Origanum vulgare vapor primes defence mechanisms in grapevine (*Vitis vinifera*) and hinders *Plasmopara viticola* infection

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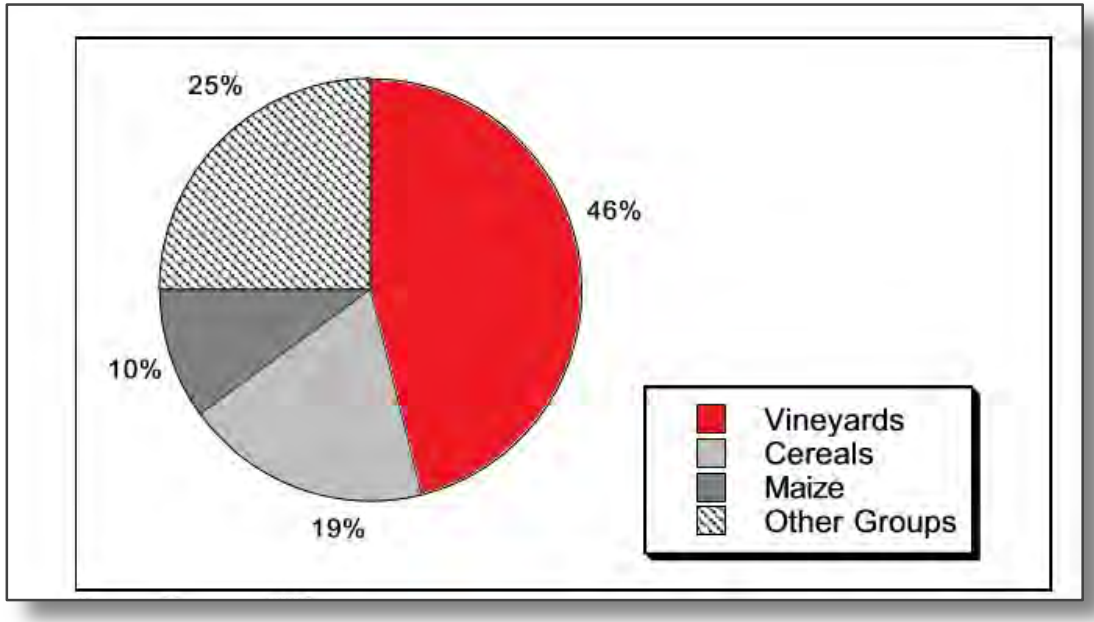
Background

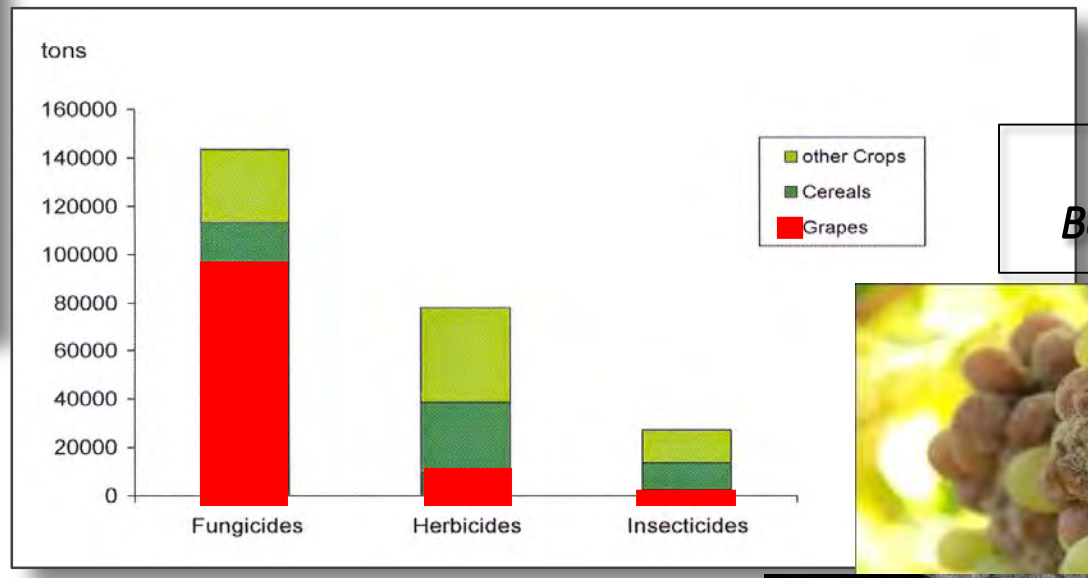
Pesticide use by crop in the EU



- 3% of agricultural surface
- 46% of the total pesticide use

Mildou - downy mildew – *Pernospora (viticole)–*

Oidium – powdery mildew – Erysiphe necator



Bunch rot – *Botrytis cinerea*

Essential oils: alternatives to fungicides?

Table 1. Publications related to various bioactivities of essential oils (PubMed search 9/29/2016).

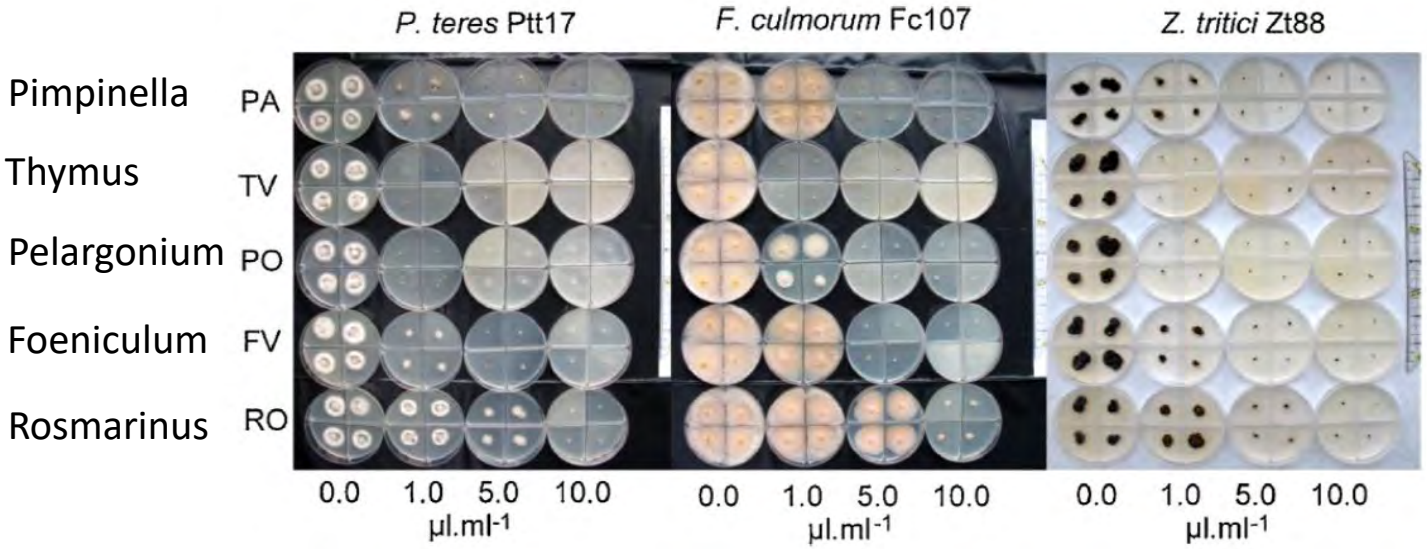
Activity	Number of publications[a]
Antimicrobial	2671
Antioxidant	1186
Anti-inflammatory	587
Analgesic	388
Anticancer	108
Sedative	102
Spasmolytic	73
Wound healing	44
Immunomodulatory	34
Anti-allergic	22
Gastroprotective	13
Anti-aging	5
Antidepressive	5
Pain relief	4

[a]Keywords used: "name of activity," "essential oil" (*e.g.*, antioxidant activity, essential oil).

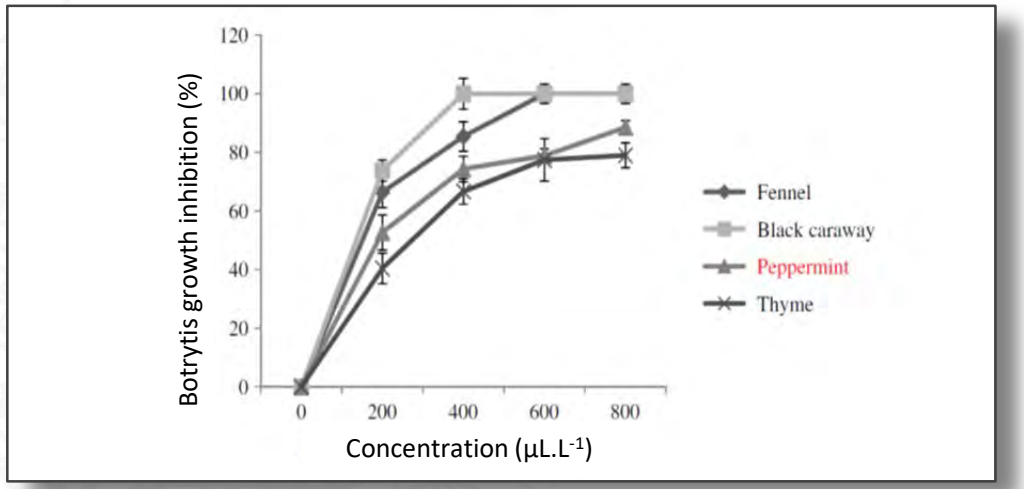
Sakkas & Papadopoulou., 2016

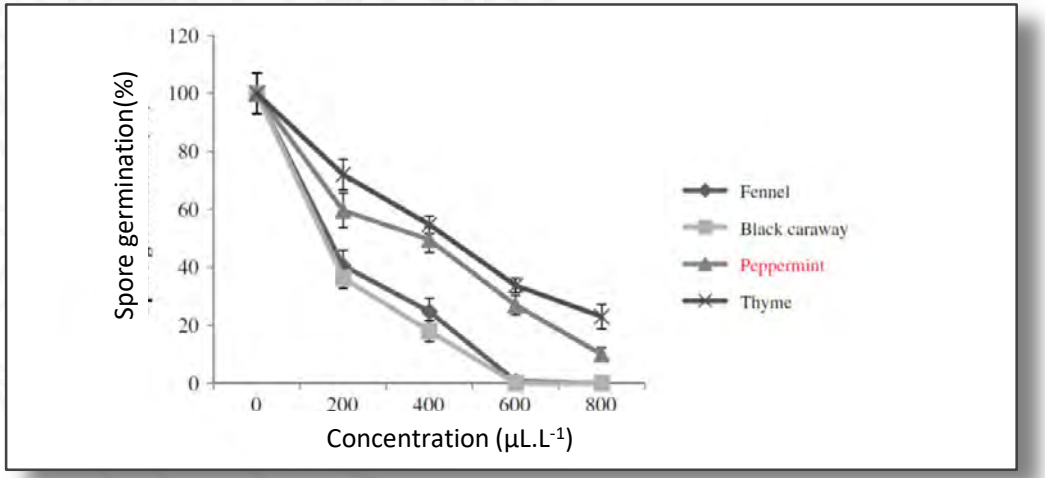
Essential oils: alternatives to fungicides?

Botrytis in vitro



Matusinsky et al., 2015





S. Mohammadi et al. 2014

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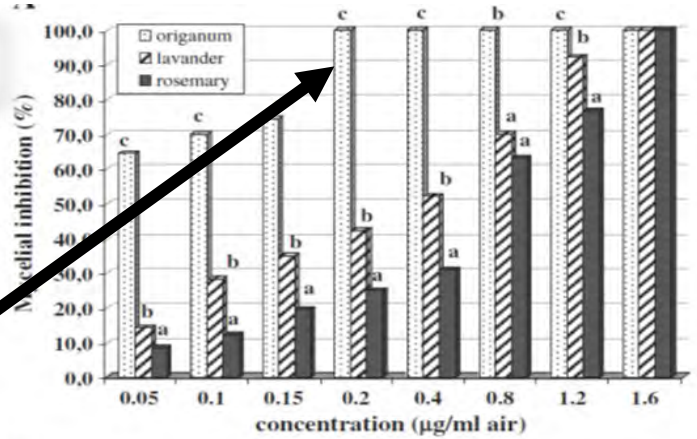
Essential oils: alternatives to fungicides?

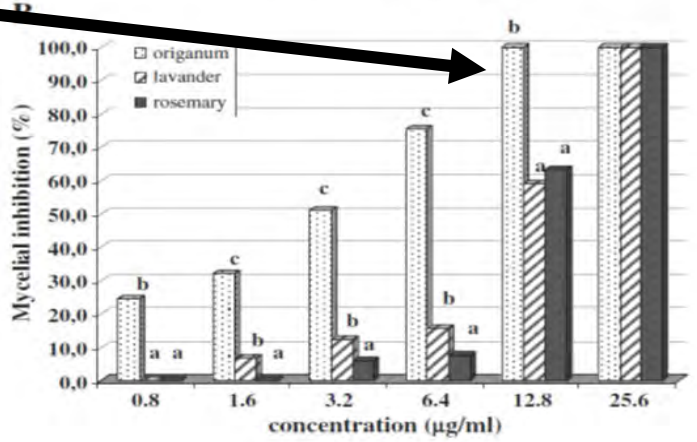
Botrytis in vitro

volatile

Origanum

direct



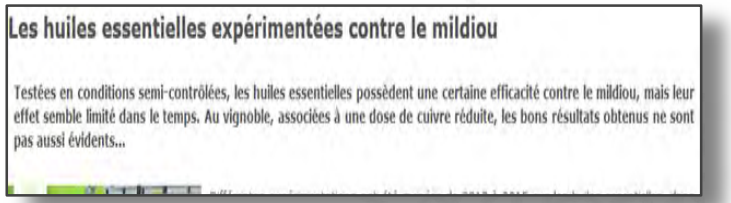


Mechanisms underlying the action of essential oil on the vegetative and reproductive phases of fungal development and host remains to be understood

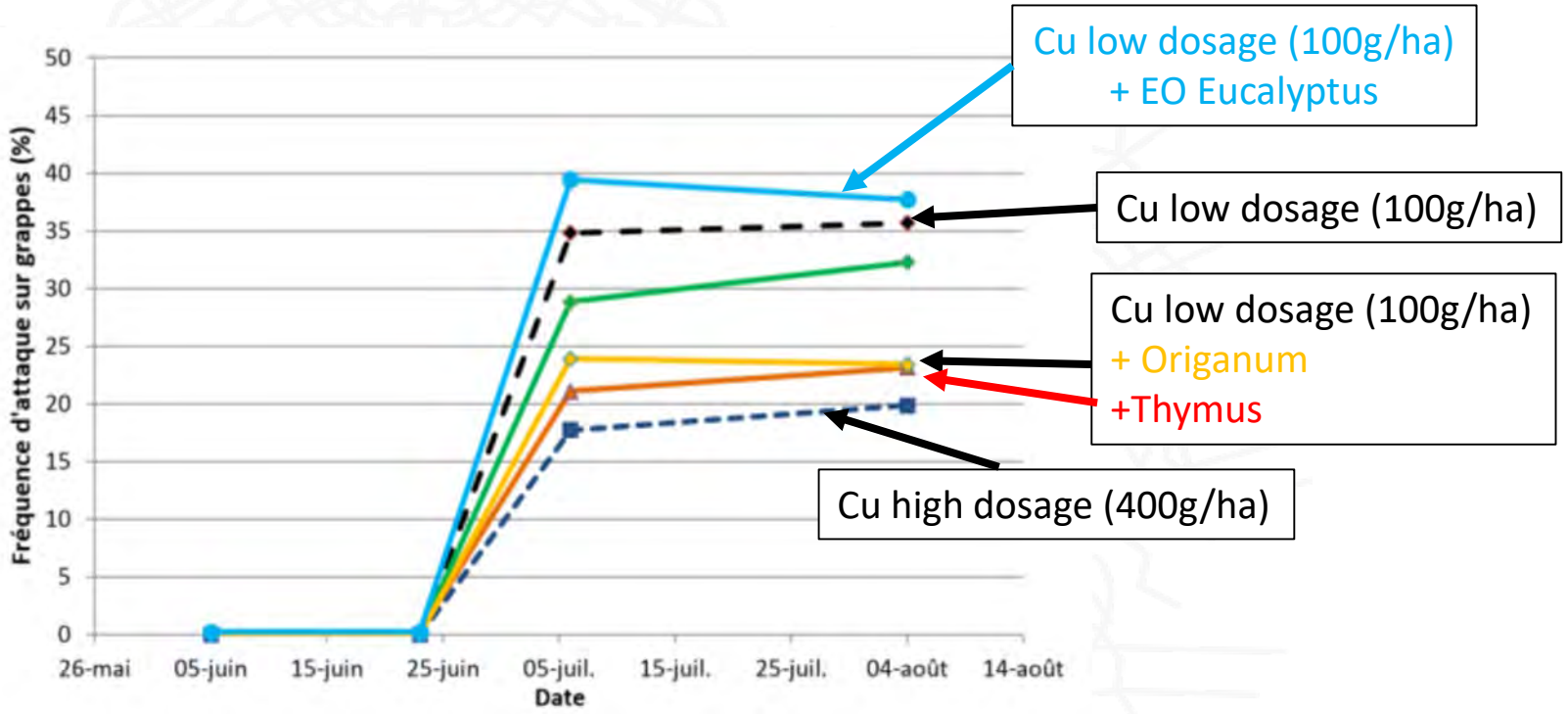
E.M. Soylu et al 2007, 2010

Essential oils: alternatives to fungicides?

Downy mildew on vine


Les huiles essentielles expérimentées contre le mildiou

Testées en conditions semi-contrôlées, les huiles essentielles possèdent une certaine efficacité contre le mildiou, mais leur effet semble limité dans le temps. Au vignoble, associées à une dose de cuivre réduite, les bons résultats obtenus ne sont pas aussi évidents...



Problems:

- **Hydrophobe**
- **Efficiency only very brief after application and inoculation**
- **Termination seems to be crucial**

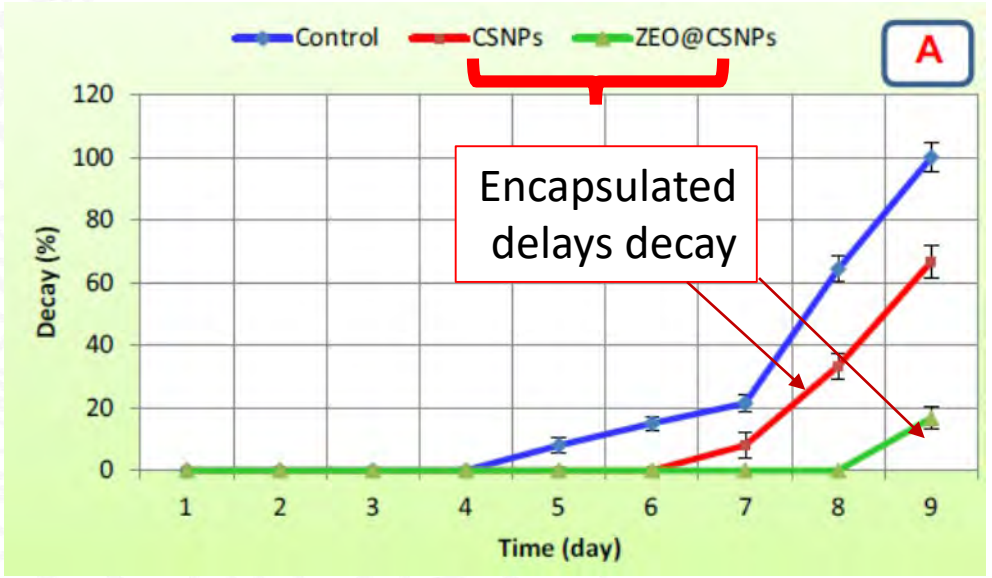
- **IFV –Vinopôle Bordeaux Aquitaine** AVELINE et al., 2015

Essential oils: alternatives to fungicides?

Nanoencapsulation of *Zataria multiflora* essential oil preparation and characterization with enhanced antifungal activity for controlling *Botrytis cinerea*, the causal agent of gray mould disease

Ali Mohammadi [a], Maryam Hashemi [b,*], Seyed Masoud Hosseini [a,**]

Fig. 6. Appearance of strawberries coated with CSNPs (1500 ppm) a
(1500 ppm) during storage. Fruits were treated, inoculated with fungus
7 days at 4 °C followed by 2 days at 20 °C.



Short communication

Long-term antifungal activity of volatile essential oil components released from mesoporous silica materials

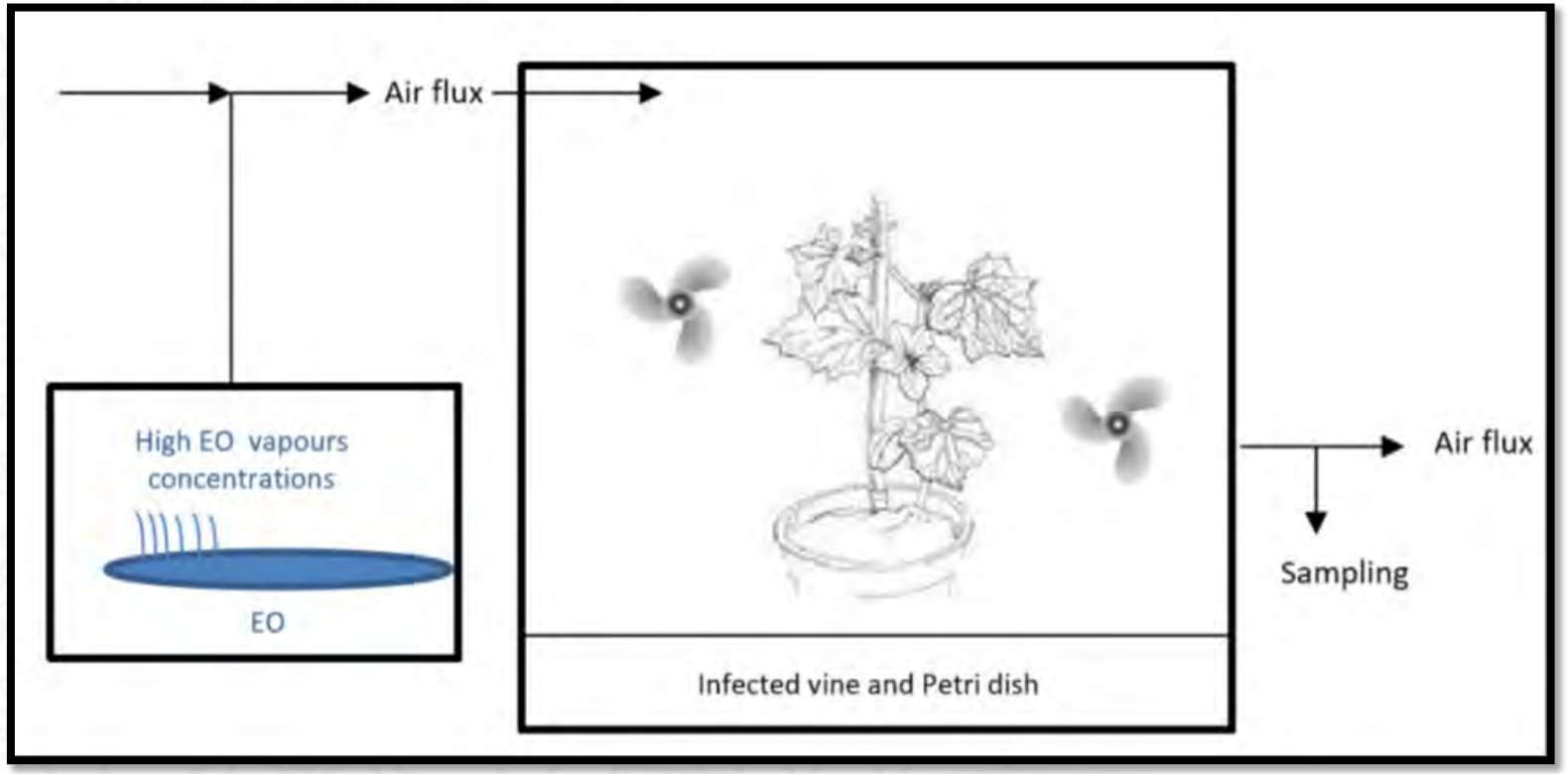
Anezka Janatova [a,b], Andrea Bernardos [a], Jakub Smid [a], Adela Frankova [a], Miloslav Lhotka [c], Lenka Kourimská [b], Josef Pulkrabek [a], Pavel Kloucek [b,*]

Background - hypothesis

What about a continuous fumigation?

Long term targets:

- **Nanoparticles?**
- **Encapsulated EO?**
- **Fumigation in greenhouses / storage of fresh fruits**
- **Co-Plantations?**



Methodology

- Develop/construct a chamber with a vaporization syster
- Validate the system (concentrations etc)
- Test different oils and their impact on:
  - Plant development/physiology
  - Different pathogens

- Understand the involved molecular mechanisms

  → RNA-sequencing

I-66LLVL

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Fachhochschule Westschweiz
University of Applied Sciences Western Switzerland

Methodology

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Results – Vapour concentration assessment

Thymus

BOX (30g/L)

0,603 -1,2016g/L

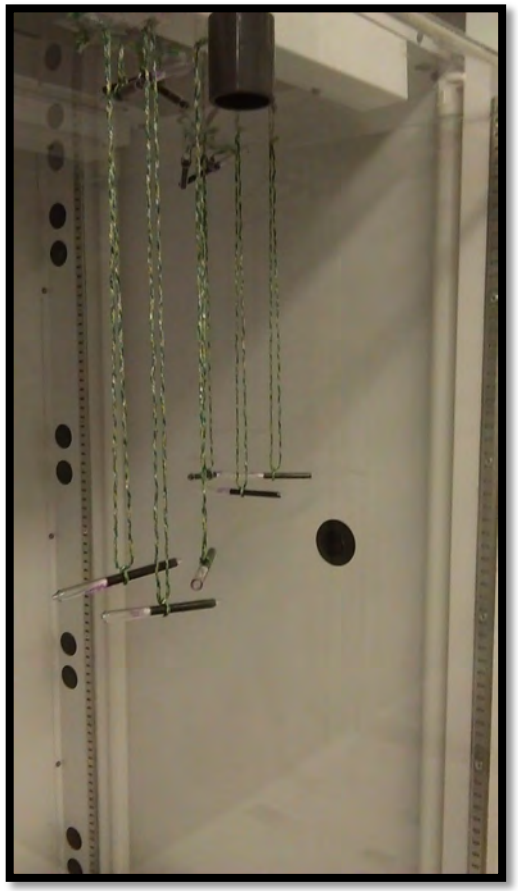
3-4,76 g/L

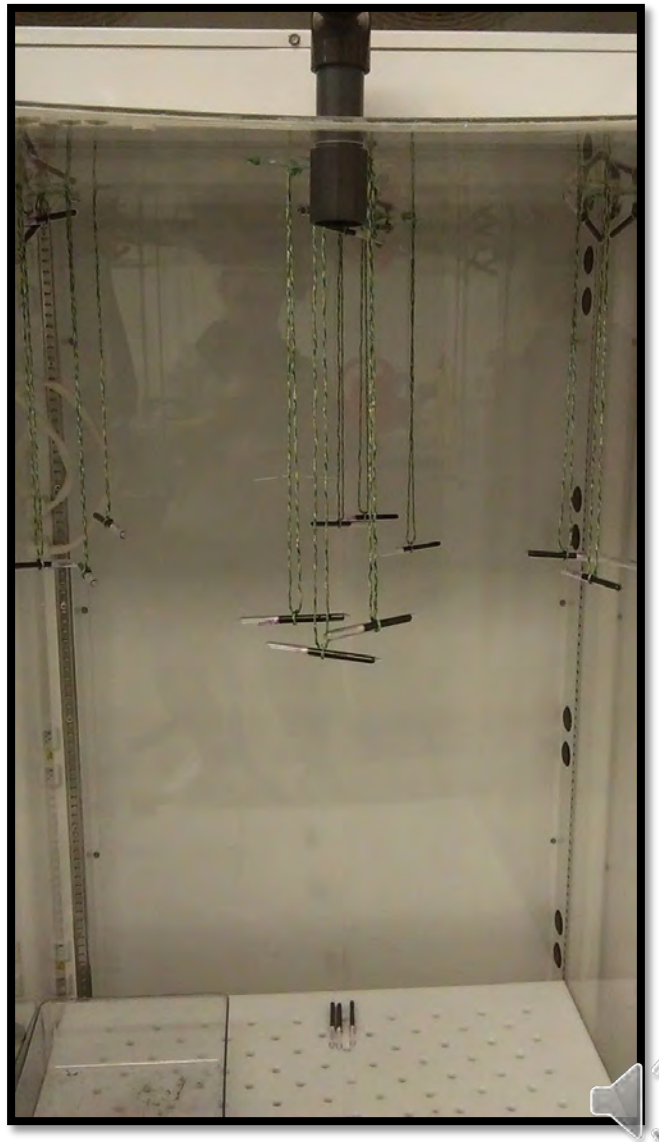
Origanum

BOX (3,5g/L)

0,1 - 0,15 g/L

0,38 -0,53

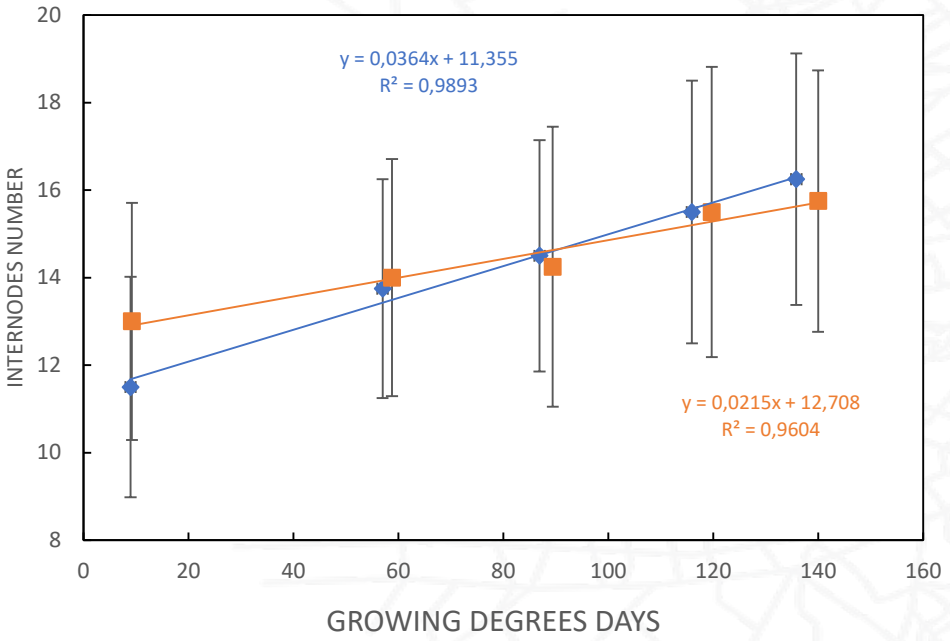




Results – Vine physiology

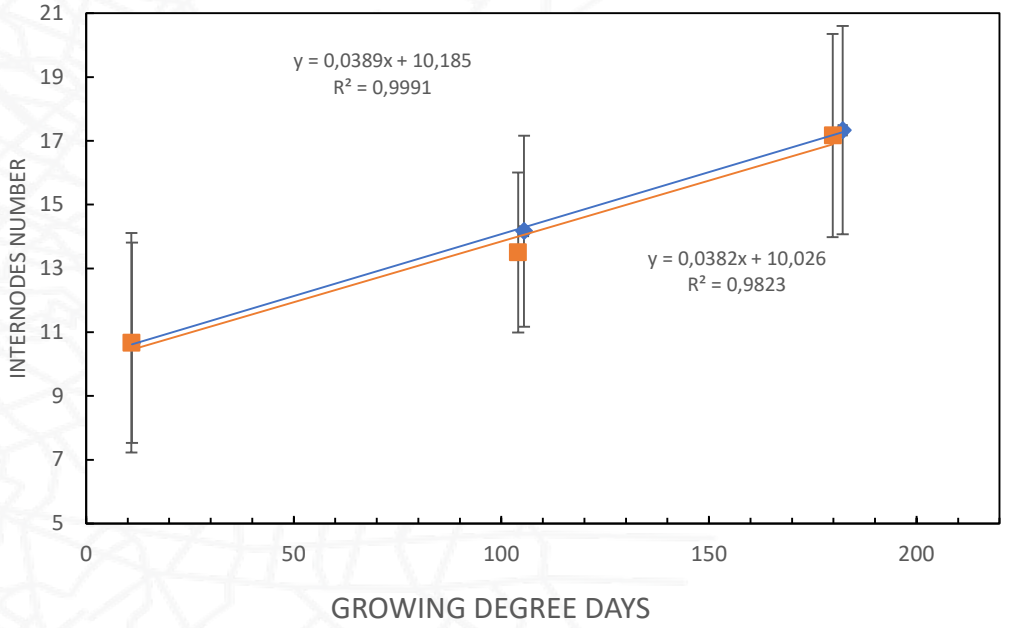
Growth Rate

Thymus



◆ control ■ Thymus

Origanum



◆ Control ■ Origanum

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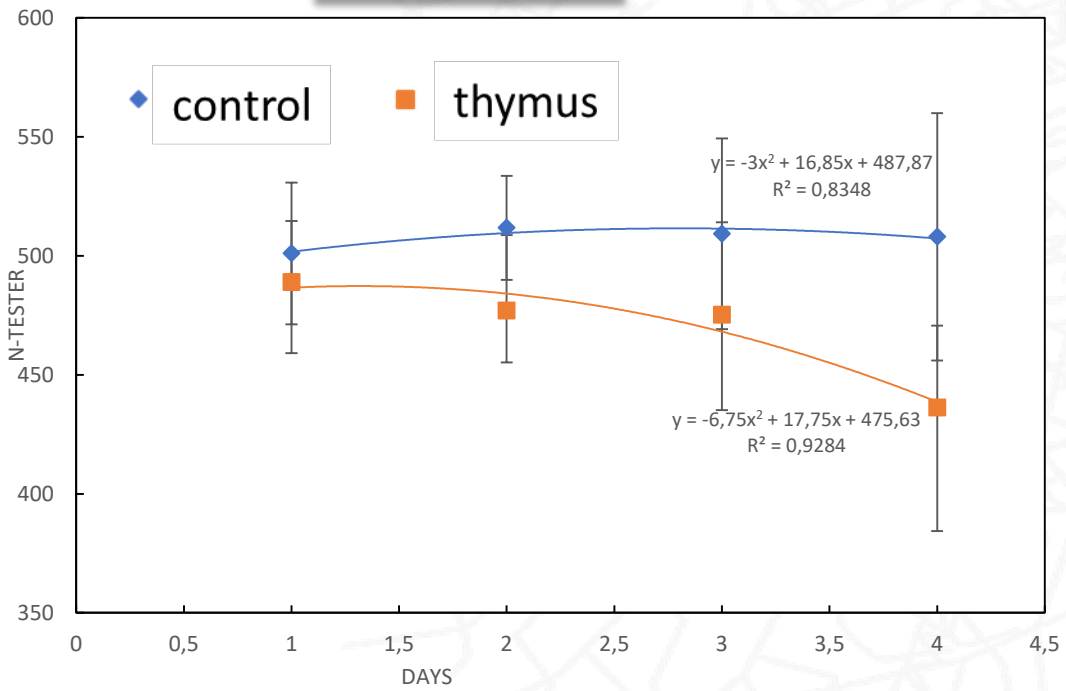
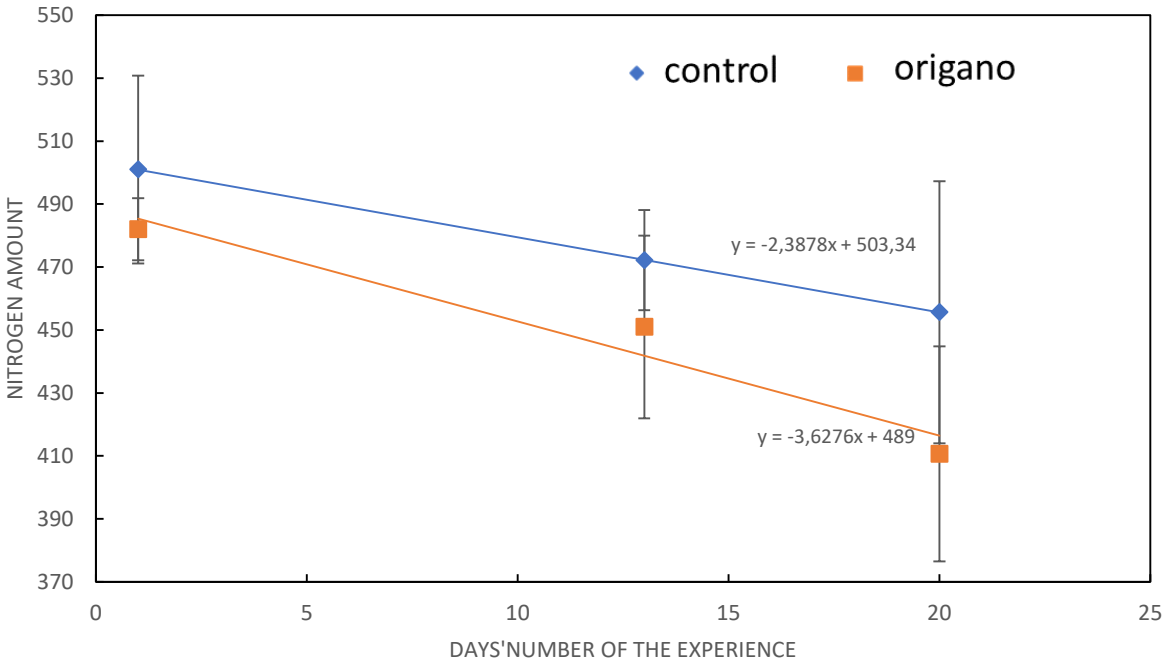
Results – Vine physiology

N-Tester

Thymus



Origanum



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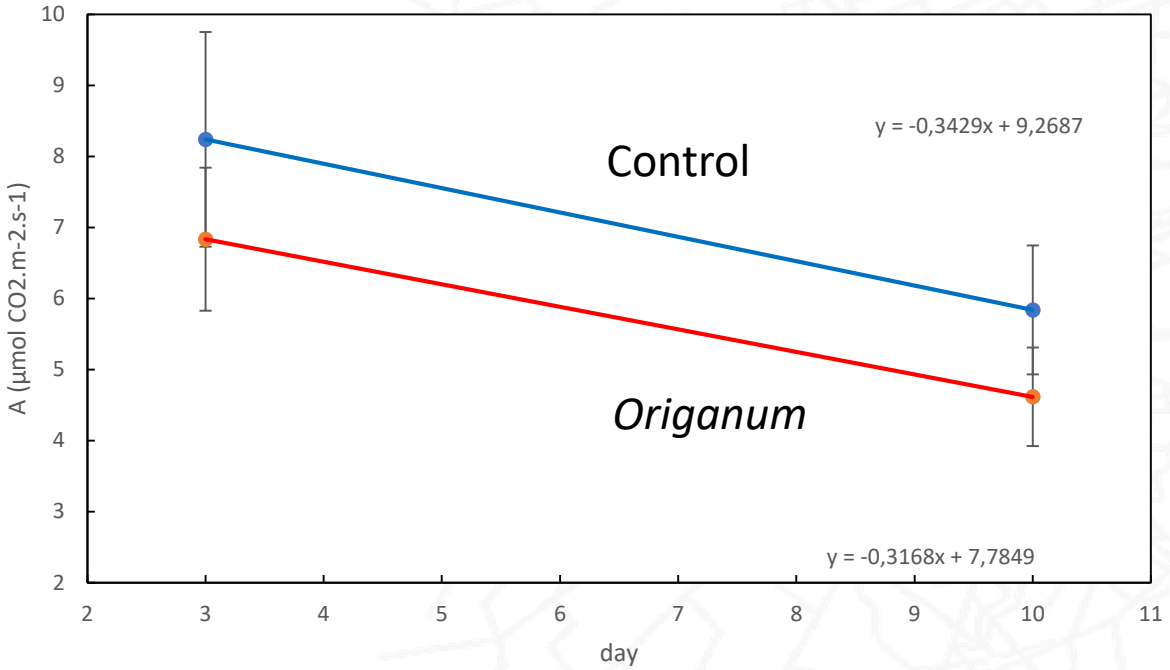
Results – Vine physiology

Photosynthesis



- No impact on growth speed
- But negative impact on chlorophyll content & photosynthesis,

→ Lower leaf area

→ *Thymus* seems to impact more then *Origanum*

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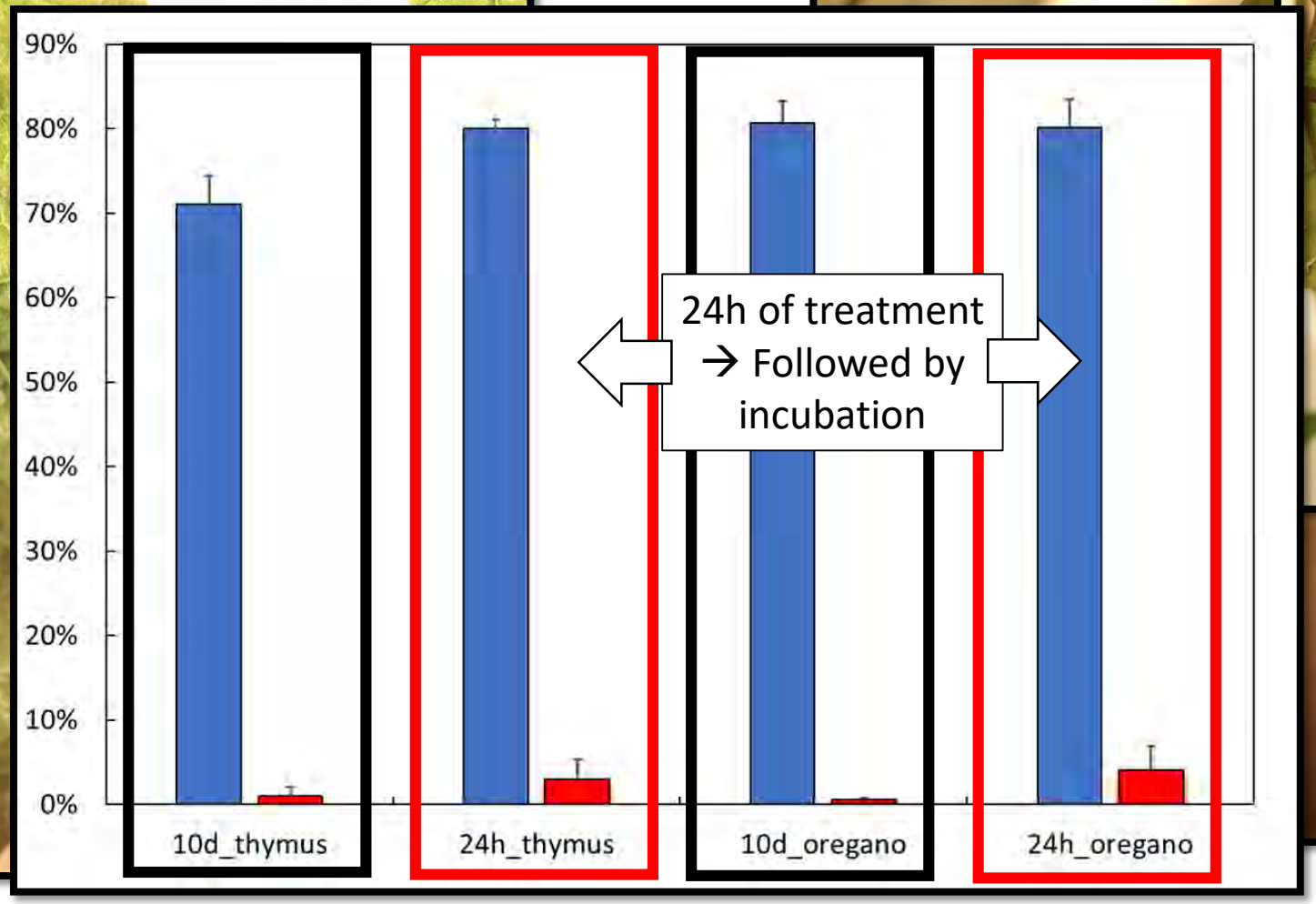
Results – disease severity

After the incubation period (oil spot appearance), sporulation was triggered and visually assessed



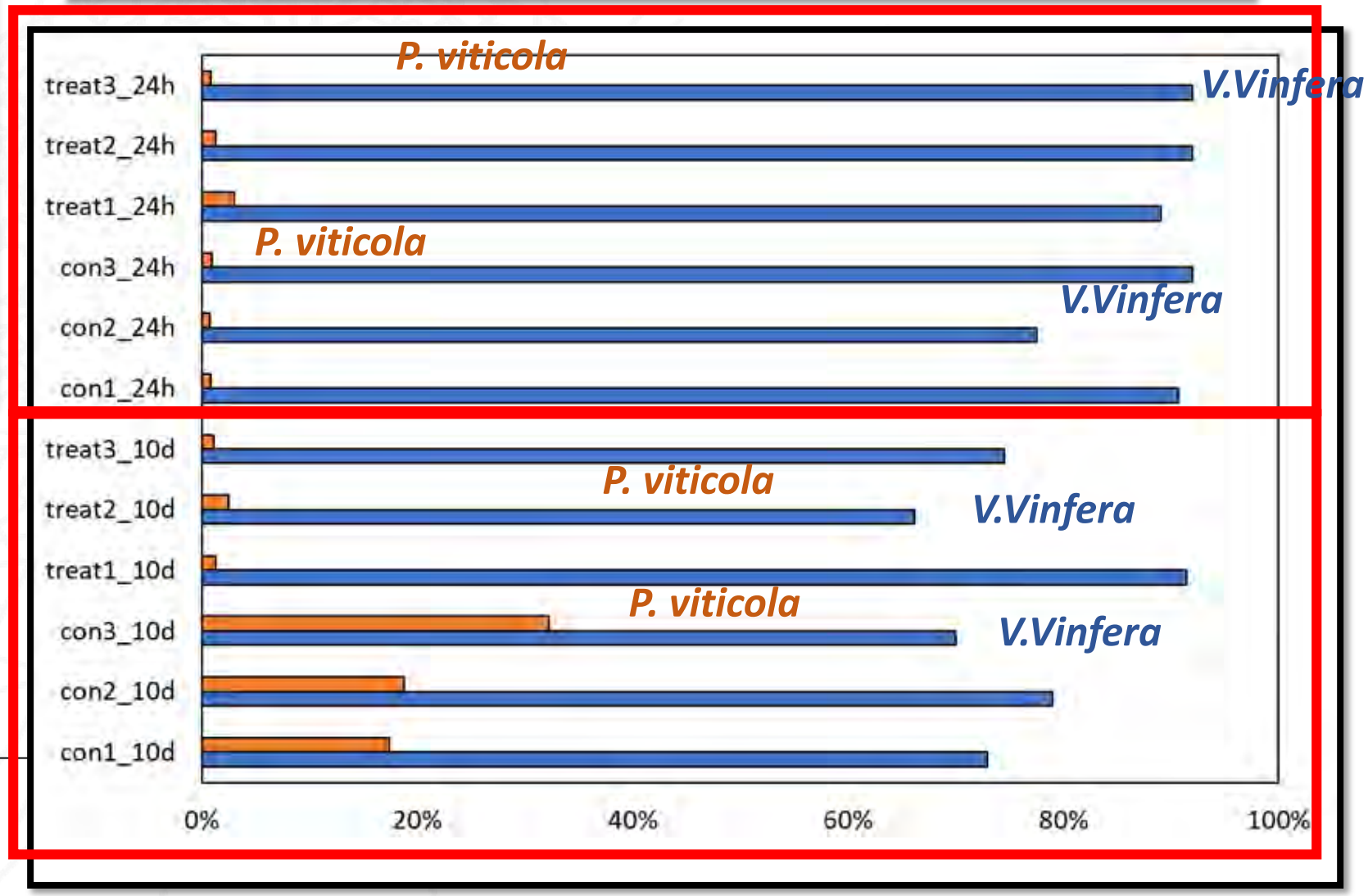
Rienth *et al.*, 2019 PloS

RNA-sequencing

Mapped Reads on the *V.vinfera* & *P. viticola* genome

Pair-end RNA-seq of Oregano experiments

- **10d treatment**
  → **Sampling after 10d**
- **24h treatment**
  → **Sampling after 24h**



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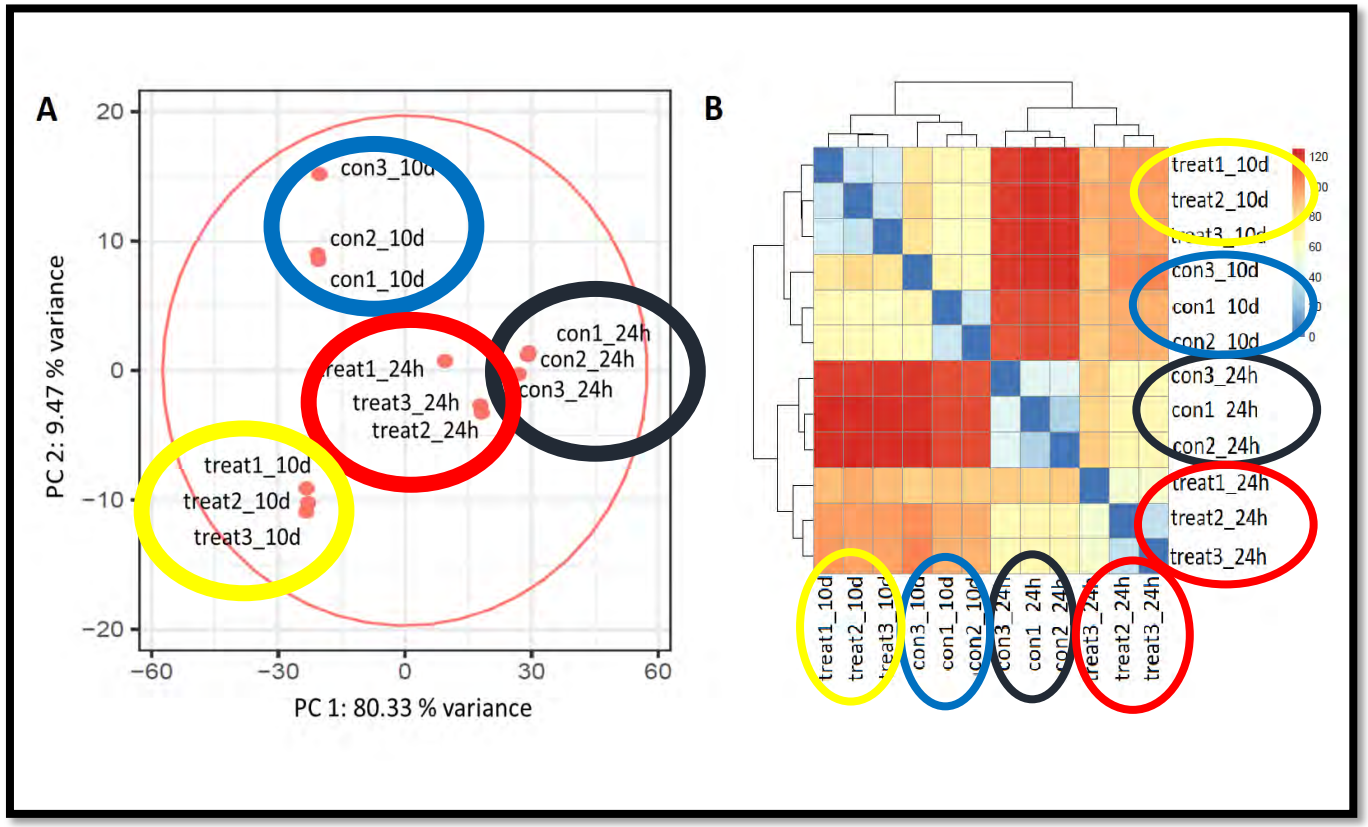
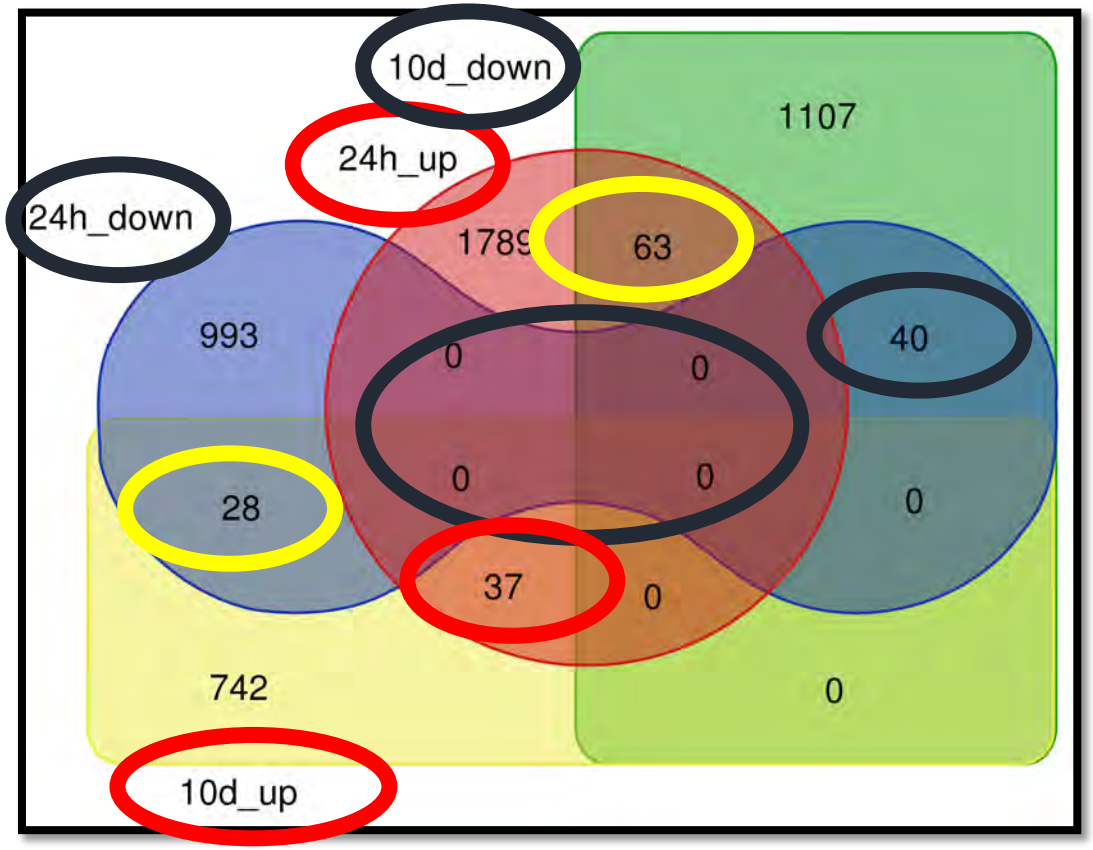
RNA-sequencing





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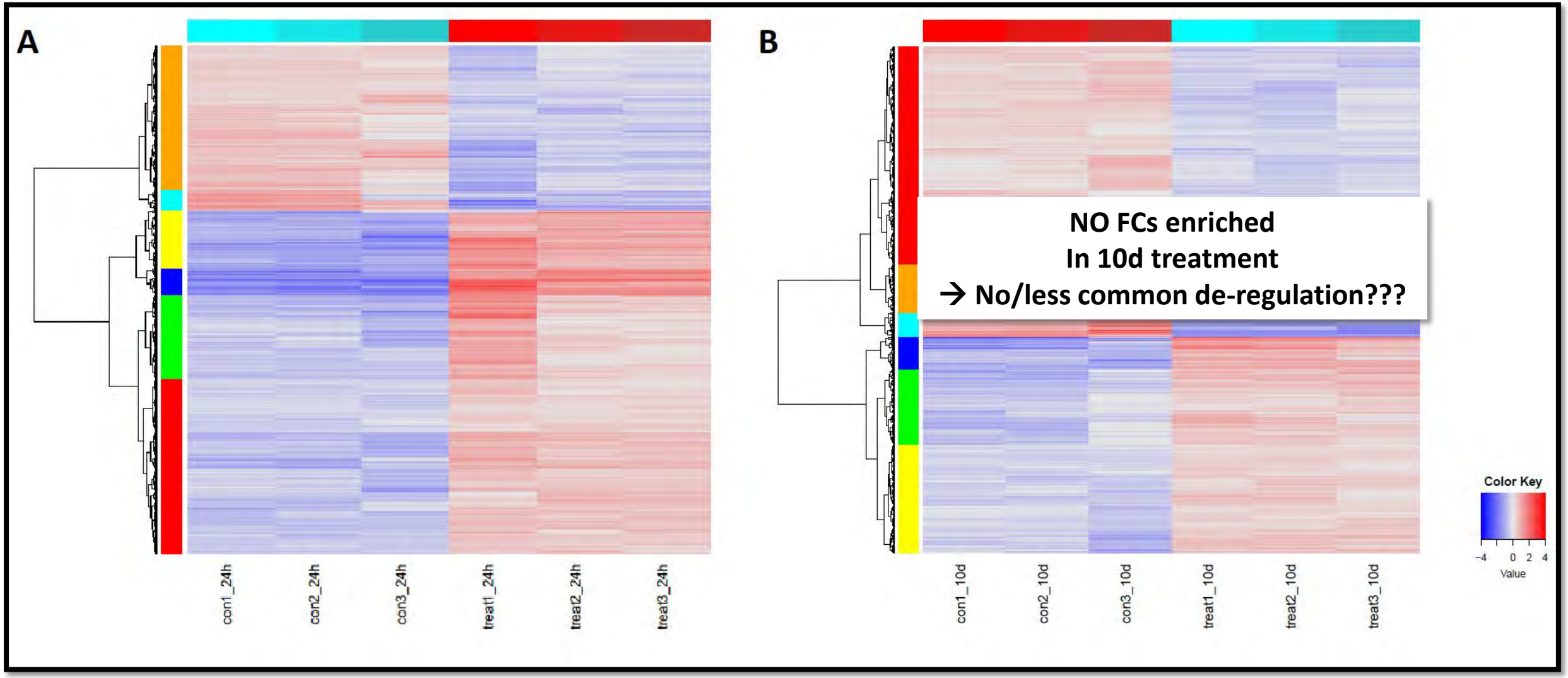

NO FCs enriched
In 10d treatment
→ No/less common de-regulation???

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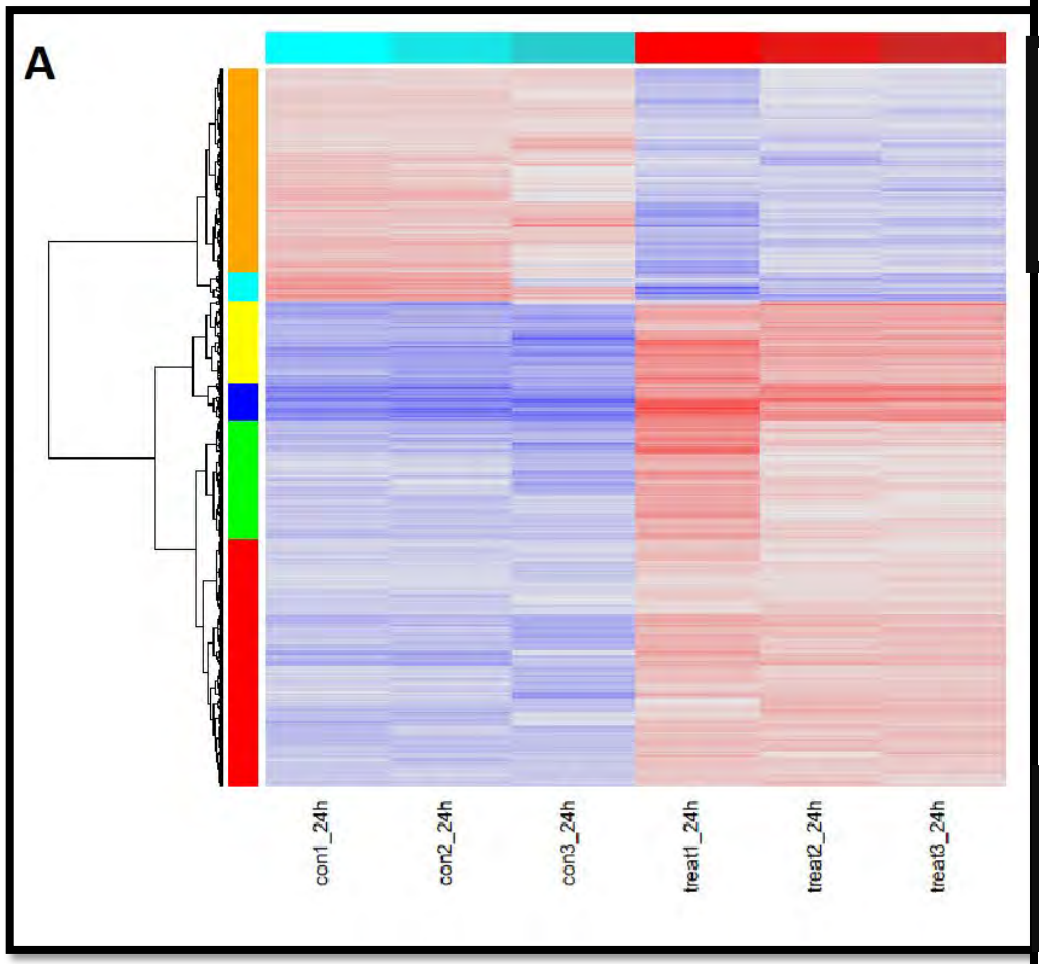
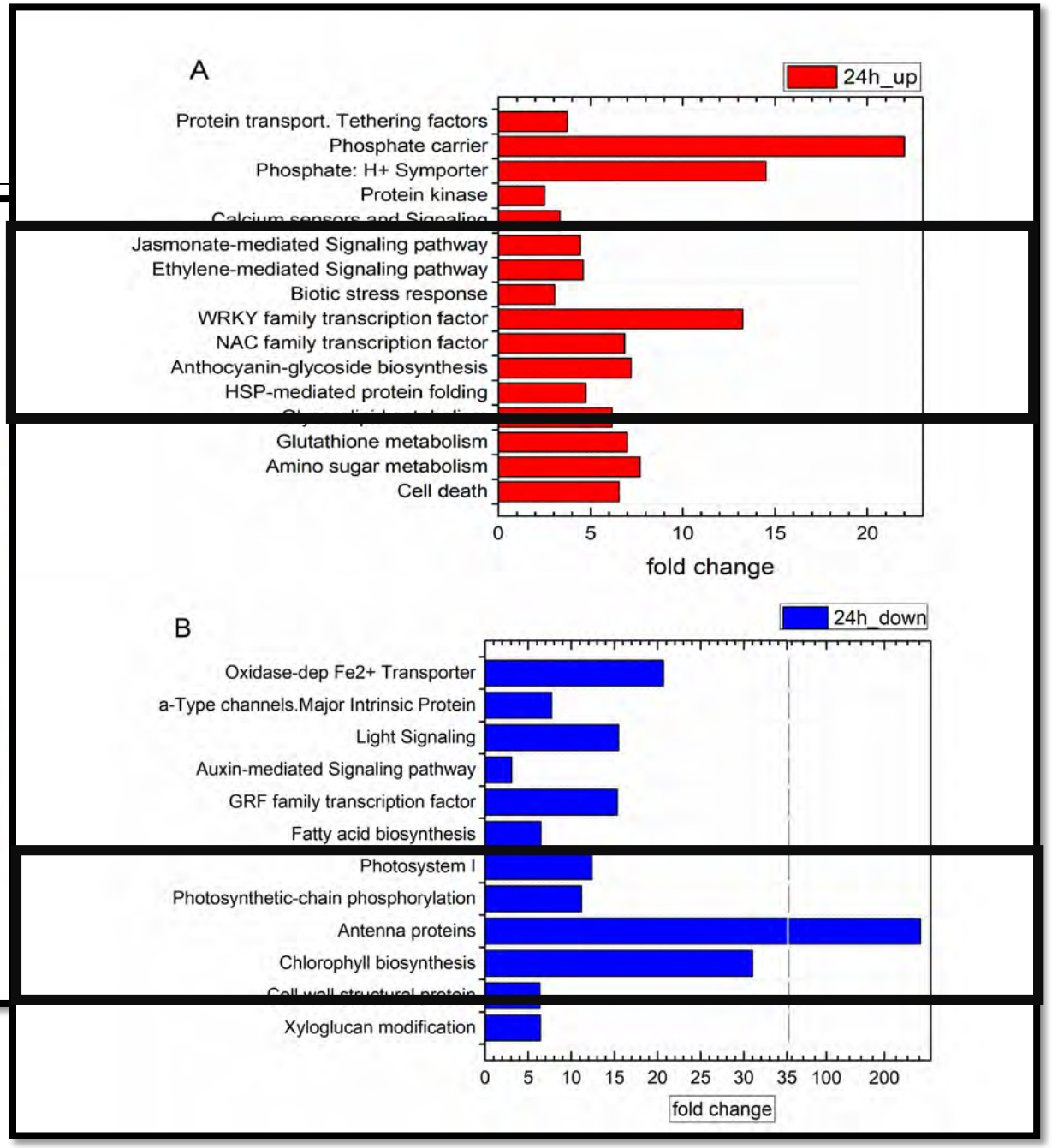
RNA-sequencing





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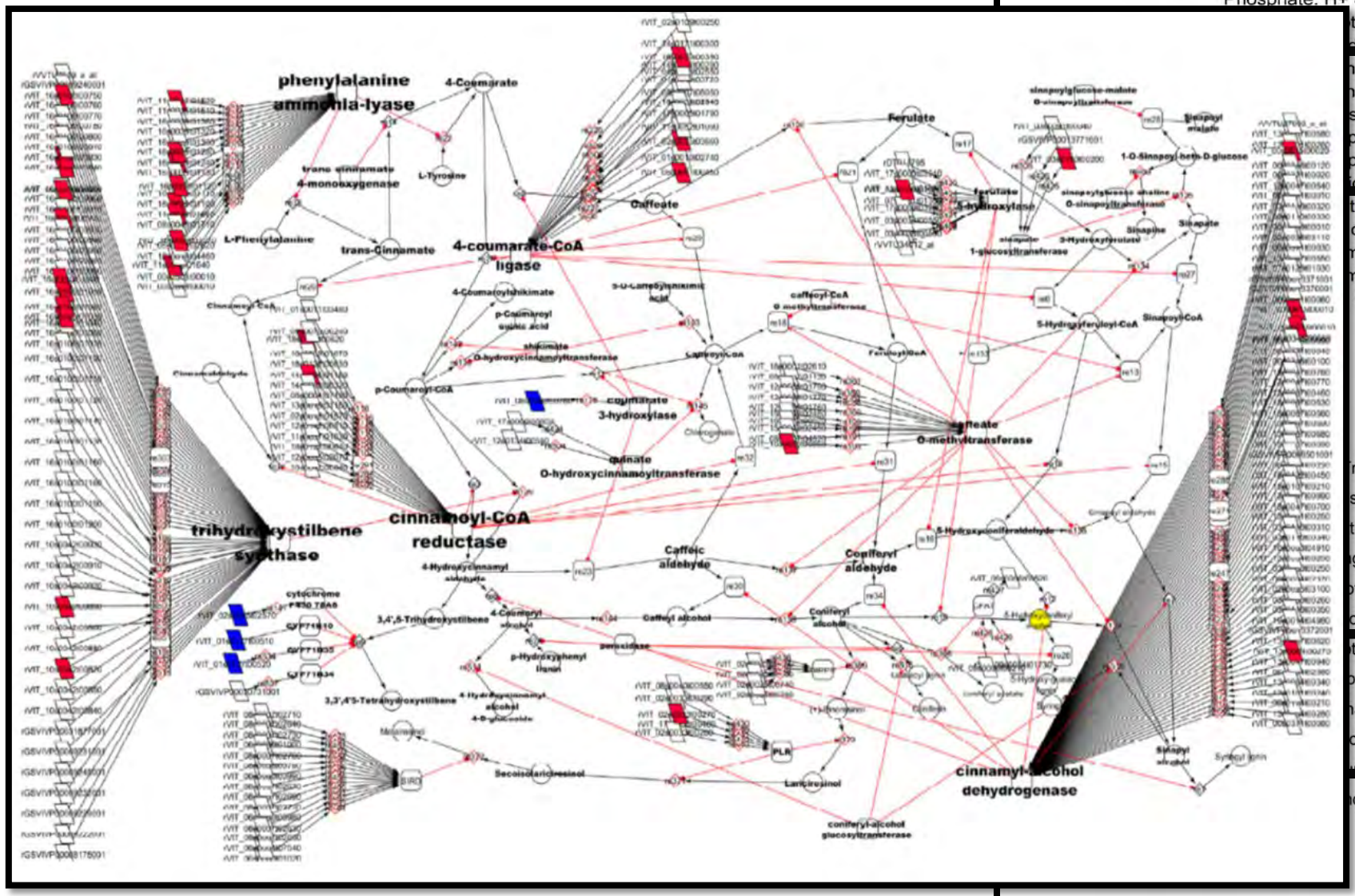
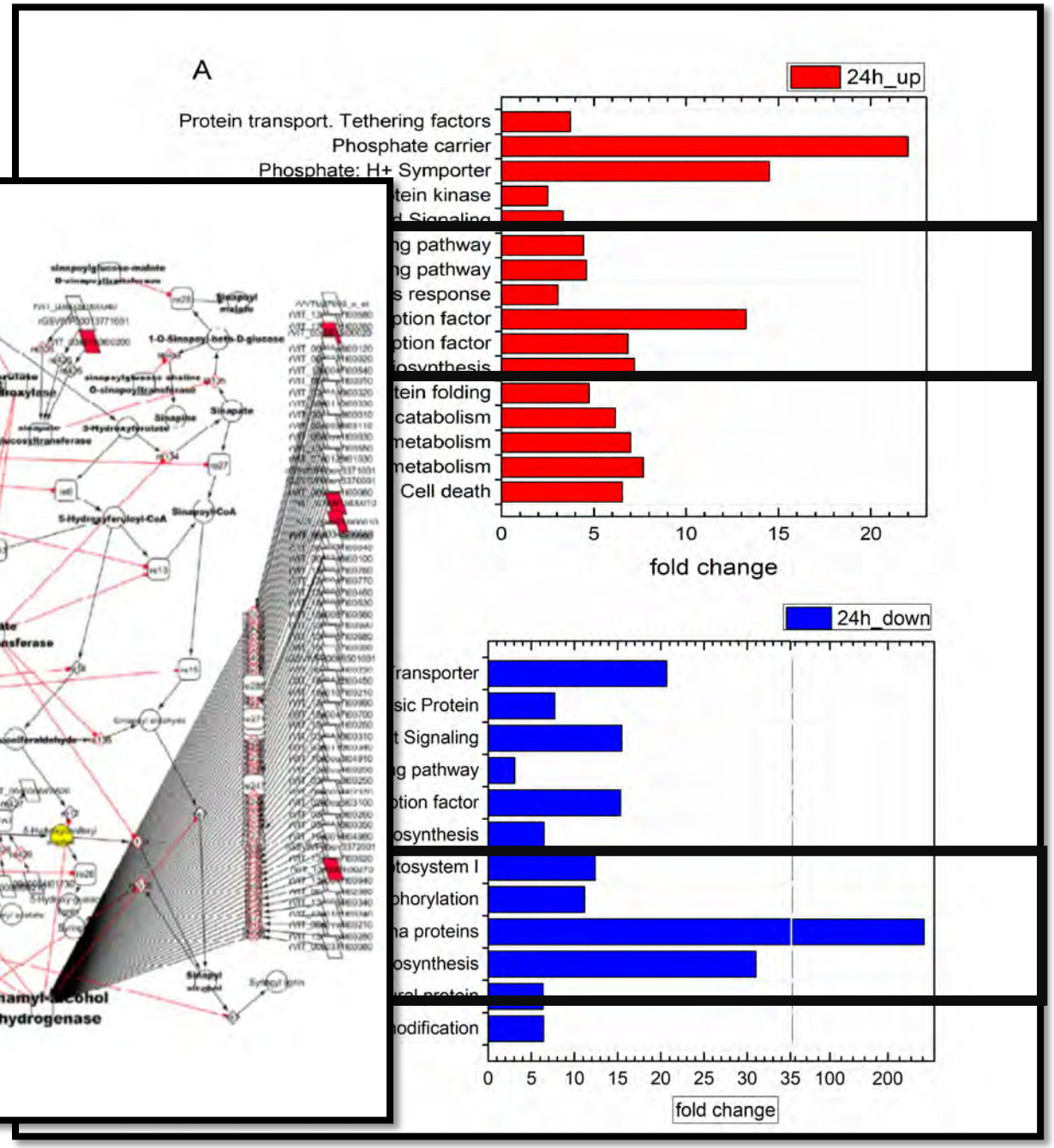


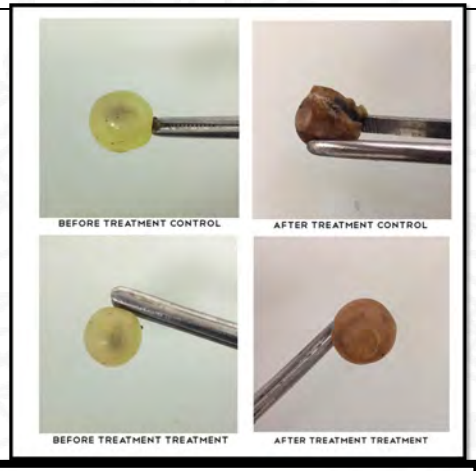


Conclusion & Outlook

- **It is the volatile phase!**
- **Trigger / Priming of innate immunity**

A lot of questions remain:

- Direct or indirect effects on the pathogen?
- Due to which oil compound / synergetic effects of compounds?
- Field diffusion system of oils or specific components?
- Plant immune priming as a future strategy to reduce fungicides?



SNF fundend Project - DuraPrimeVine

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Phytopathologia Mediterranea
The international journal of the Mediterranean Phytopathological Union

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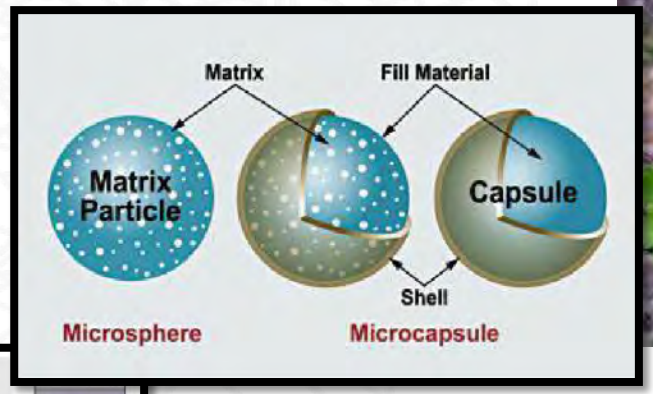
***Origanum vulgare* essential oil vapour impedes *Botrytis cinerea* development on grapevine (*Vitis vinifera*) fruit**

Andrea Burggraf, Markus Rienth*



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