EOHUB

ESSENTIAL OIL-BASED BIOPESTICIDE FOR APPLICATION BY TREE-INJECTION IN FRUIT ORCHARDS

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Presentation summary

- Apple and pear productions
- Orchards main pests
- Conventional pesticides
- Essential oils in agriculture
- Research axes and progress
- Biological test : Rosy apple aphid
- Take home message

Apple and pear productions

- World = 89 million tons
- Europe = 10 million tons
- Belgium = 240,000 tons

- World = 16 million tons
- Europe = 2.6 million tons
- Belgium = 280,000 tons
- (*FAOSTAT*, 2016)

Important market but many damages…

Apple scab –
Venturia inaequalis (Cooke)

Codling moth of apples and pears–
Cydia pomonella L.

Fire blight –
Erwinia amylovora (Burrill)

Orchards main insect pests

Dysaphis plantaginea (Passerini)

Malus domestica Borkh

Cacopsylla pyri (L.)

Pyrus communis L.

- Sap sucking insects
  - Deformation / Loss of leaves and fruits
  - Decrease in photosynthesis
- Sugar-rich honeydew secretion (mold development)
- Disease transmission (phytoplasma)

Yield loss of 20%!

Conventional pesticides

- Pyrethroids, neonicotinoids, etc…
- Effects on human health
- Chemical residues
- Biodiversity loss
- Water pollution
- Insects' resistance

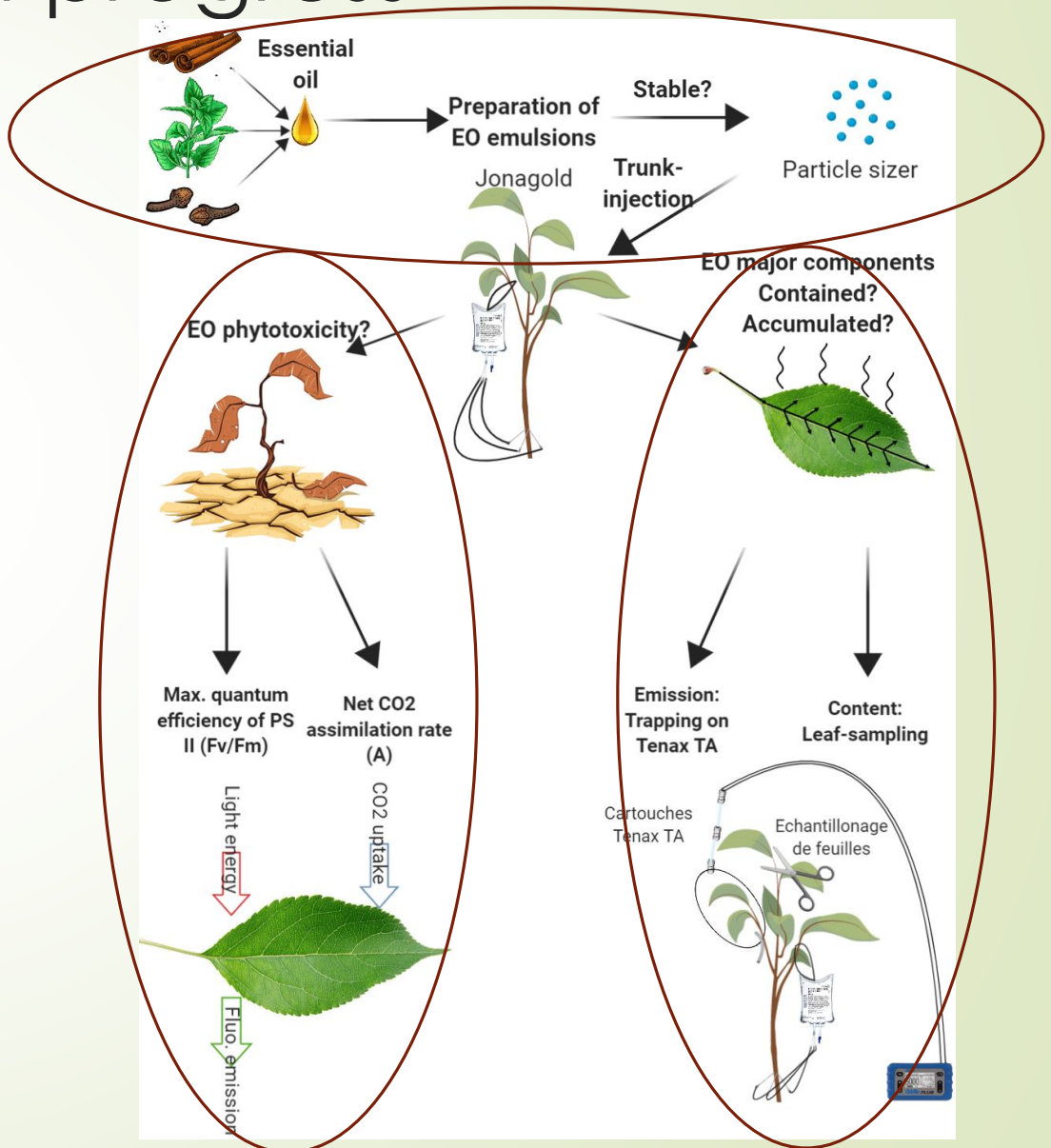
Need for alternatives !

Essential oils in agriculture

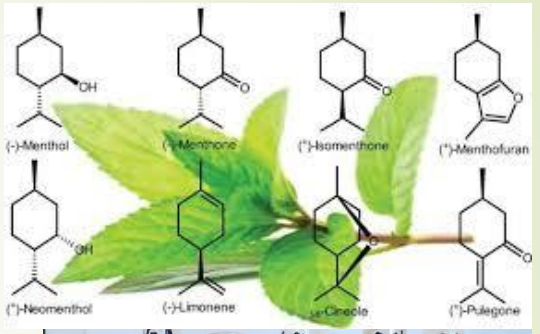
- Renewable source
- Biological properties!
  - Repulsive and insecticidal properties
- Constraints
  - High volatility
  - Sensitivity to abiotic factors
  - Phytotoxicity of some EOs

Research axes and progress

- 1) Selection, formulation and application of essential oils
- 2) Study of phytotoxic properties
- 3) Emitted and contained volatile organic compound (VOC) profiles



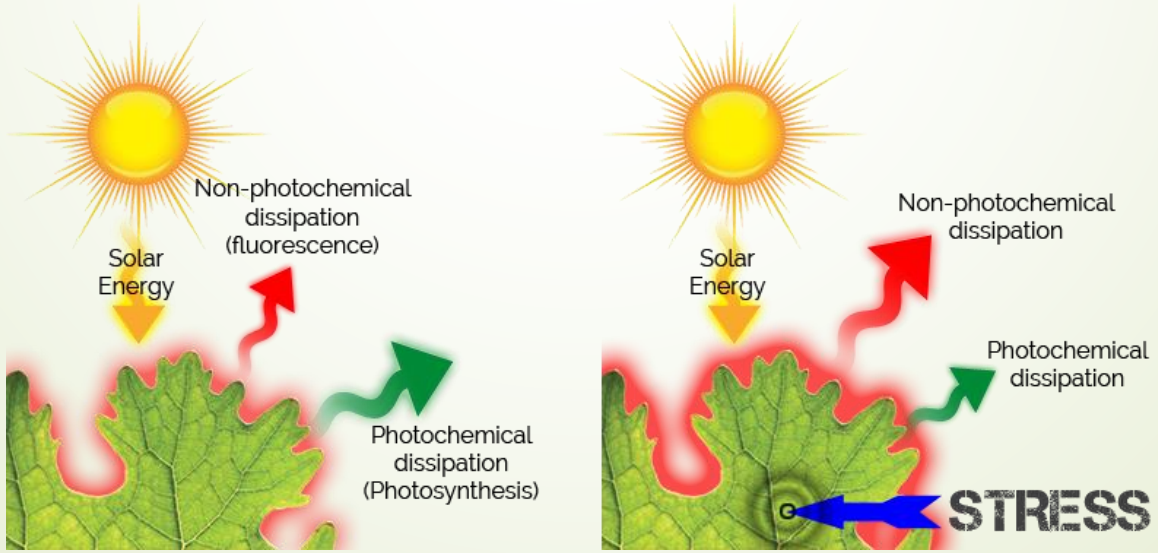
1) Selection, formulation and application of essential oils



- Spearmint, peppermint, Thyme (savory leaf/ thujanol), Tea tree, Chinese cinnamon tree, Clove tree
- Essential oil nano-emulsion (<200nm) with tween surfactants
- Design of a laboratory injection method

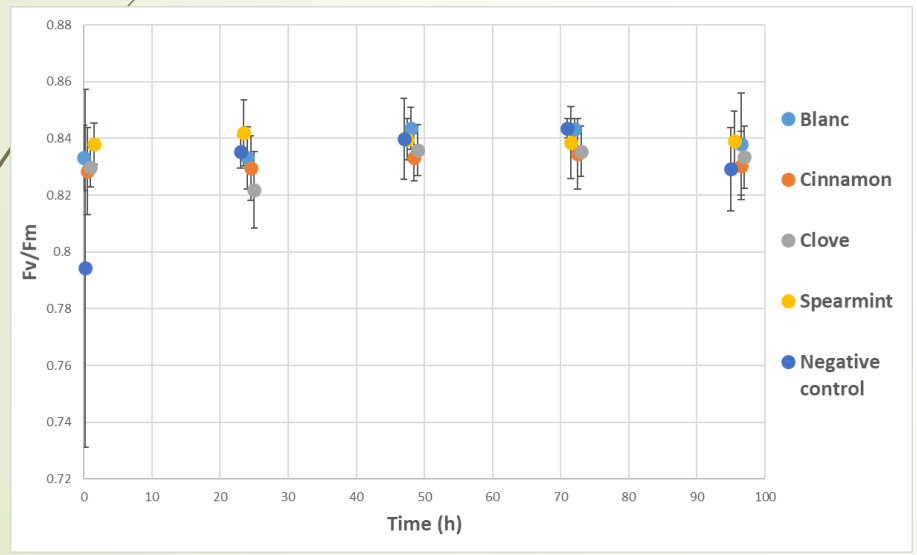
2) Phytotoxic properties of allelopathic compounds

- Inhibition of cell division and elongation
- Increases in cell membrane permeability
- Influence on respiration
- **Effect on plant photosynthesis**

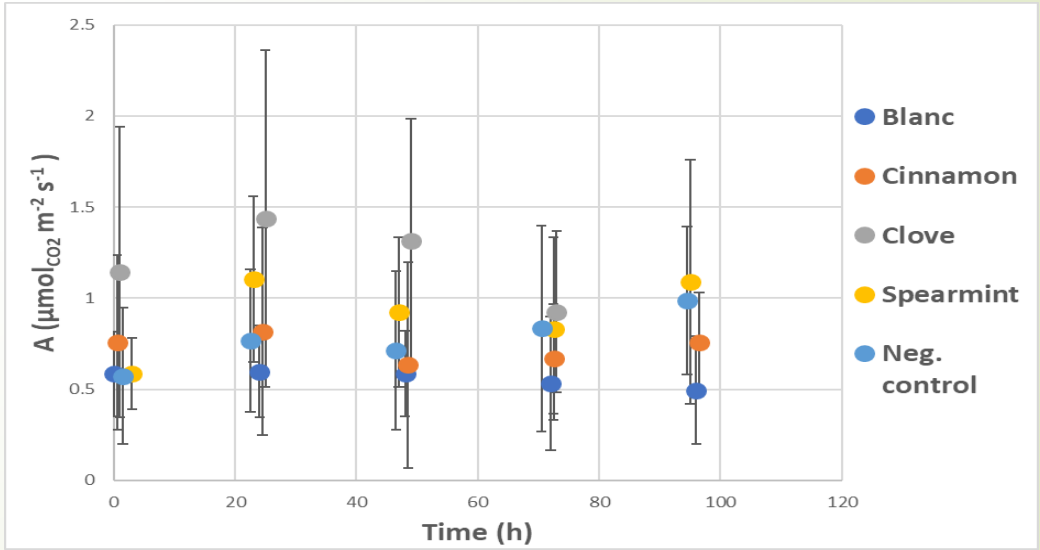


Photosynthetic activity of injected trees

- Fluorimeter
- Maximum quantum efficiency of photosystem II (Fv/Fm)



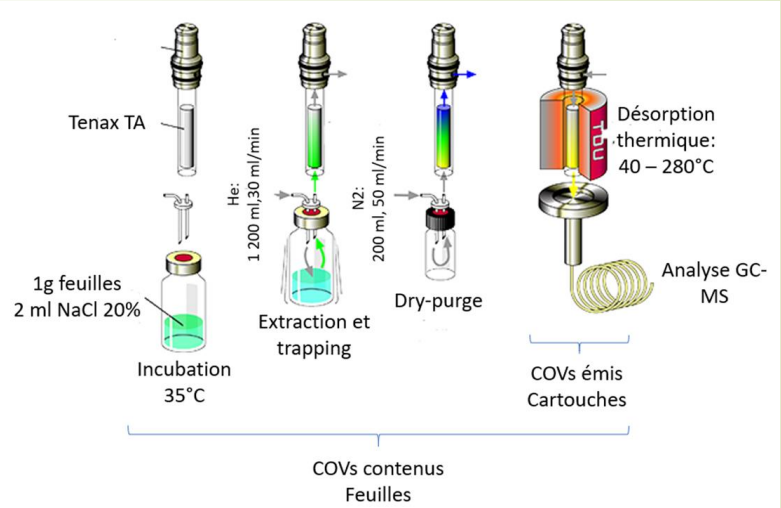
- Infra-red gas analyser (IRGA)
- Net CO2 assimilation rate/ net photosynthetic rate (A)

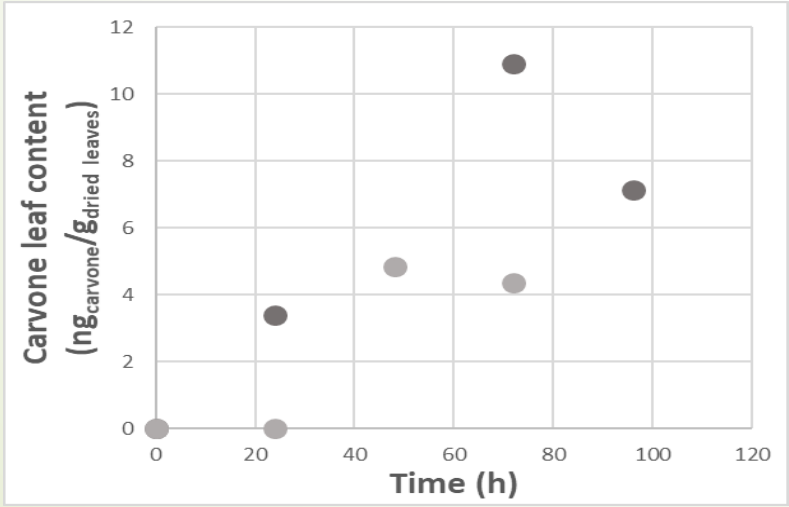


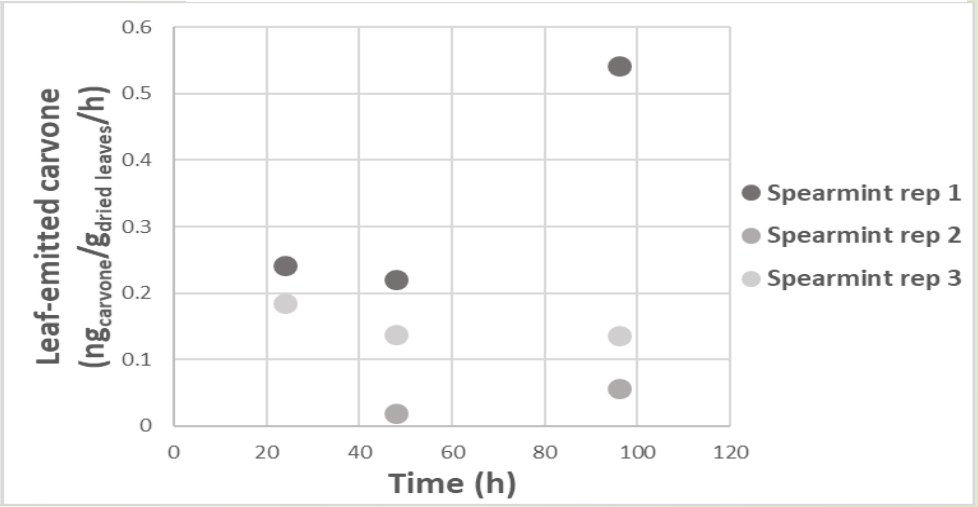
No significant impact on the photosynthesis apparatus

3) Volatile organic compound (VOC) profiles emitted and contained

- TDU-GC-MS/ DHS-GC-MS
- Up to ng per g of dried leaf
- Essential oil major compounds quantification + other compounds modifications



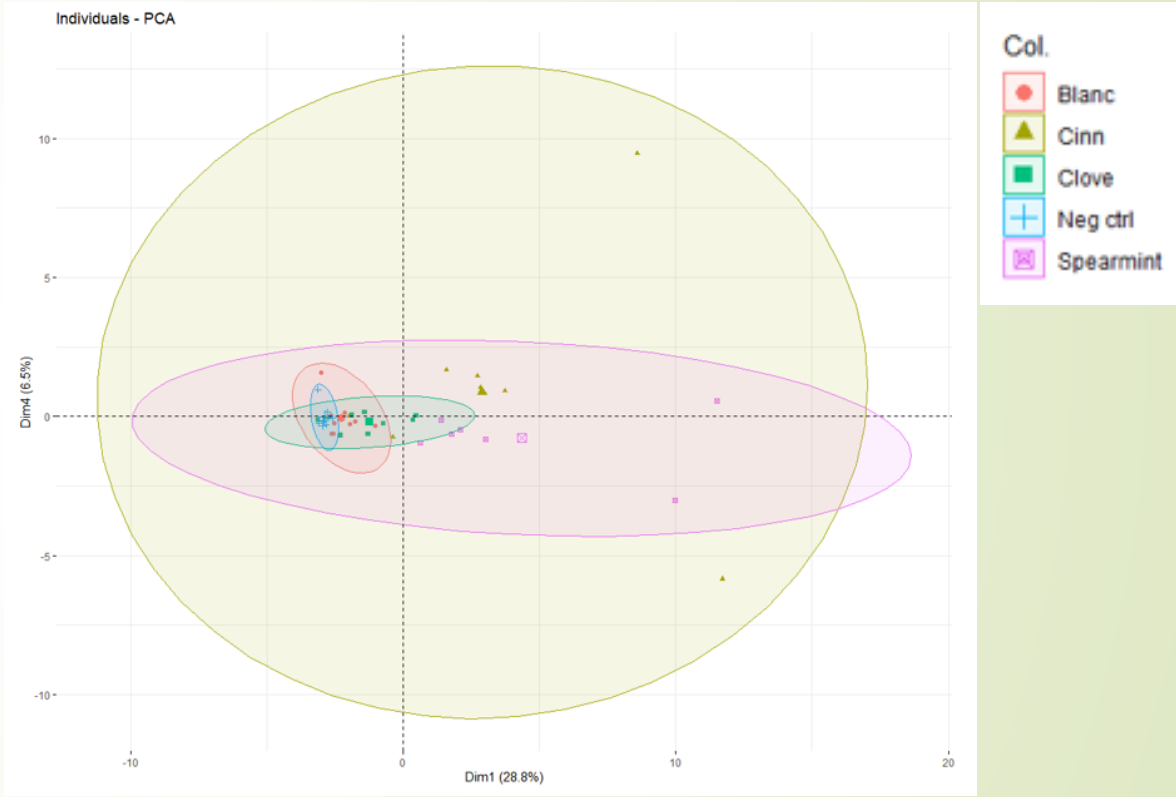




3) Volatile organic compound (VOC) profiles emitted and contained

- Principal component analysis (PCA) on the resulting profiles

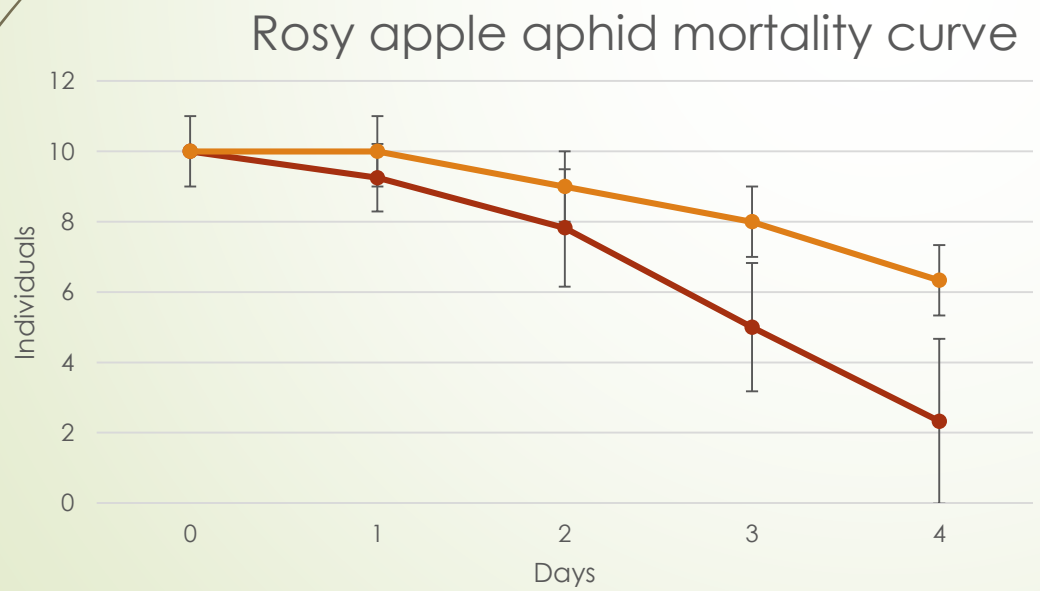
- Variation in terpene and stress compounds indicates a significant reaction of the plant



CP 3	CP 4
Caryophyllene	γ-Muurolene
(3E,7E)-4,8,12-Trimethyltrideca-1,3,7,11-tetraene	δ-Cadinene
Germacrene D	α-muurrolene
Methyl salicylate	Non identif 12
β-Ocimene	Methyl salicylate

Biological test : Rosy apple aphid

- Clip-cage on injected trees
- Dysaphis plantaginea larvae in stage 2



Significant death rate after 3 days of injection

What's next ?

- Field trials: effective?
- Effect on auxiliary insects?
- Impact on fruit production?

Take home message

- Demonstration of diffusion and occurrence in the plant tissues
- Demonstration of the physiological impact of these xenobiotics on the plant
- Demonstration of efficiency on the target insects
- Essential oils can be used in agricultural practices as bio-pesticides


Thank you very much
for your attention !