



GT3

Development of new
viticulture management
strategies to optimise spray
distribution of PPP following
best management practices
considering canopy structure

INTERREG SUDOE COPPEREPLACE

GT3 Activities

Activity		Partners	Status
3.1	Implementation of an alternative management for the protection of crops for a more sustainable use of copper	SVBNA UPC	12.2020 – 11.2021 E 3.1.1 – 31/12/2021
3.2	Implementation of new technologies as a tool for the sustainable use of copper	JEAN LEON UPC	11.2020 – 11.2022 E 3.2.1 – 30/11/2022
3.3	Development of biodegradable capsules with copper and polyphenols	EURECAT	11.2020 – 02.2021 E 3.3.1 – 28/02/2021
3.4	Capsule characterization and scaling of the coacervation process	EURECAT	02.2021 – 04.2021 E 3.4.1 – 30/04/2021
3.5	Definition of optimal working conditions for spraying capsules with spray and their biological effects	IFV UPC	04.2021 – 11.2022 E 3.5.1 – 30/11/2022
3.6	Large-scale field case study with liquid formulations of the capsules	JEAN LEON EURECAT UPC	1.2022 – 12.2022 E 3.6.1 – 31/12/2022

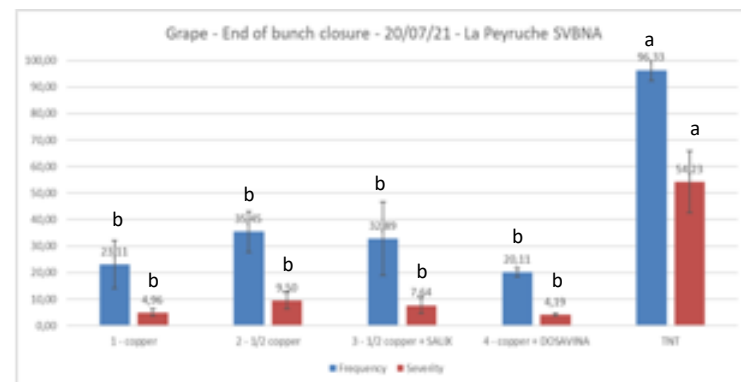
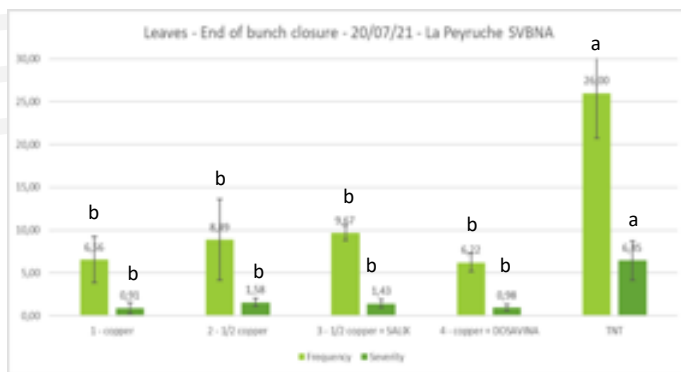
Activity 3.1 - Implementation of an alternative management for the protection of crops for a more sustainable use of copper

SVBNA – UPC

E3.1.1



Treatments 2021	Estate dose (g Cu ²⁺ /ha)	Dosaviña dose (g Cu ²⁺ /ha)	Estate vol. (l/ha)	Dosaviña vol. (l/ha)
19	5663	5663	2861	2950



CONCLUSIONS

- Very similar volume was applied in the two treatments.
- Usual practice by farmers in the area showed similar values as DOSAVIÑA.
- Very high downy mildew pressure in Bordeaux in the 2021 season.
- Biological efficacy: No differences were found between treatments, neither in leaves nor in bunches.





Activity 3.2 - Implementation of new technologies as a toll for the sustainable use of copper

JEAN LEON – UPC

E3.2.1

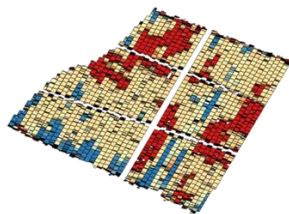
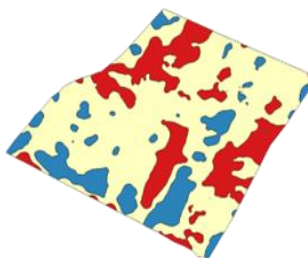
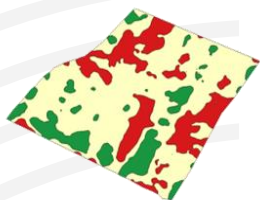


VRA
treatment

Variable application rate

0,35% Codimur 50

Vigor Map (NDVI)



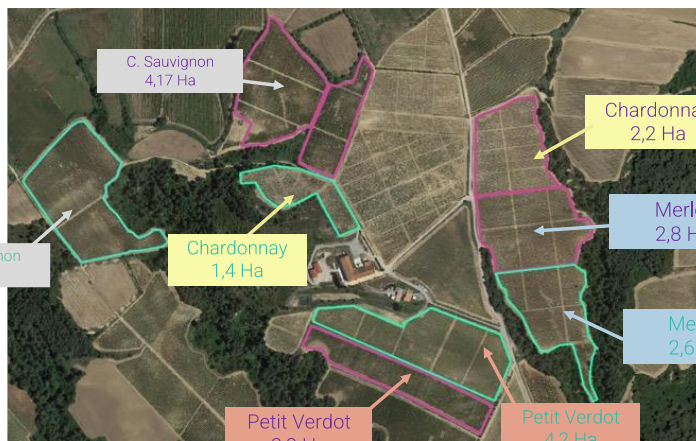
As applied map
(L/Ha)



**Conventional
treatment**

160 - 180 l/ha

0,5 – 1,4 kg/ha Codimur 50

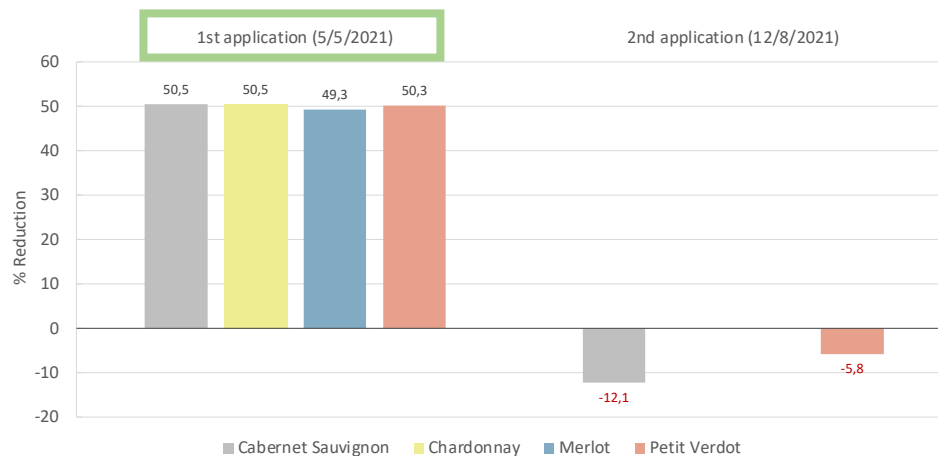


Year	Treatments	Data	Grape variety
2021	2	6th May	CS, CH, MT, PV
		12th August	CS
2022	4	9th May	CS, CH, MT, PV
		23th May	CS, CH, MT, PV
		31st May	CS, CH, MT, PV
		11th August	CS

Activity 3.2 - Implementation of new technologies as a toll for the sustainable use of copper

JEAN LEON – UPC E3.2.1

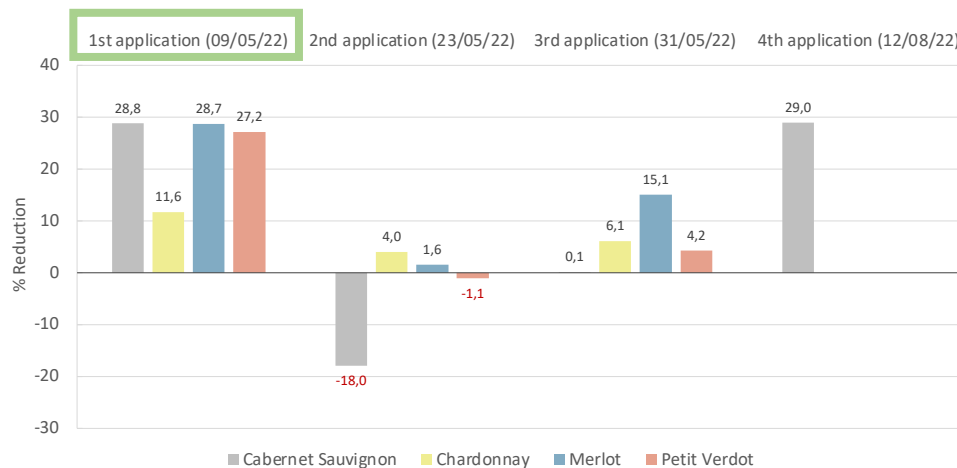
Reduction of application volume (%) in 2021



21%



Reduction of application volume (%) in 2022



11%



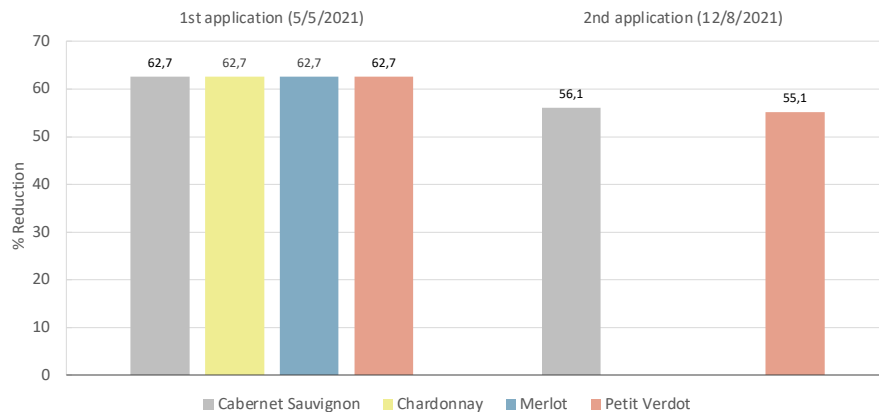
APPLICATION
VOLUME

Activity 3.2 - Implementation of new technologies as a toll for the sustainable use of copper

JEAN LEON – UPC E3.2.1

COPPER DOSE

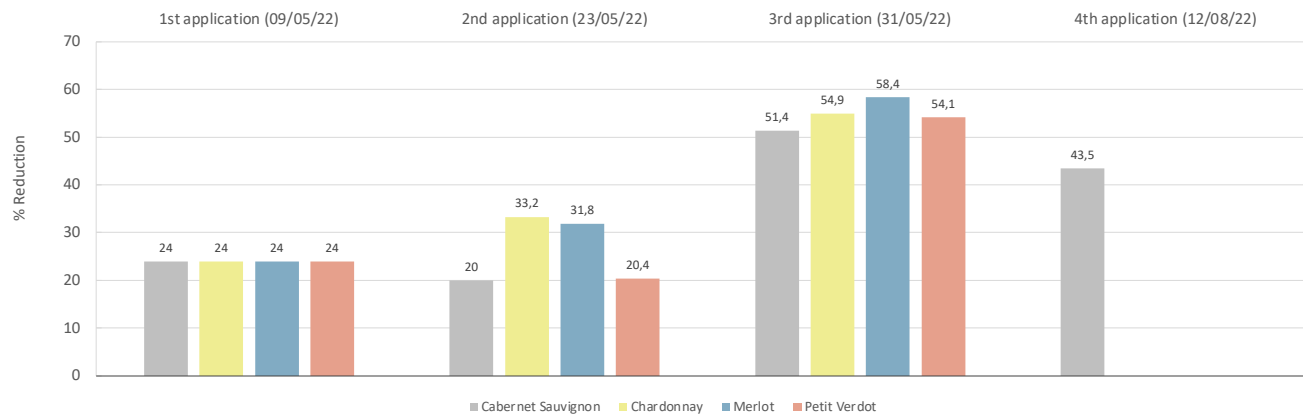
Reduction of copper used (%) in 2021



59%



Reduction of copper used (%) in 2022



32%





VRA
treatment

Activity 3.2 - Implementation of new technologies as a toll for the sustainable use of copper

JEAN LEON – UPC

E3.2.1

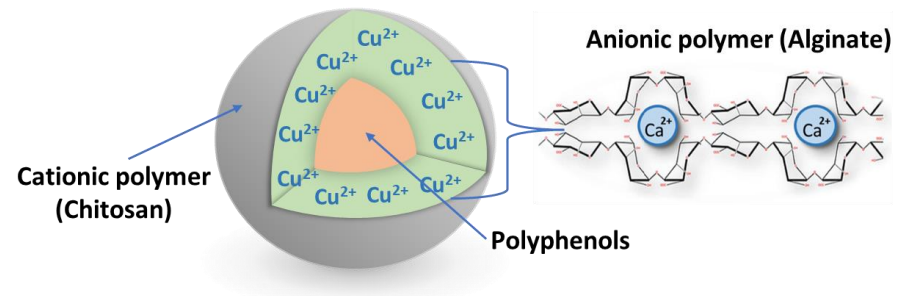
CONCLUSIONS

- Reduction in the volume of water used (21% in 2021 and 10% in 2022).
- Significant reduction of applied copper (59% in 2021 and 37% in 2022).
- Biological efficacy: No differences were found between treatments, neither in leaves nor in bunches.
- Very low downy mildew pressure in Jean Leon plots in 2021 and 2022.

Encapsulation in biopolymer matrices

Advantages:

- ✓ controlled release of bioactive agent
- ✓ prolonged presence and higher deposition on the leaves

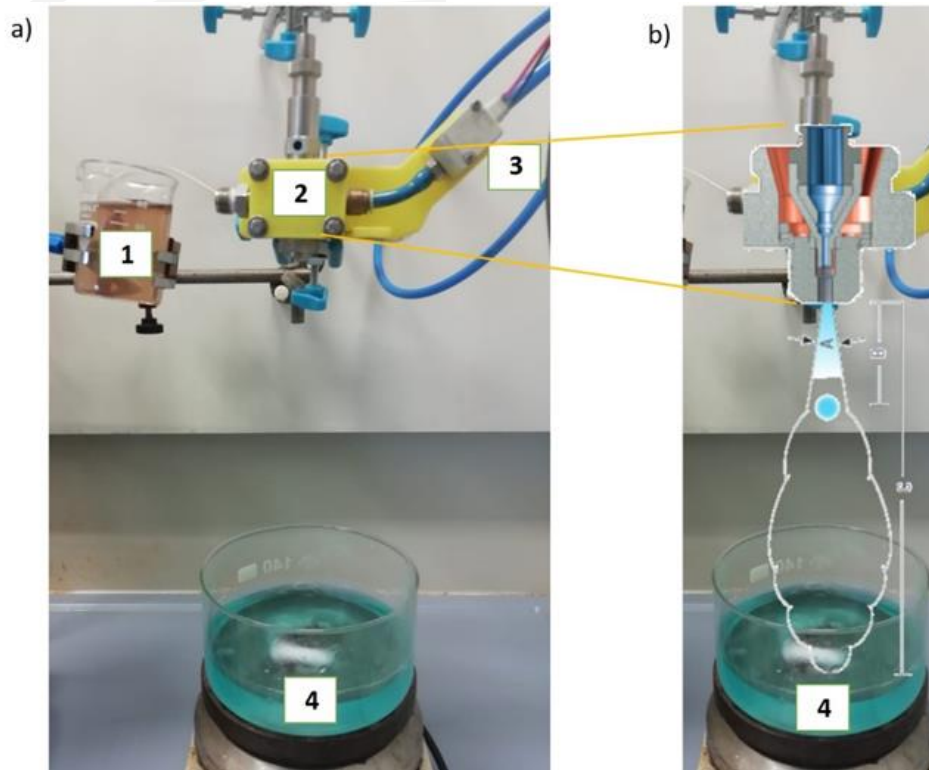


New copper product, more efficient in terms of deposition

Product content:

- ✓ biodegradable polymers
- ✓ copper cations which are present in both; microcapsules and solution
- ✓ Polyphenols with additional antifungal properties
- ✓ wetting agent which reduces the surface tension and thus spreads the drops of product well on a leaf surface

3 formulations developed at lab scale

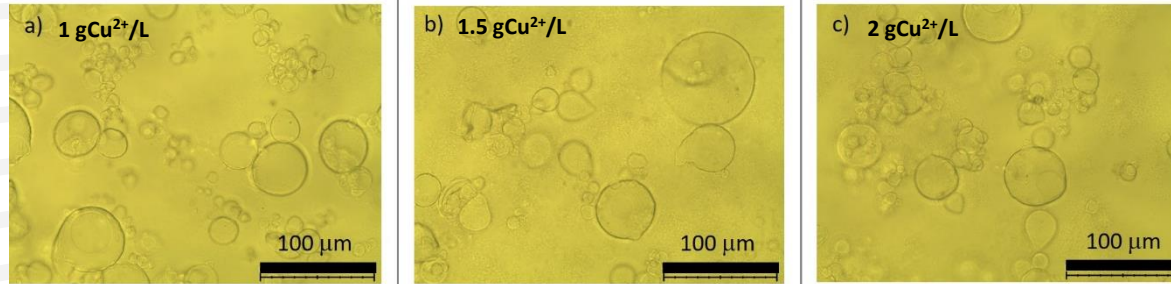


Formulation	Cu ²⁺ content [g·L ⁻¹]	ALGINATE + Polyphenols [g·L ⁻¹]	CHITOSAN [g·L ⁻¹]
1	1	1.5 + 0.02	2.5
2	1.5	1.5 + 0.02	2.5
3	2	1.5 + 0.02	2.5

- 1 - alginate/polyphenols aqueous solution (150 ml)
- 2 - SU1A-SS nozzle
- 3 - an automated spray deposition system (ASDS)
- 4 - CuSO₄ aqueous solution (250 ml)

The optimization results are presented in next activity 3.4

Optical microscope micrographs of microcapsules



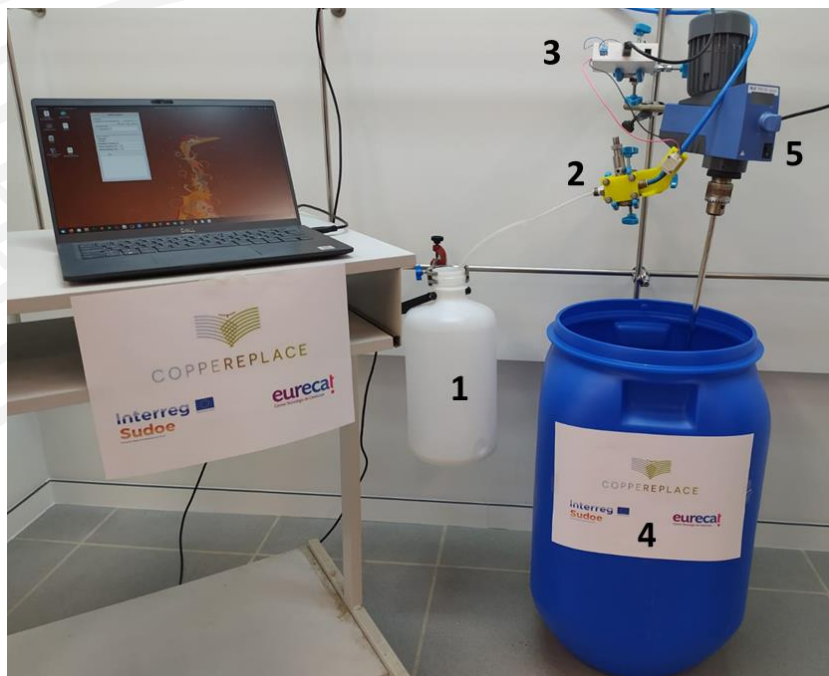
All fabricated microcapsules appear separated, well-formed and globe shaped. The size of prepared capsules is between 3-70 (±2) μm, independently of the copper concentration tested.

Scanning electron microscope micrographs of microcapsules



Semi-quantitative micro-analysis indicates that all microcapsules contain approximately 28% of copper cations in their structures, independently of the copper concentration used for their preparation.

Cu²⁺ formulation preparation – scale-up



- 1 - alginate/polyphenols aqueous solution (9 L)
- 2 - SU1A-SS nozzle
- 3 - an automated spray deposition system (ASDS)
- 4 - CuSO₄ aqueous solution (16 L)
- 5 - mechanical agitator

4 different formulations developed
for vineyard application



Formulation	Cu ²⁺ content [g·L ⁻¹]	ALGINATE + Polyphenols [g·L ⁻¹]	CHITOSAN [g·L ⁻¹]
Control*	1.0	-	-
F1	1.0	1.5 (NA4012) + 0.02	1.25
F2	1.0	1.5 (NA7507) + 0.02	1.25
F3	1.0	1.5 (NA4012) + 0.02	2.5
F4	1.0	1.5 (NA7507) + 0.02	2.5

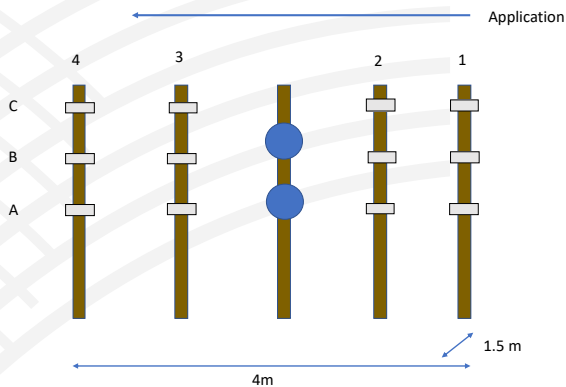
***Control** - Commercial product Ossirame 50wp (MANICA COBRE S.L.), Cu²⁺ content 1 g/L

Activity 3.5 - Setting of optimal working conditions for spraying capsules and their biological effects

IFV – UPC

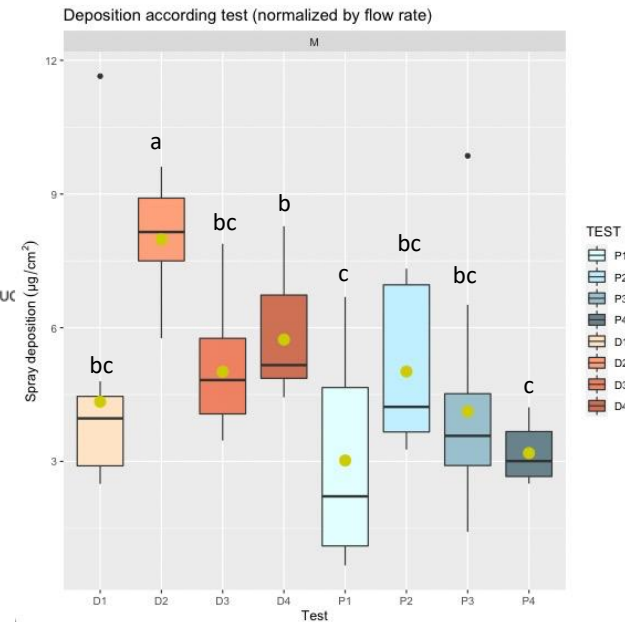
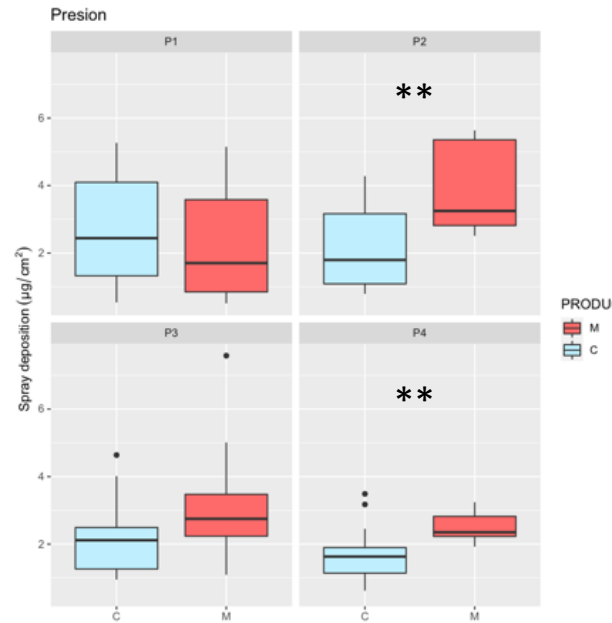
E3.5.1

Effect of pressure and droplet size on the deposition of copper microcapsules on filter paper, compared to a conventional copper treatment.



Pressure
Drop Size

Treatment	
P1	3 bar
P2	7 bar
P3	15 bar
P4	25 bar
D1	Very fine
D2	Fine
D3	Medium
D4	Coarse



CONCLUSIONS

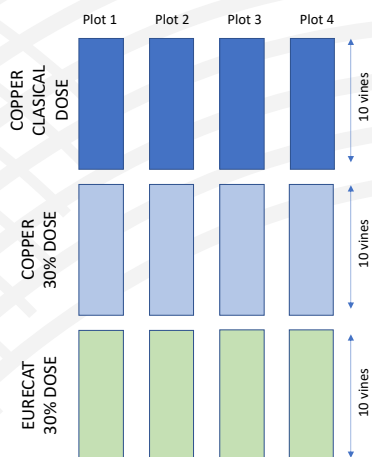
- Significant higher deposition at 7 and 25 bar.
- Better application parameters: D2: 12 bar , ISO Lechler AD 90 01 , Drop size: Fine

Activity 3.5 - Setting of optimal working conditions for spraying capsules and their biological effects

IFV – UPC

E3.5.1

Biological effects of microencapsulated copper product

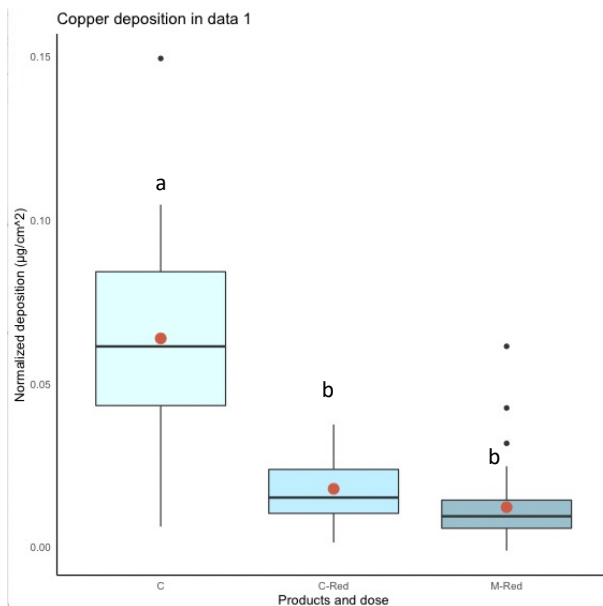


[Cu²⁺] microcapsules = 0,33 gr/l

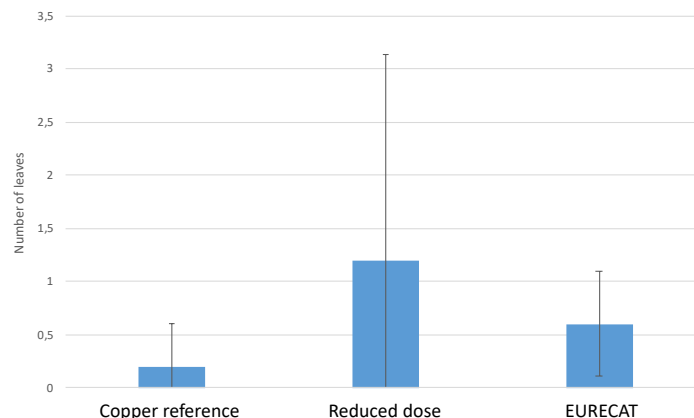
[Cu²⁺] classical copper dose= 1 gr/l



1st deposition trial (30/05/22)



Average number of leaves attacked by downy mildio by plot (14 June 2022)



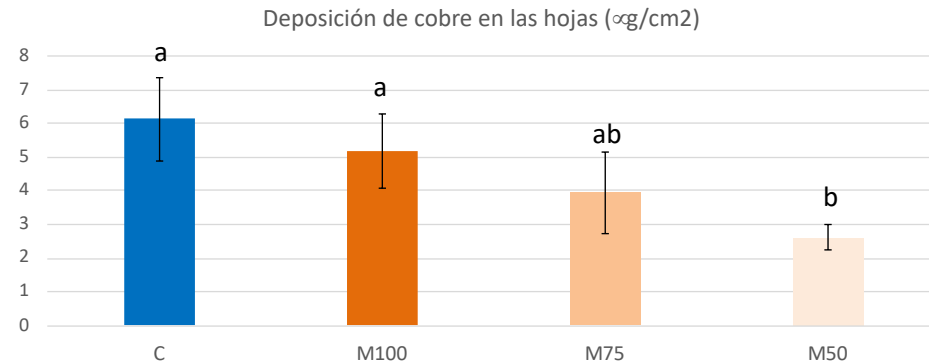
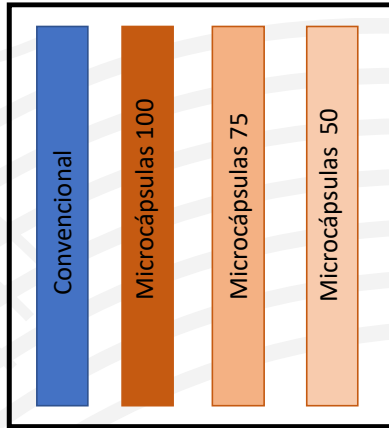
CONCLUSIONS

- Reduction in deposition according to [Cu²⁺] reduction
- Similar biological efficacy
- Big hail damage. Use of a copper conventional product.

Activity 3.6 - Large-scale field case study with liquid formulation of capsules

JEAN LEON – UPC

E3.6.1



Control	MC100	MC75	MC50
3,20 g/l	3,20 g/l	2,40 g/l	1,60 g/l



CONCLUSIONS

- It was not possible to conduct the trial on a large scale
- A 25% copper reduction would be possible.
- Similar biological efficacy, but very little mildew pressure in 2022.

4 copper applications in 2022

GT3 Activities

CONCLUSIONS

- Very good variable application results with respect to copper reduction and application volume.
- Further deposition and biological efficacy tests with the microcapsules would be necessary to obtain more robust results.

Thank you!

INTERREG
SUDOE
COPPEREPLACE

