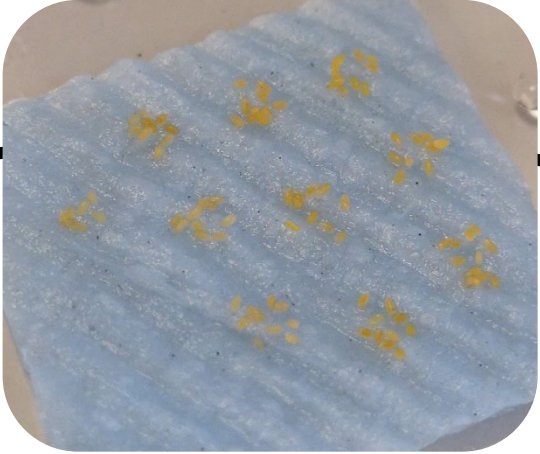


Are there genes that are specifically expressed because of CSFB?



How do resistant *B. napus* varieties defend themselves against CSFB?

Eggs collected
from rearing box



Eggs added to
pak choi



CSFB rearing cycle (3 months)

Adults added
to rearing box



Adults
collected



CSFB Feb 1 RB
+S 10.2.22 1=22
+T 17.2.22
x22 17.2.22
x19 23.2.22
x18 4.3.22
x17 9.3.22
x16 16.3.22
x14 29.3.22
x15 30.3.22

CSFB feeding screening

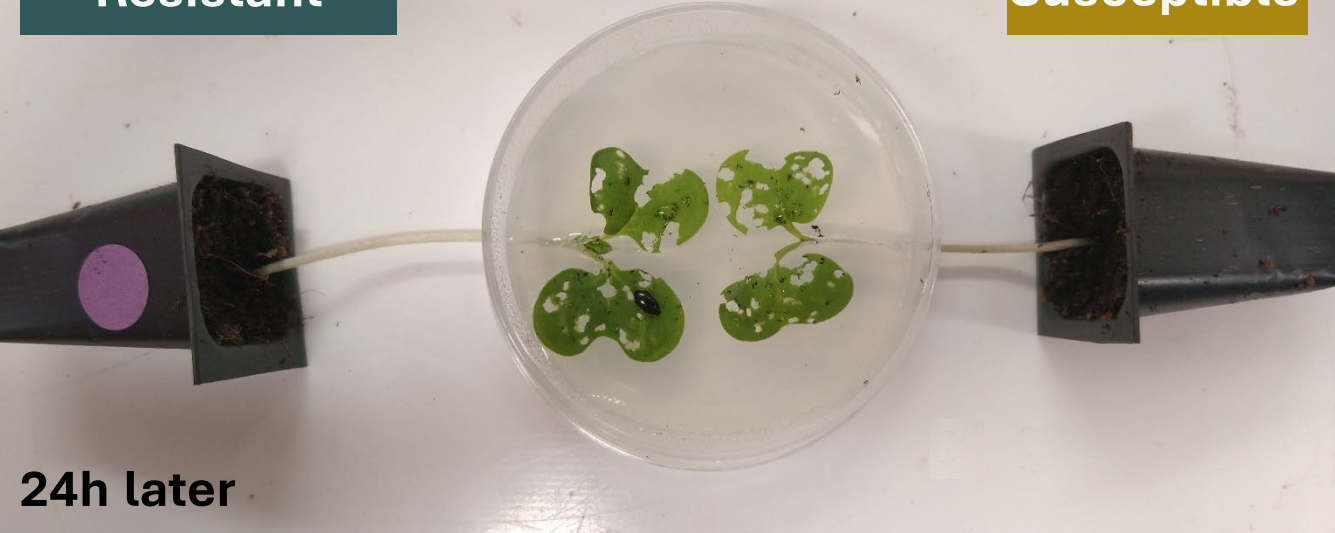
Choice screen

Non-choice screen



Resistant

Susceptible

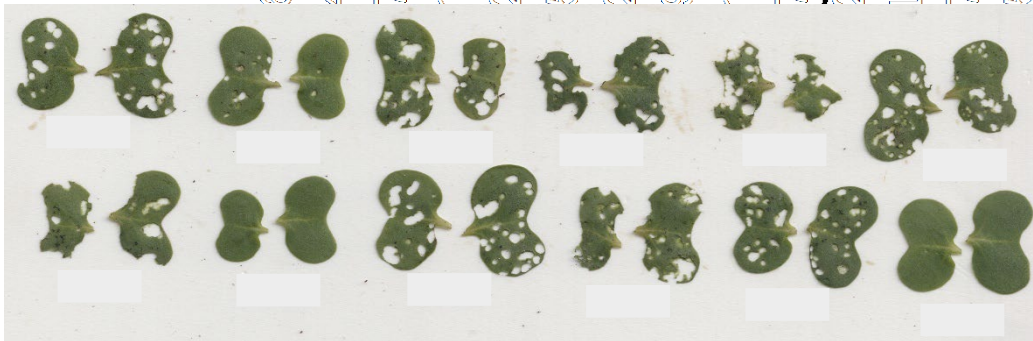
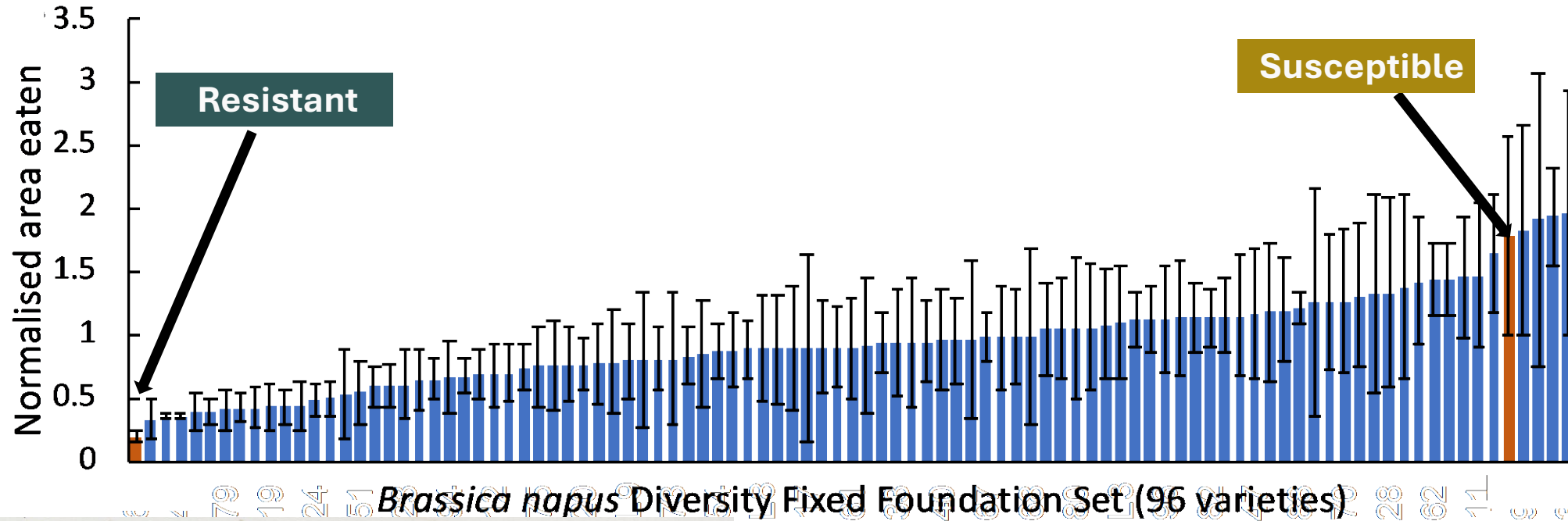


24h later

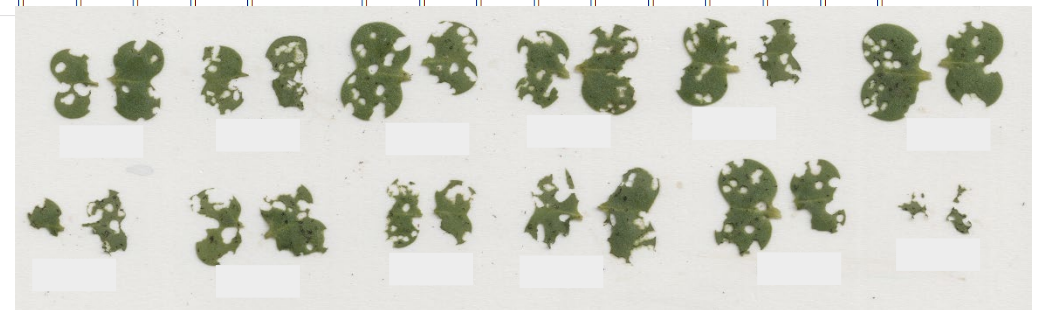


24h later

Choice screening of *B. napus* diversity set for CSFB resistance

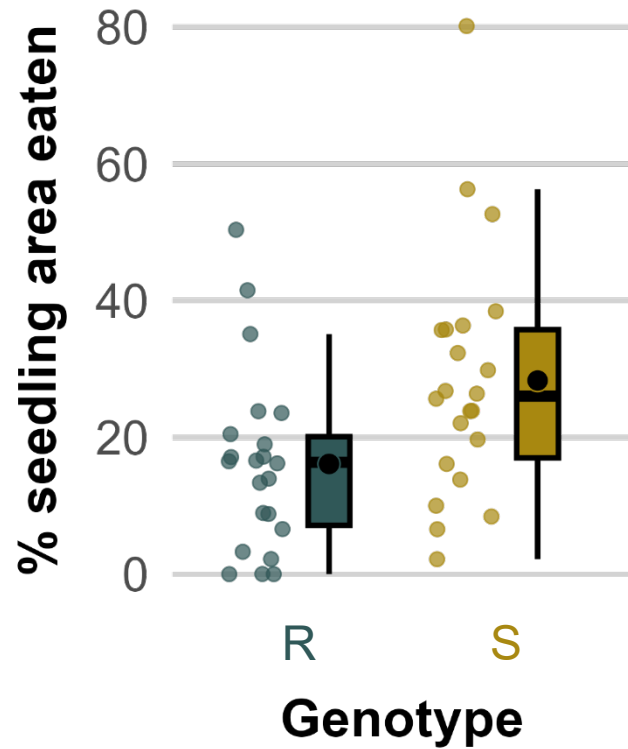


Resistant

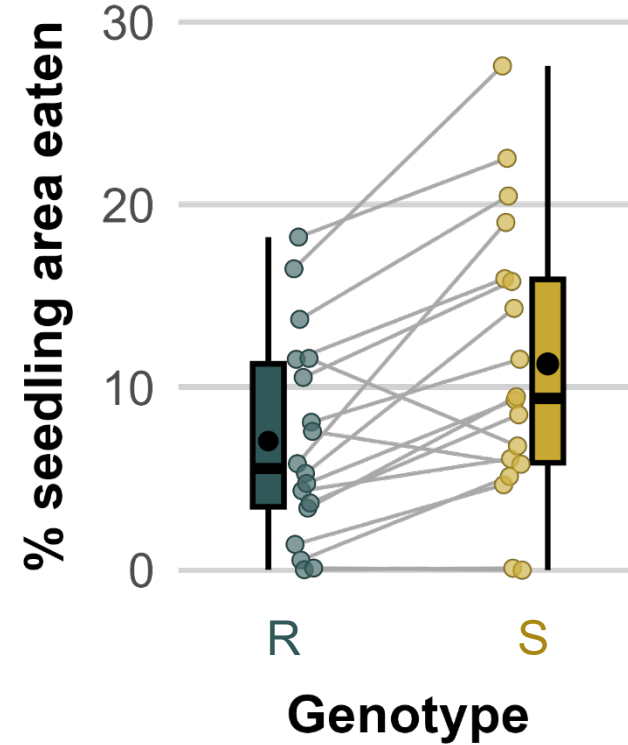


Susceptible

Differences between resistant and susceptible genotypes are consistent across lab- and field-based screens

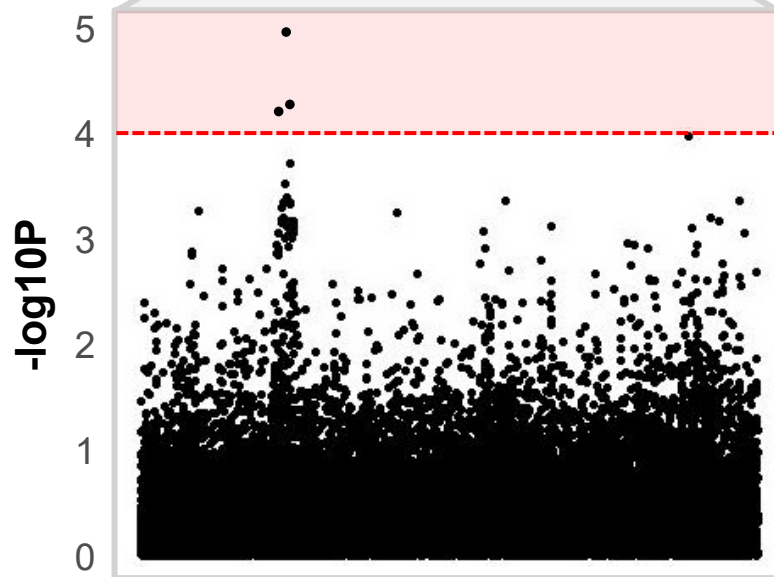
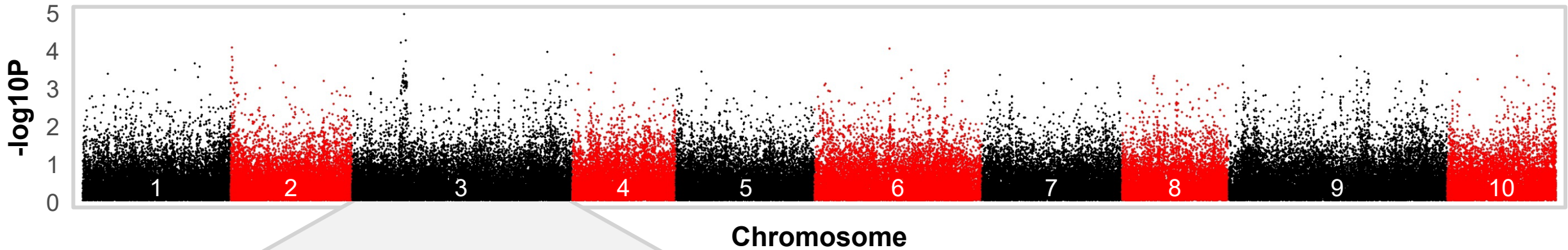


Non-choice



Choice

Associating beetle resistance using GWAS



Used a panel of 260,000 SNPs, we identified region highly associated with beetle feeding on chromosome A3/C3

Variation within these genes are associated with feeding from CSFB

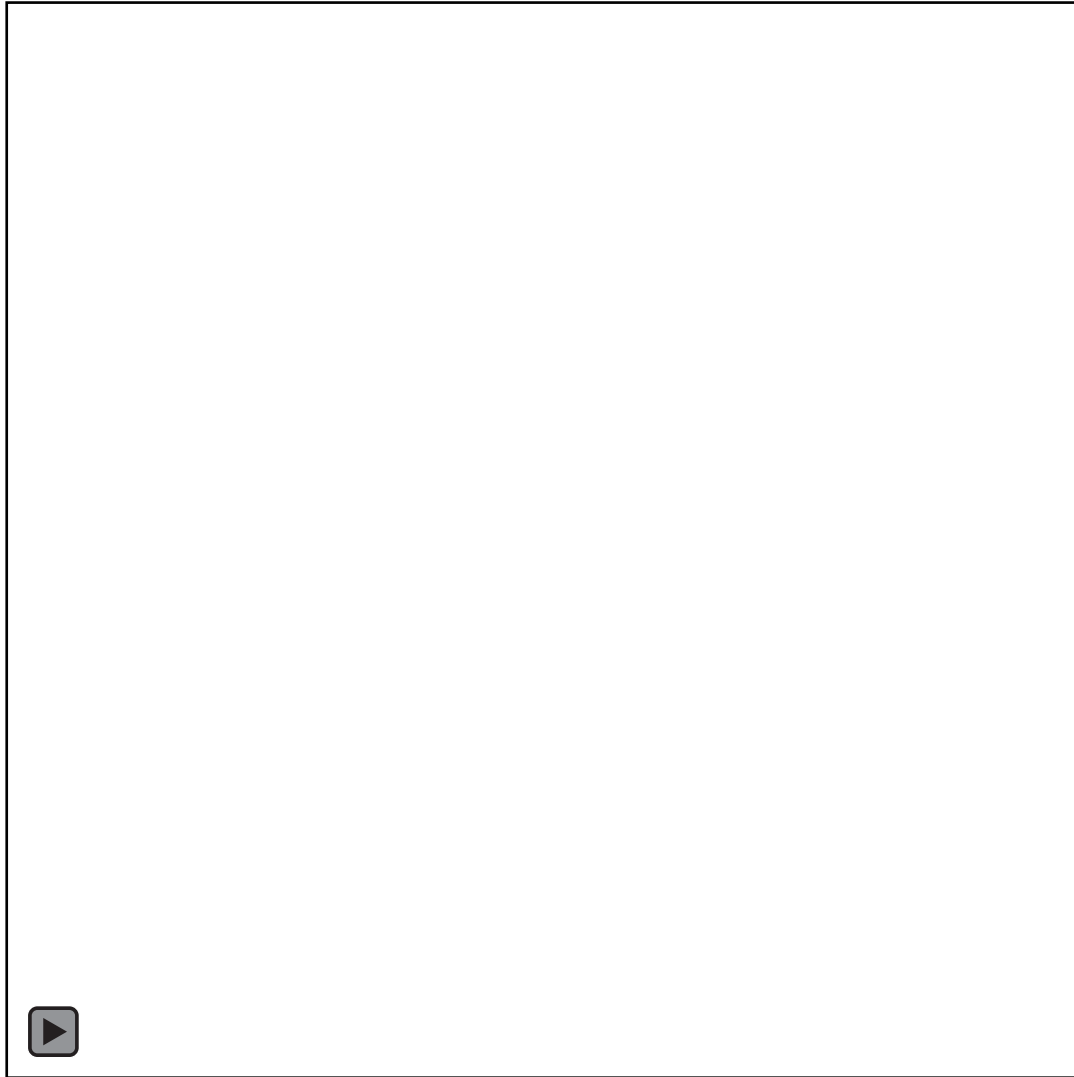
CSFB damage elicits a calcium burst



Low [Ca²⁺]  High [Ca²⁺]

- CSFB induces calcium signals – likely a result of damage but are there beetle specific defence mechanisms in Arabidopsis
- Can plant recognise beetle specific damage?

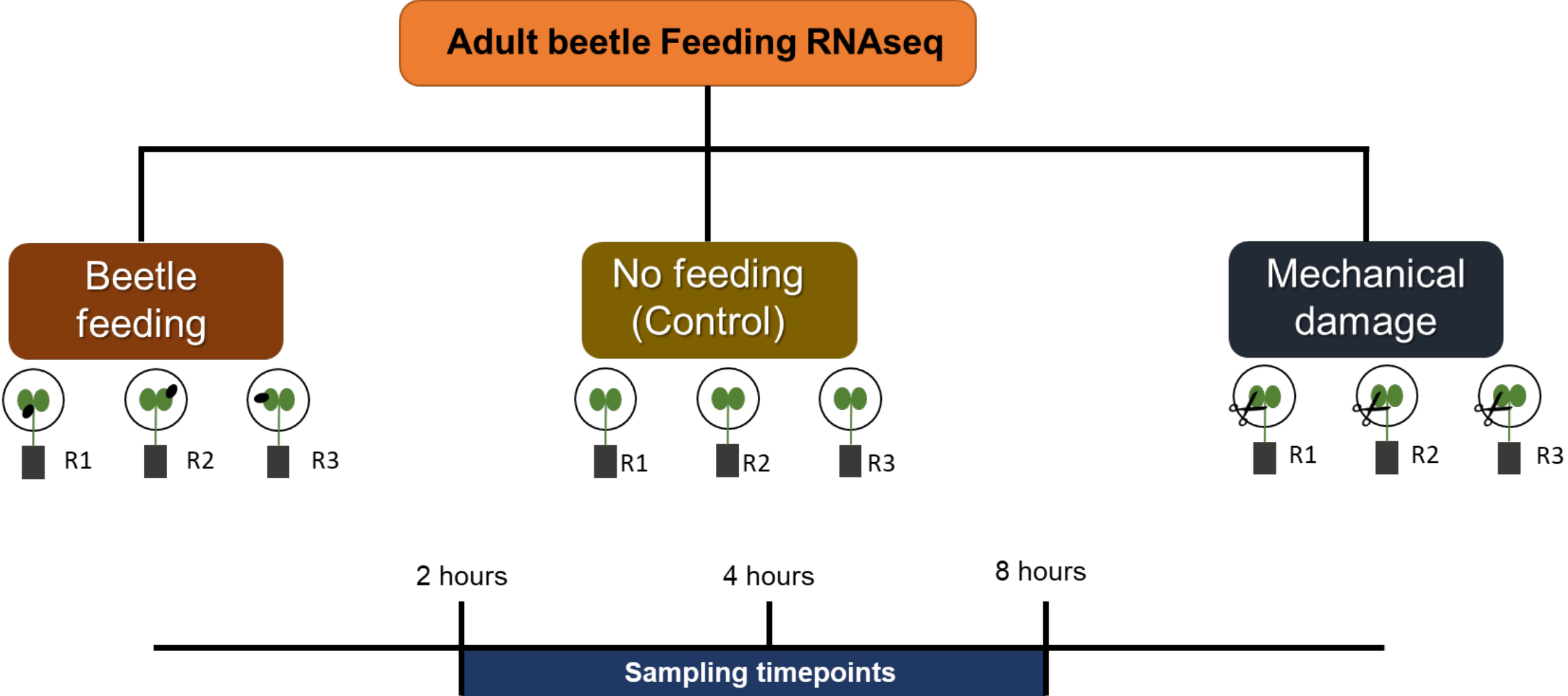
CSFB damage elicits a calcium burst



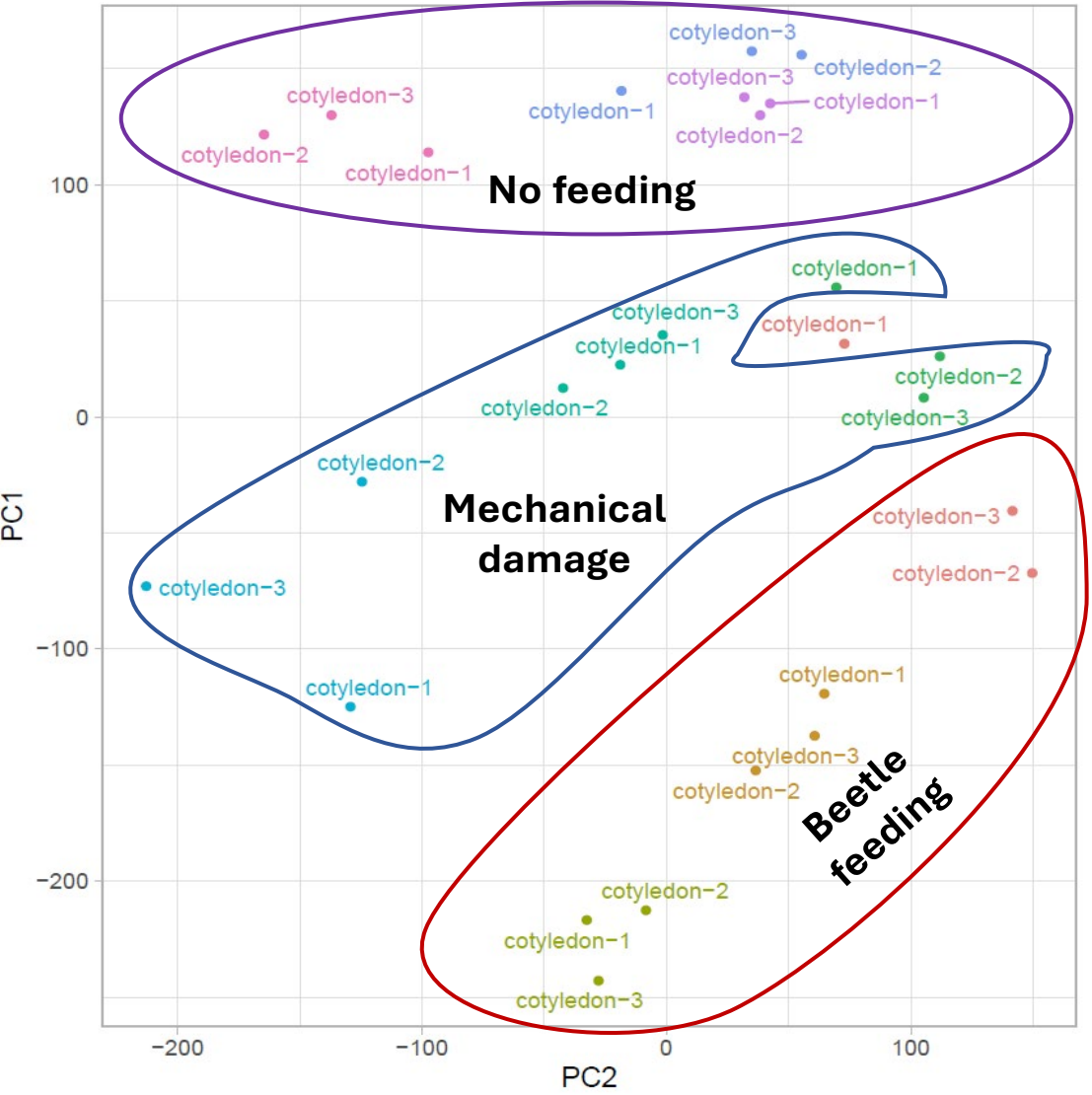
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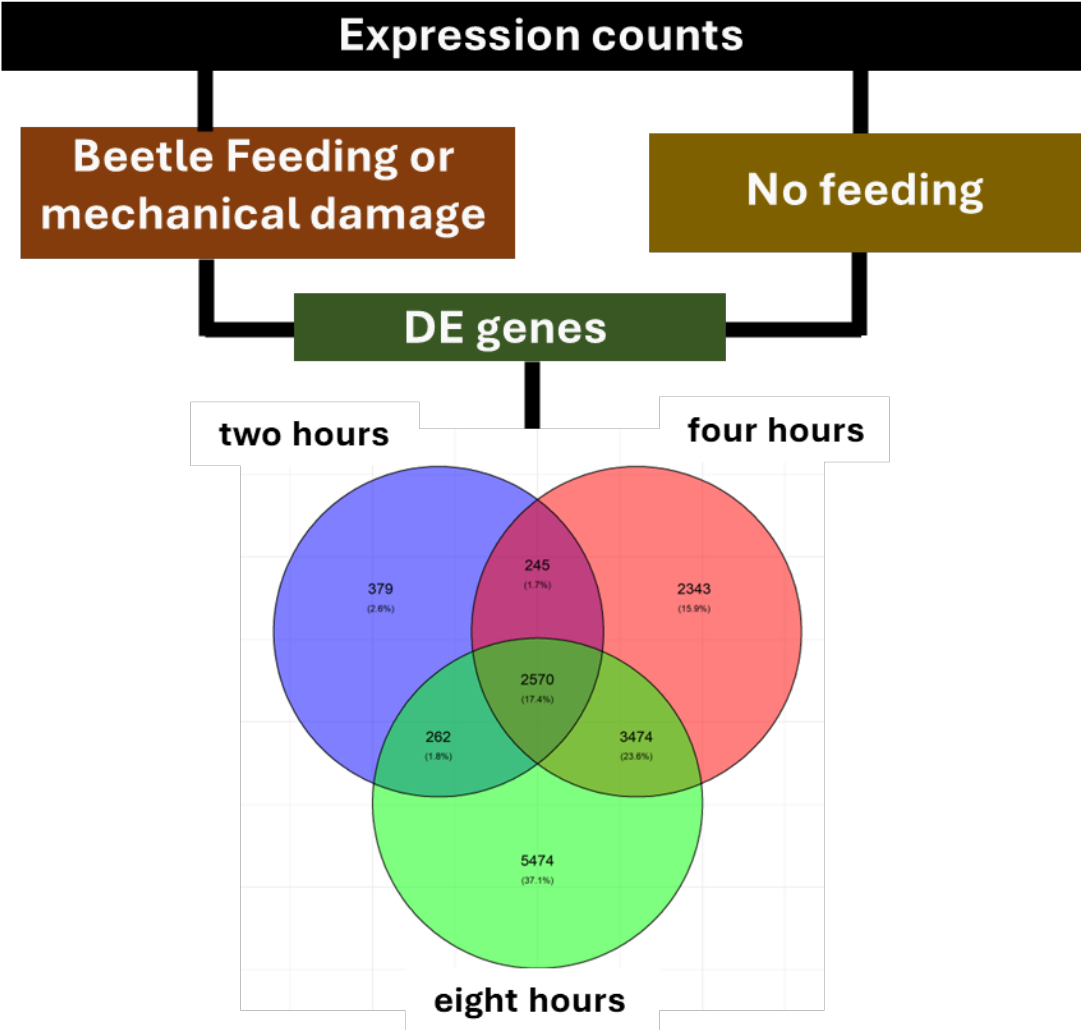
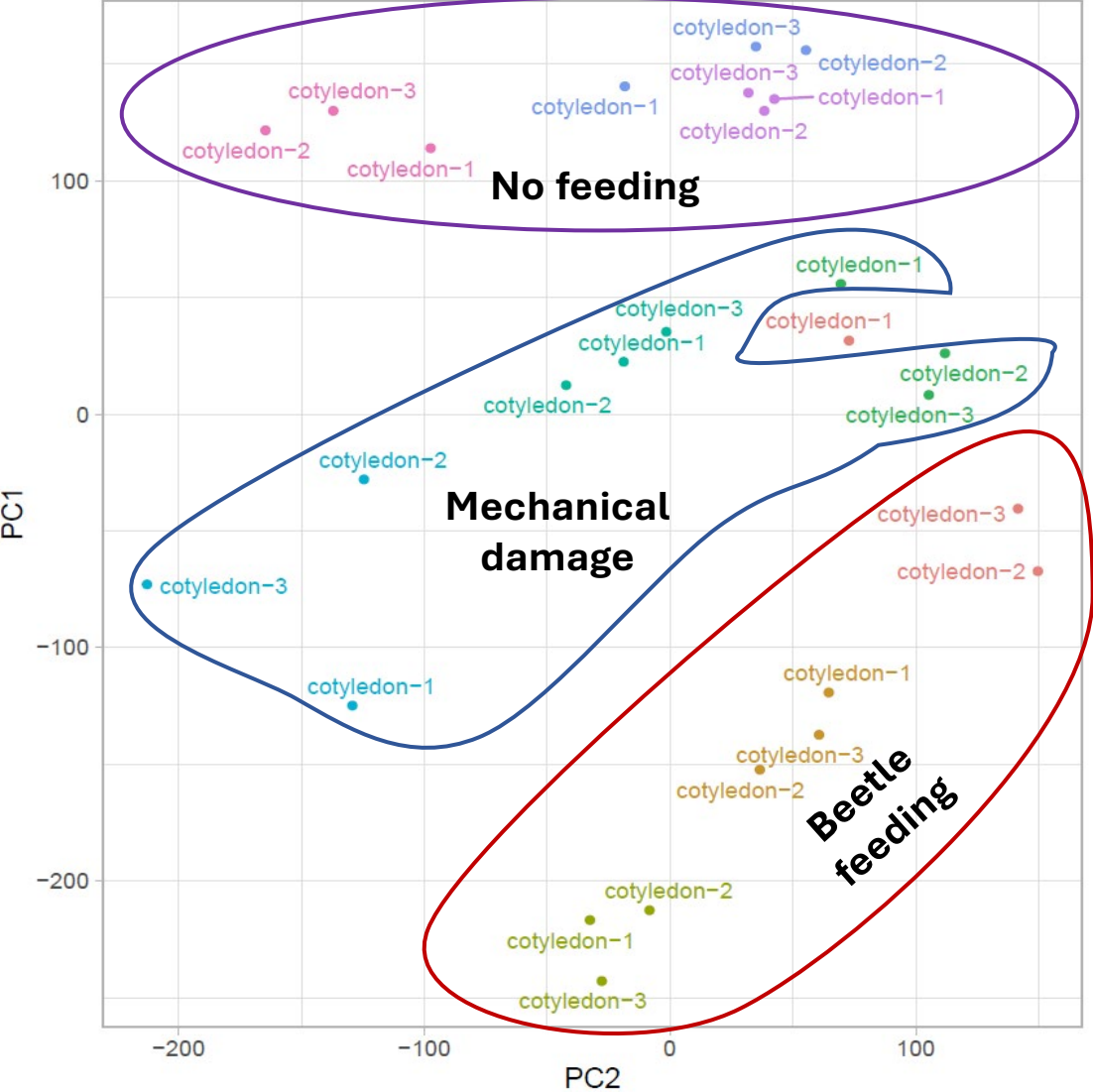
Can plant recognise beetle specific damage?



Samples for the different treatments show distinct clustering



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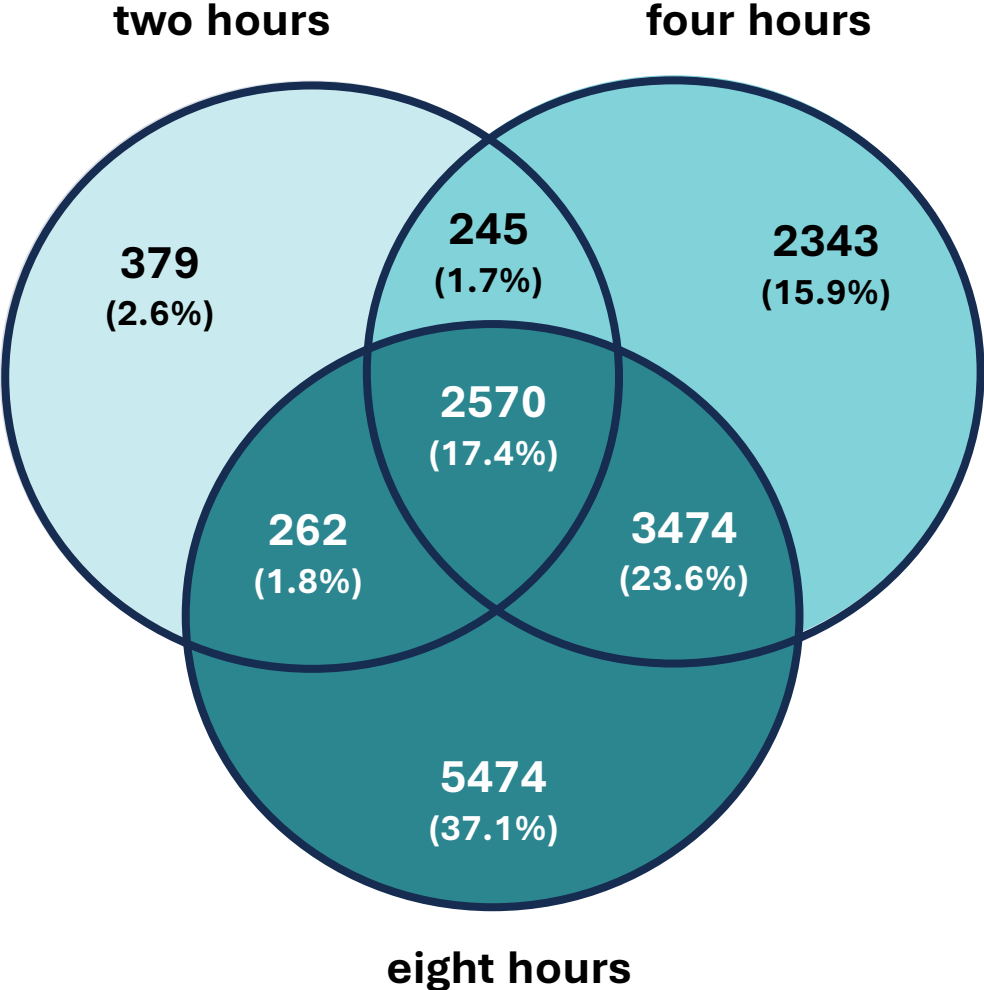


Can plant distinctly differentiate between beetle feeding and mechanical damage?

What defence pathway(s) are specifically activated in response to beetle feeding in the Resistant line?

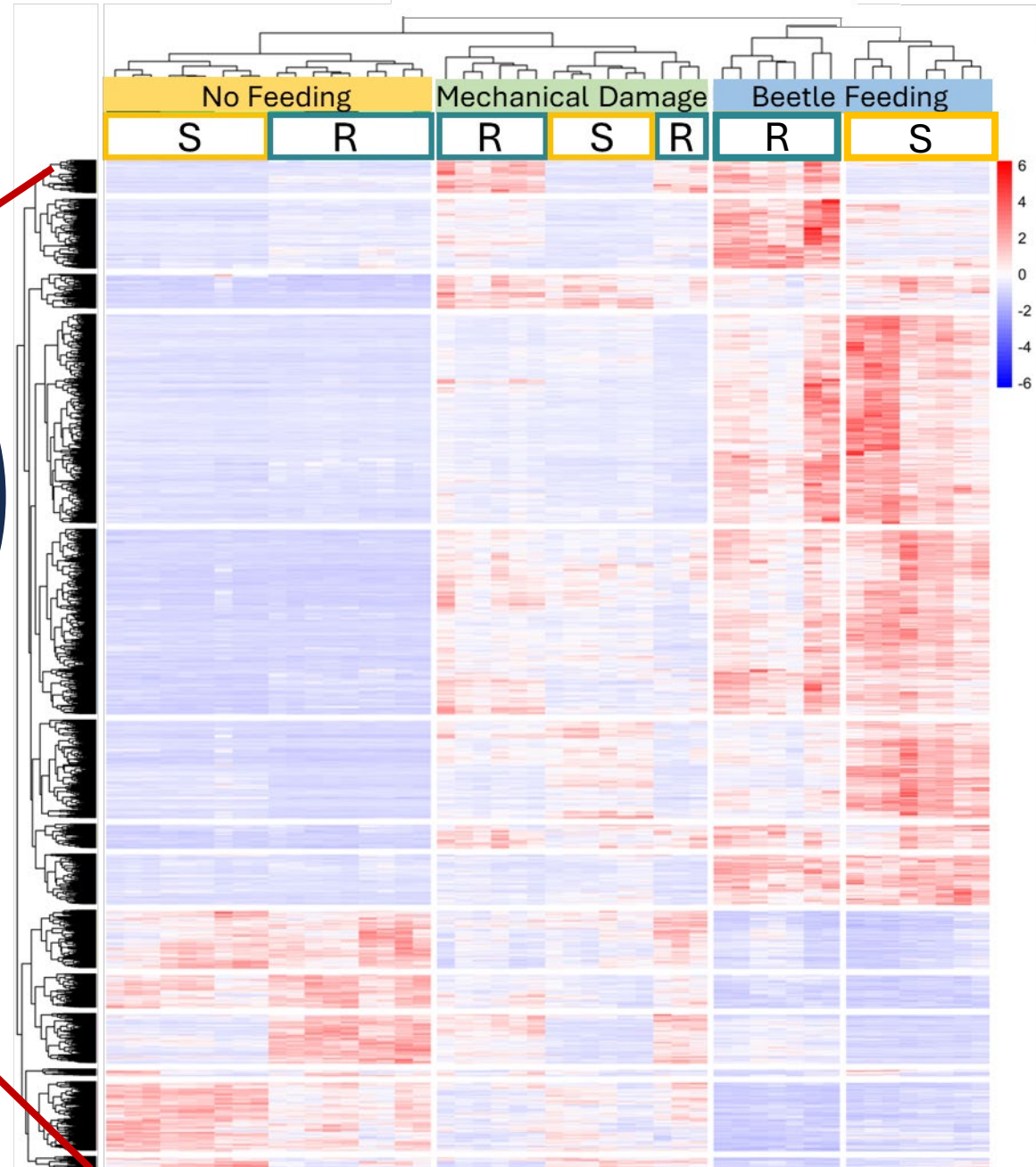
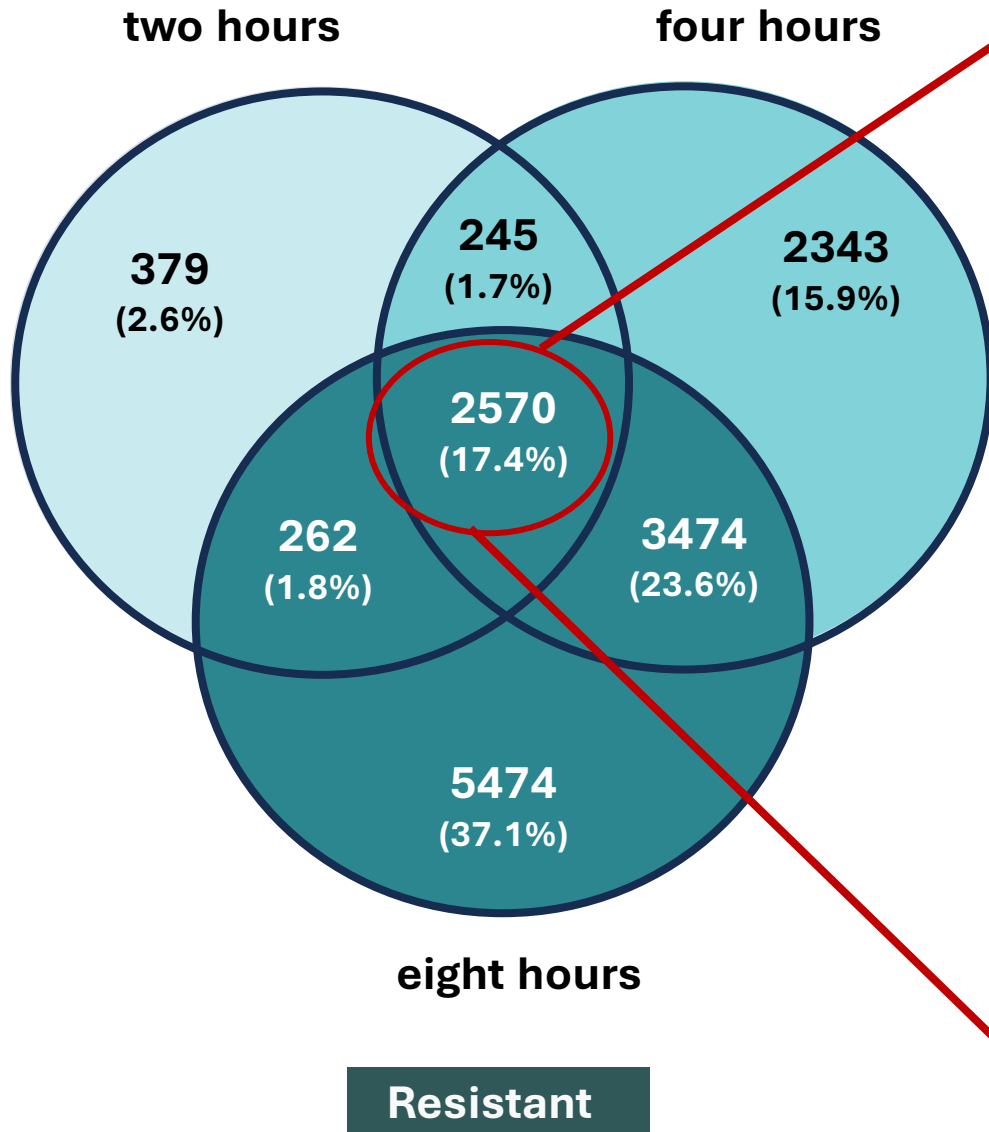
Comparison of Differentially Expressed (DE) genes between Beetle feeding and no feeding

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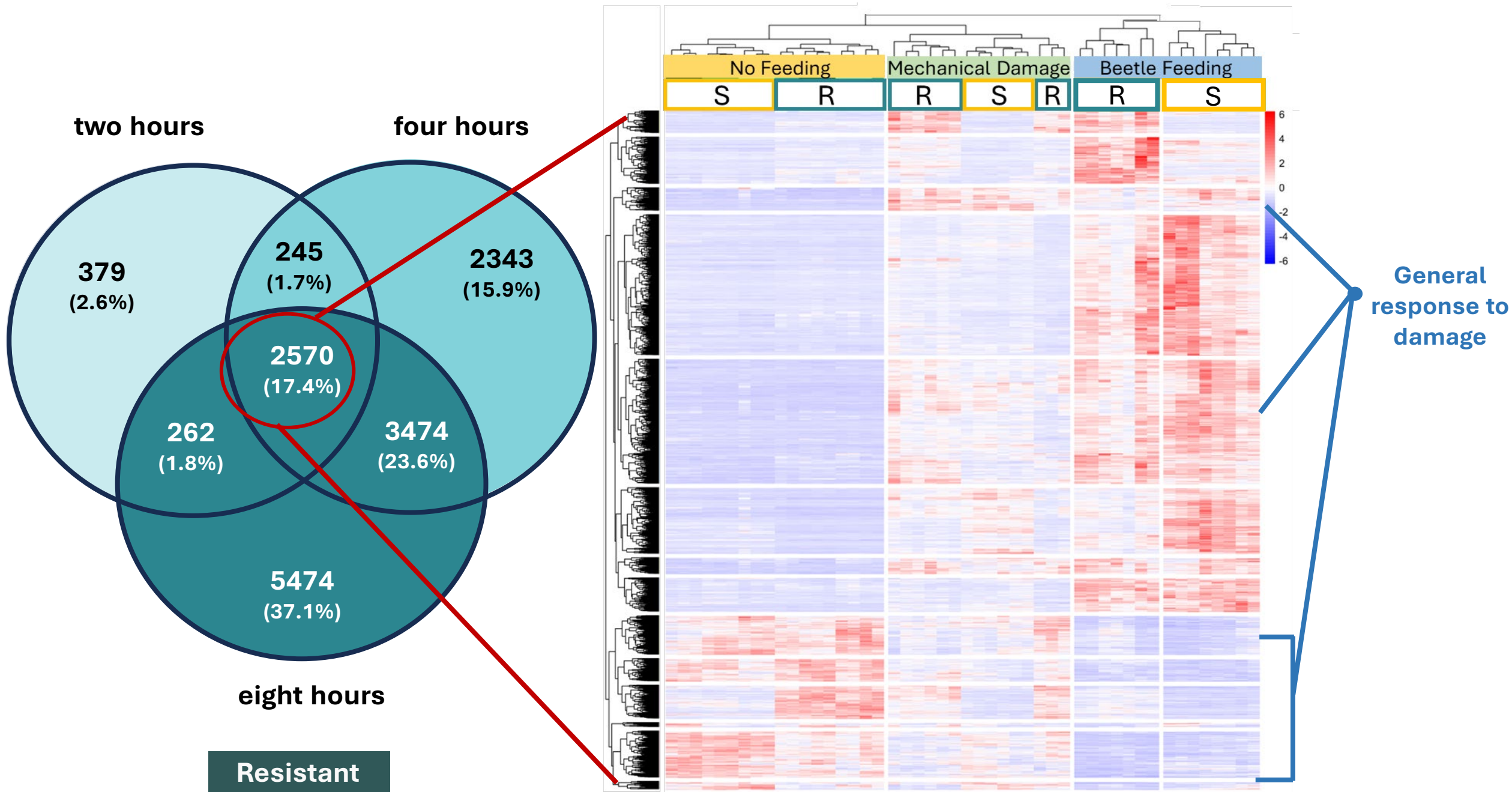


Resistant

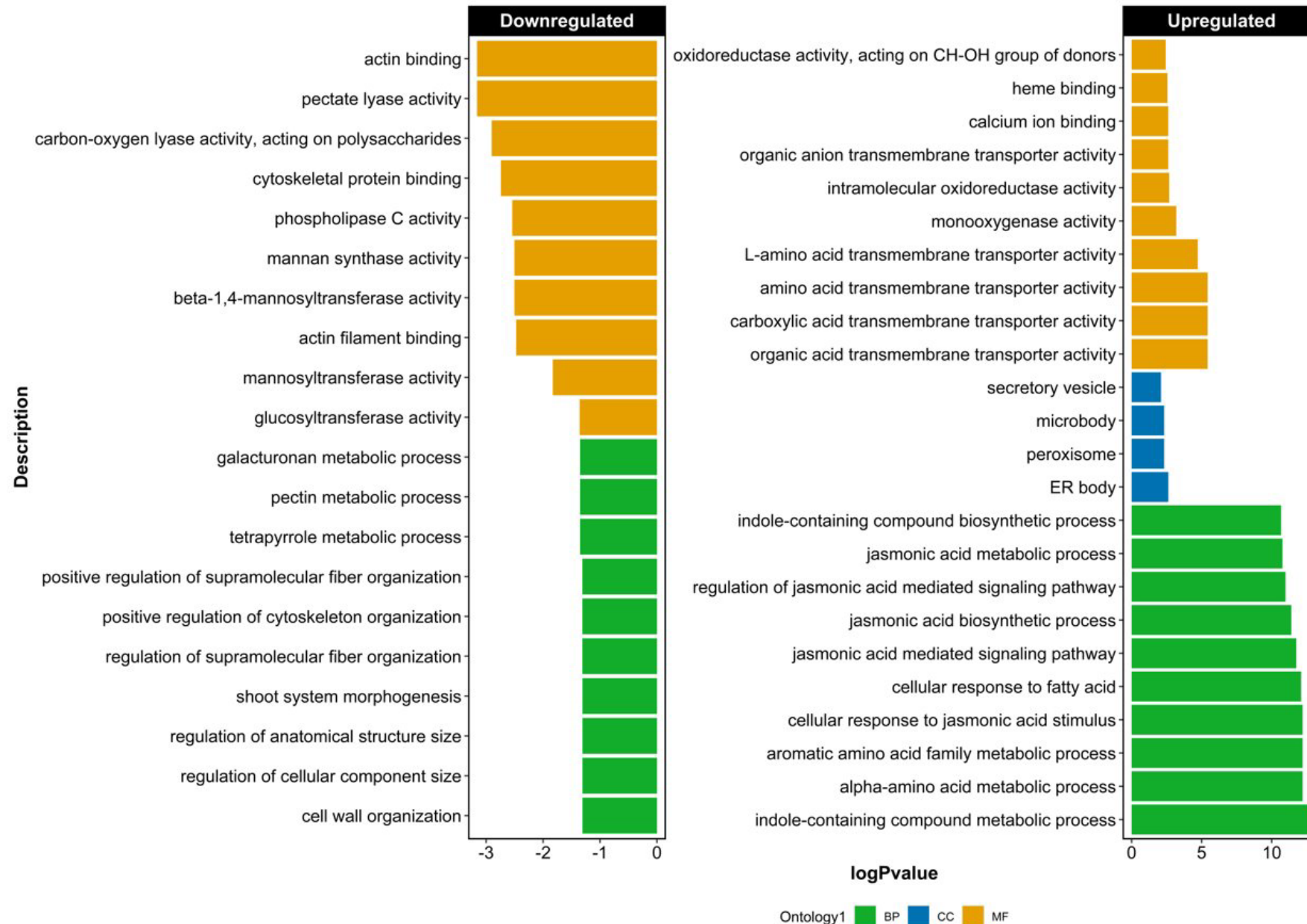
Plants can distinctly recognise beetle feeding damage



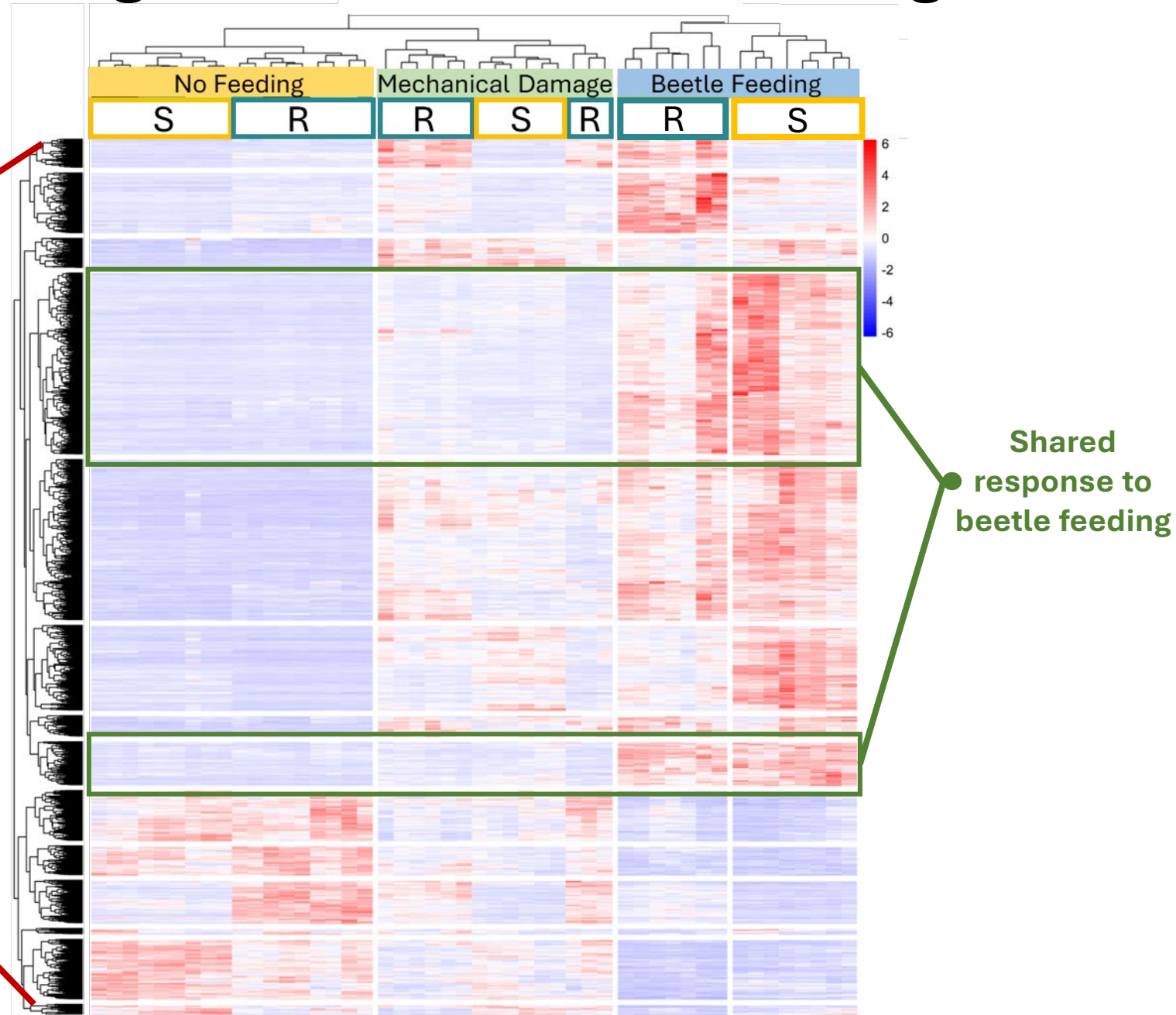
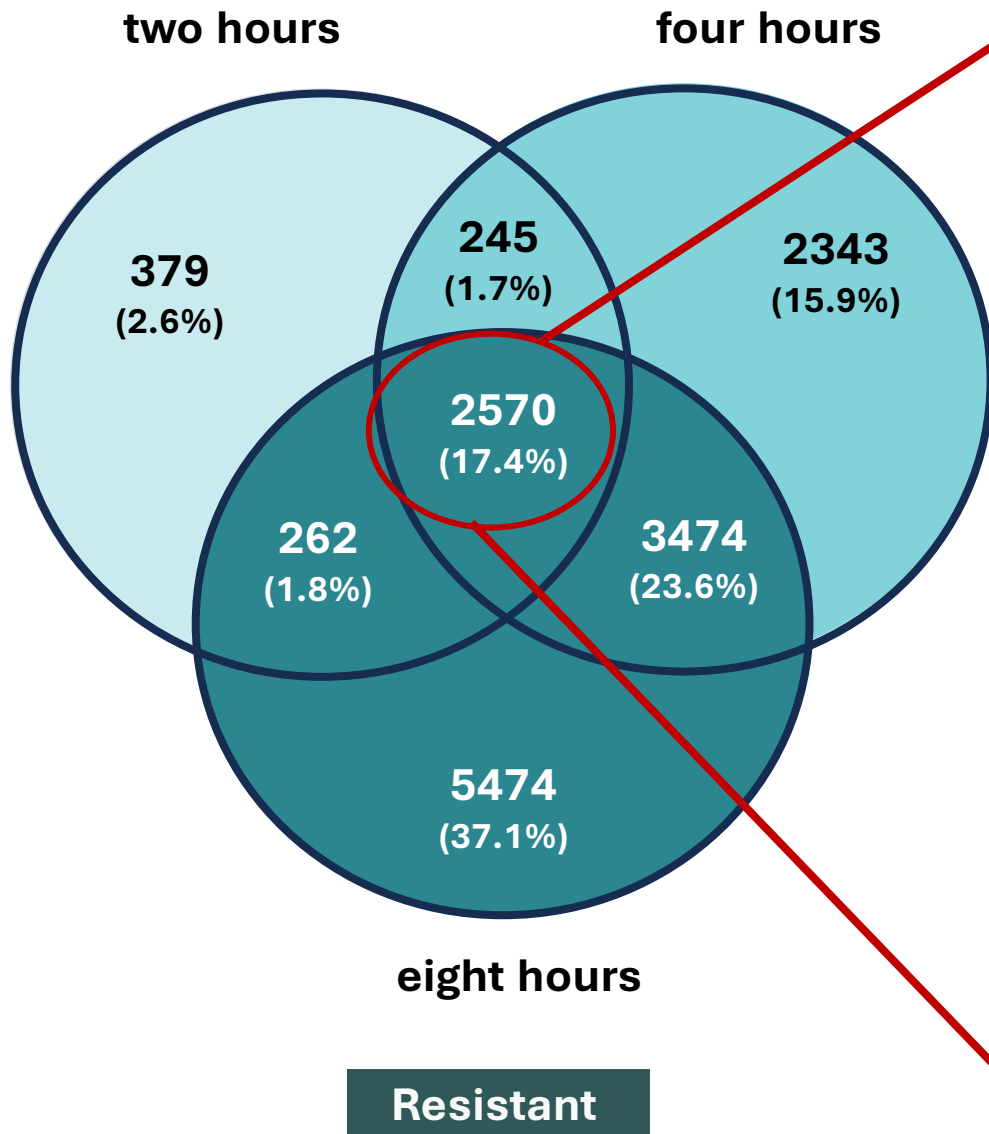
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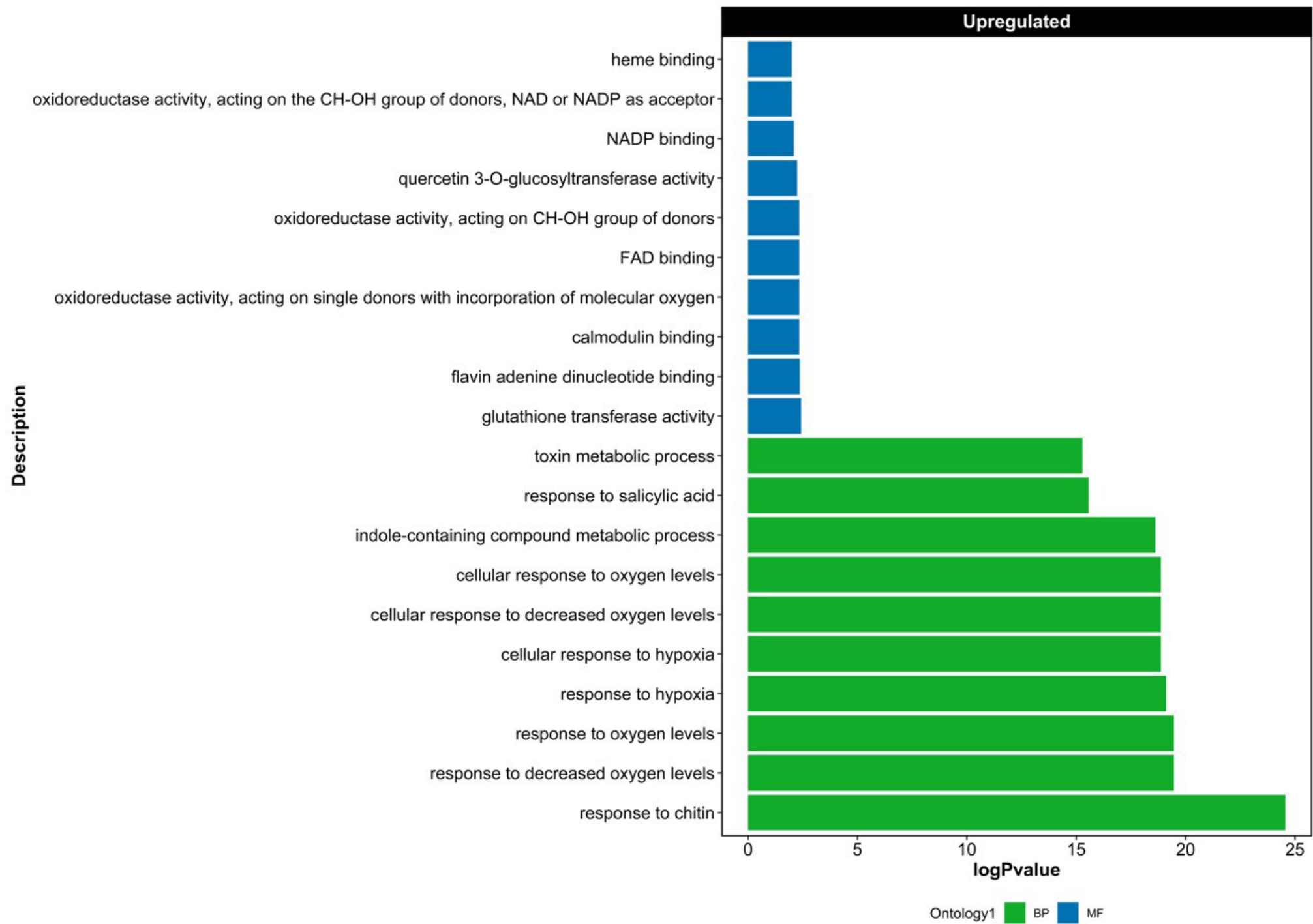


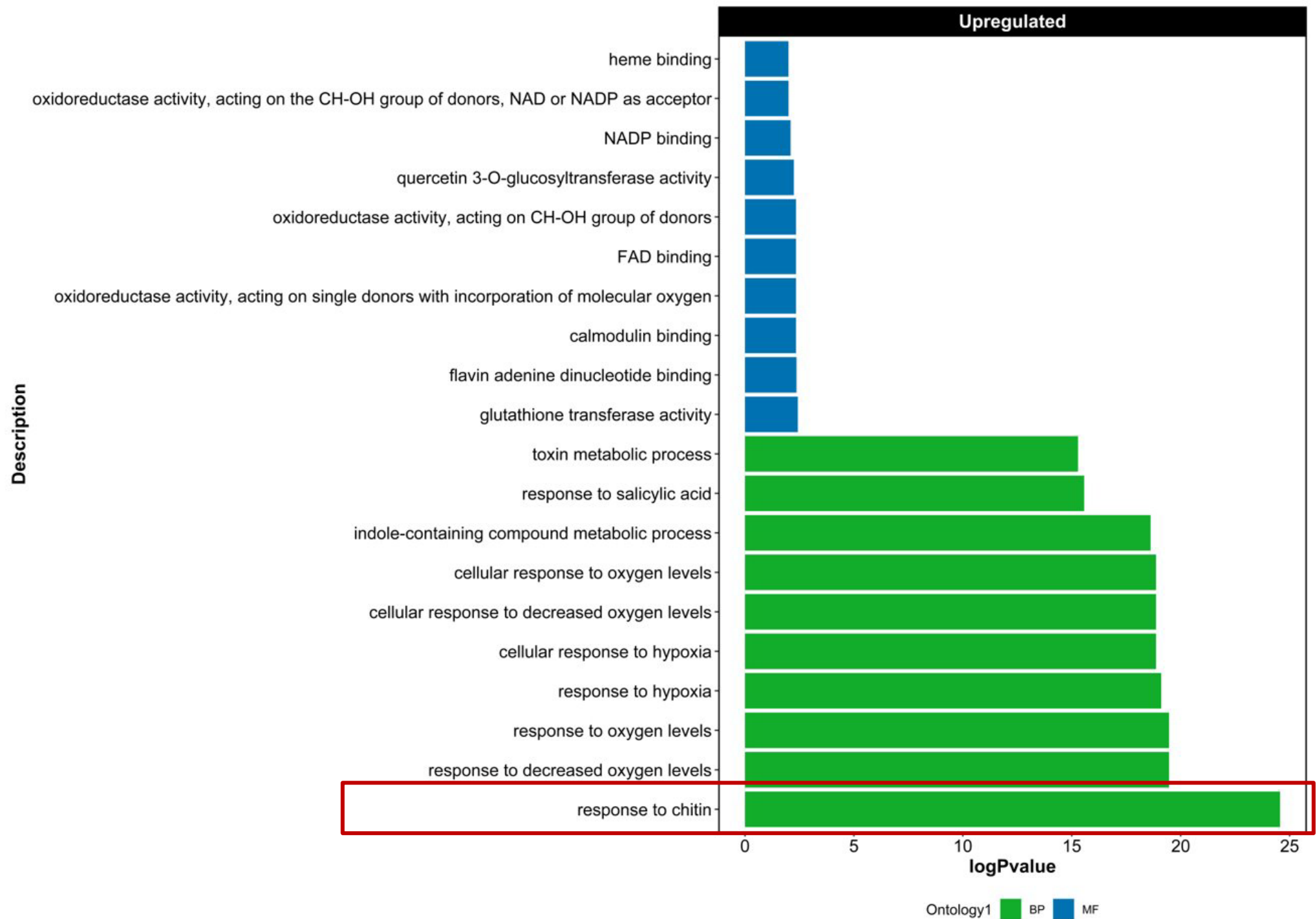
Plant growth-to-defense transition in response to damage



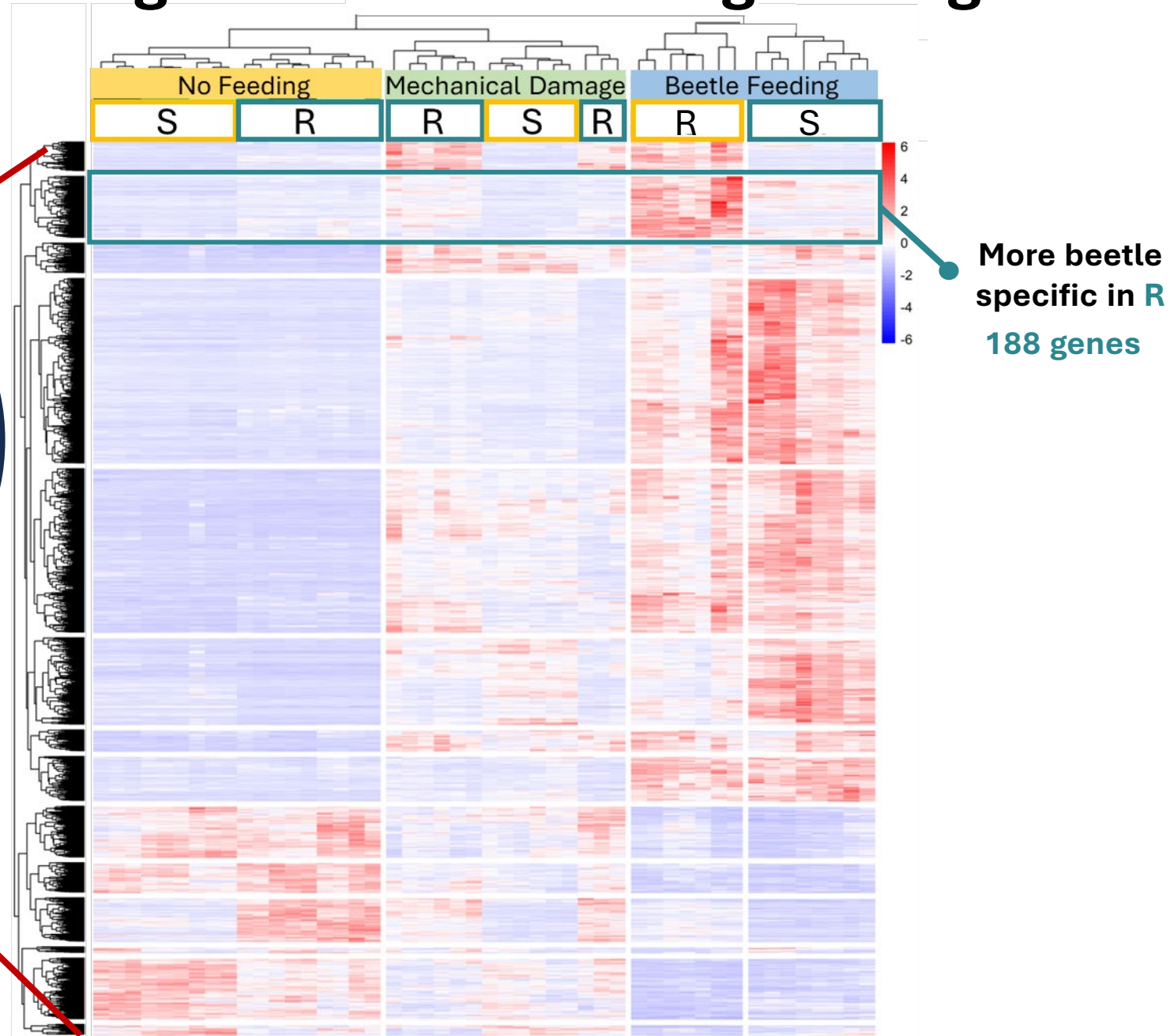
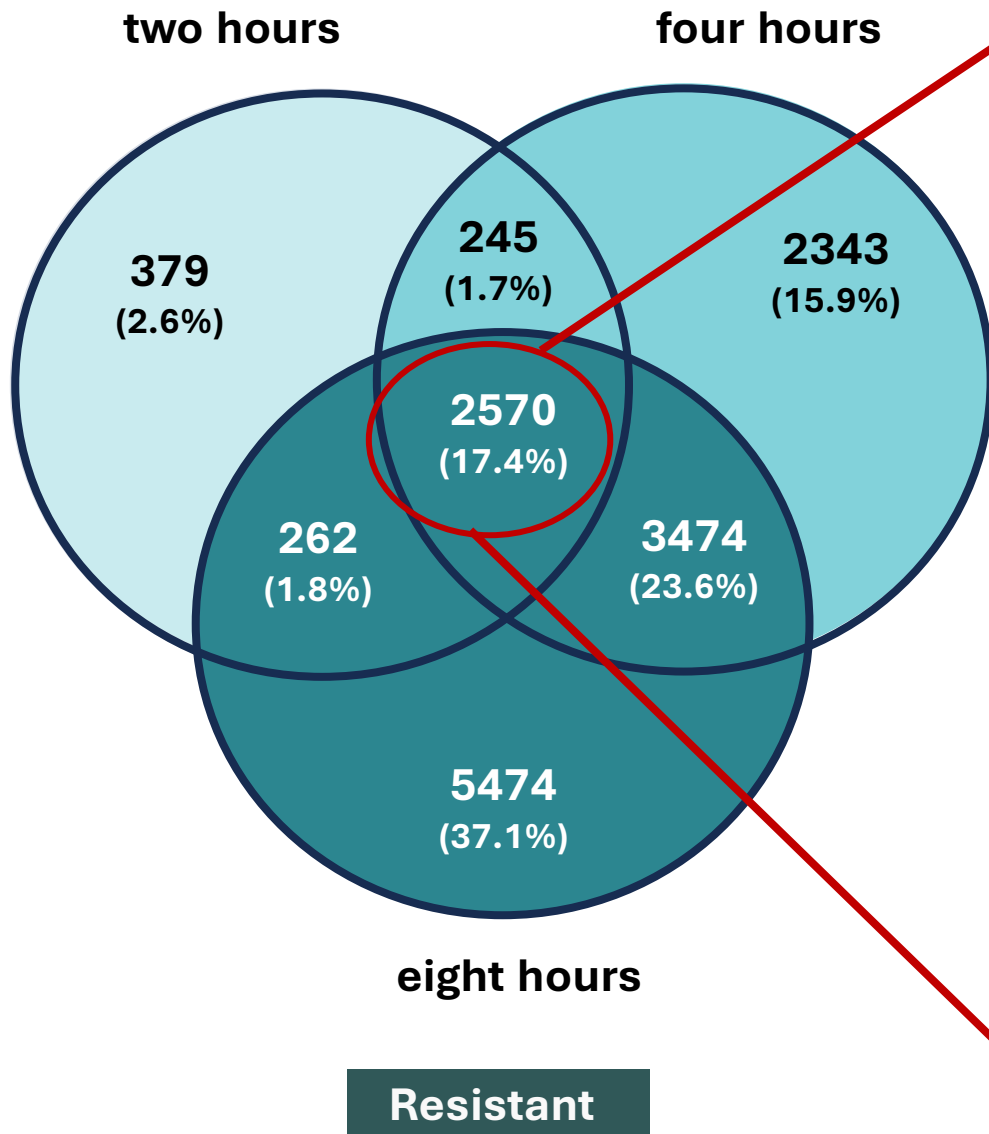
Plants can distinctly recognise beetle feeding damage







Plants can distinctly recognise beetle feeding damage



Upregulated

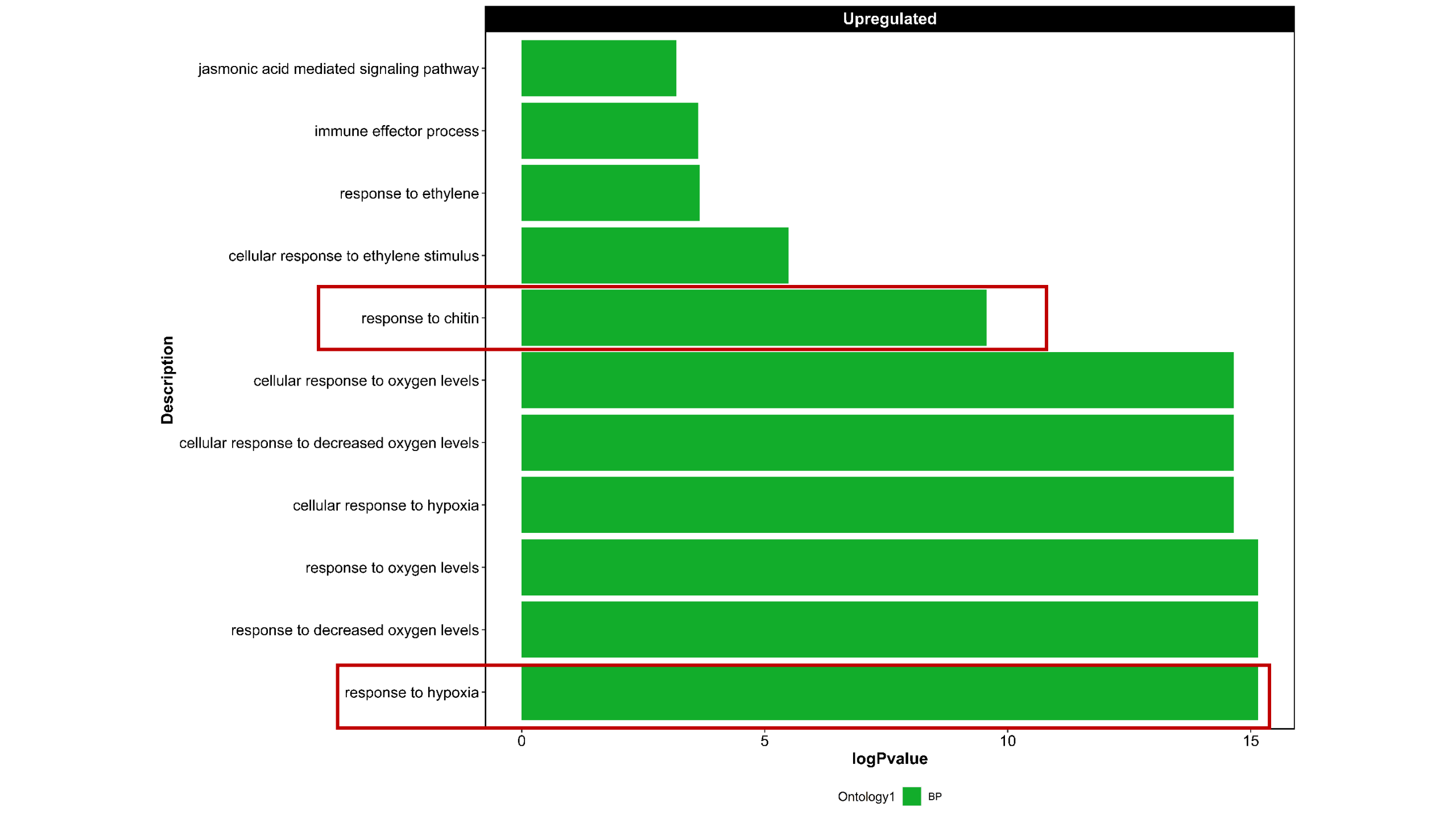
Description

- jasmonic acid mediated signaling pathway
- immune effector process
- response to ethylene
- cellular response to ethylene stimulus
- response to chitin
- cellular response to oxygen levels
- cellular response to decreased oxygen levels
- cellular response to hypoxia
- response to oxygen levels
- response to decreased oxygen levels
- response to hypoxia

0 5 10 15

logPvalue

Ontology1 BP





Summary

- We have flea beetle population methodology that we can use for lab experiment
- Screening *B. napus* diversities has helped us to identify genotypes that are more resistant and susceptible to CSFB damage
- Both GWAS and RNAseq has helped us to identified candidate genes/pathways for CSFB resistance for further investigation
- RNAseq will allow us to understand the mechanism of interaction between the plant and beetle



Thanks for listening



✉ @JIC

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