Savings obtained from different spray systems for precision pesticide applications in orchards

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Who am I ?

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Summary

1. Context and Issues
2. GOPHYTOVID : optimization using vigour maps
3. OPTIMA : ultrasound sensors to adapt the treatment to the canopy
4. Which future for these technologies ?

01

Context and Issues

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European strategy

Moving towards a more healthy and sustainable EU food system, a corner stone of the European Green Deal

- Make sure Europeans get healthy, affordable and sustainable food
- Tackle climate change
- Protect the environment and preserve biodiversity
- Fair economic return in the food chain
- Increase organic farming

The use of pesticides in agriculture contributes to pollution of soil, water and air. The Commission will take actions to:

- ✓ **reduce by 50%** the use and risk of chemical pesticides by 2030.
- ✓ **reduce by 50%** the use of more hazardous pesticides by 2030.

Current issues

- Great variability
  - in types of sprayers
  - Within a field
  - Between fields



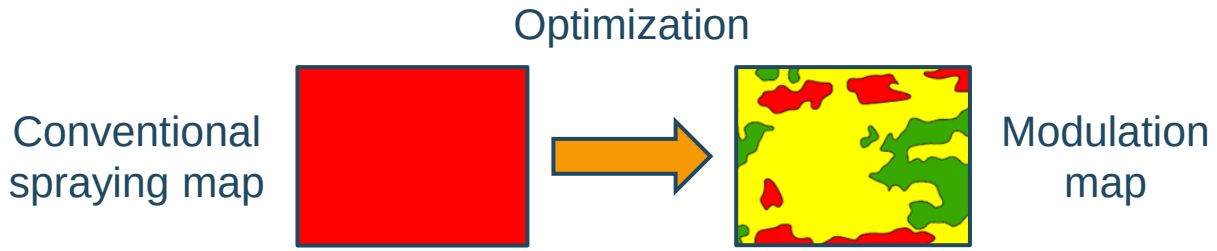


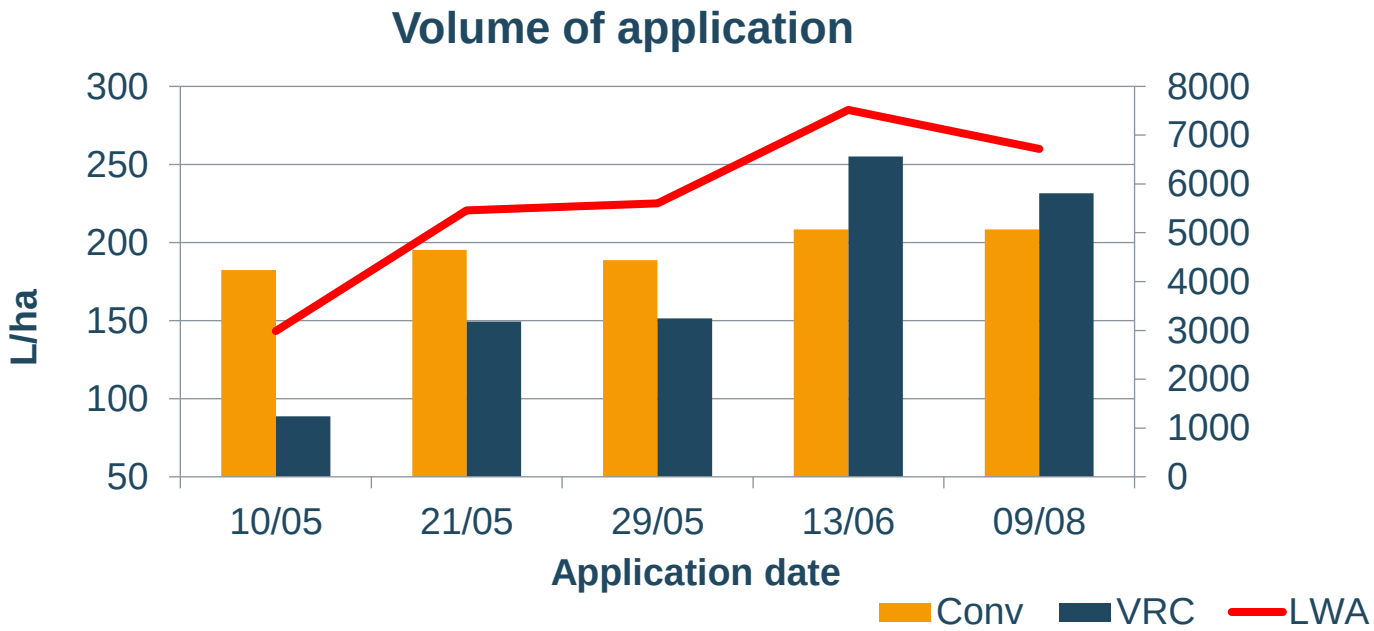

- Difficulty for farmers to adapt their treatment to canopy characteristics

Precision agriculture benefits

- Constant application rate sprayers :
  - Overdosage and significant drift

- Variable rate sprayers :
  - Facilitate the farmers' work
  - Optimization of the treatment





02

GOPHYTOVID

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Principle of GOPHYTOVID

- **Fit a conventional sprayer with a variable application system**

Intelligent control system 

Pressure sensor 

- **Determine the reliability of the system**

Saving and analysing data 

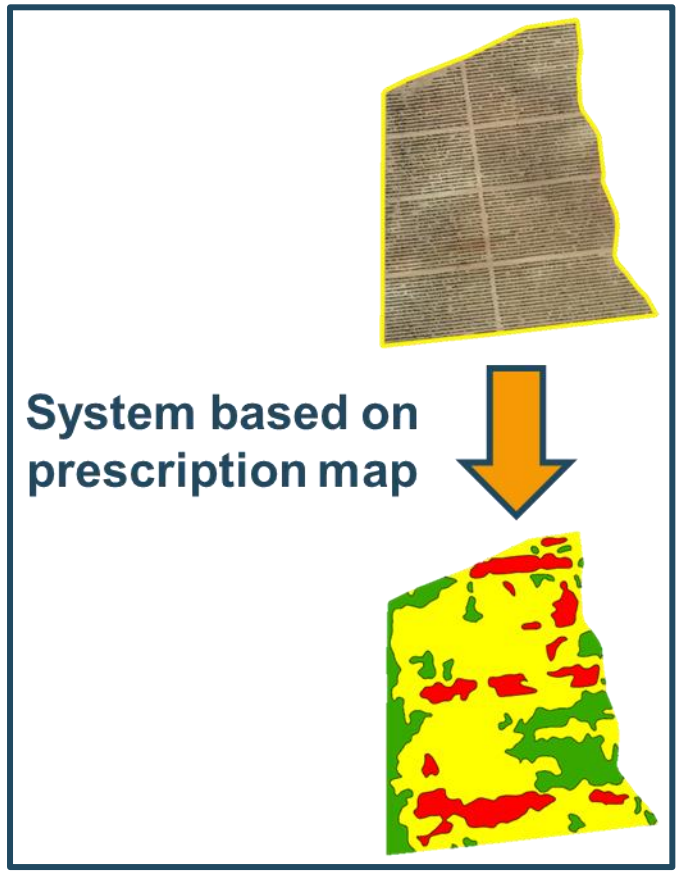
Touchscreen and GNSS 

- **Savings analysis**

Money 

Environnement 

Time 



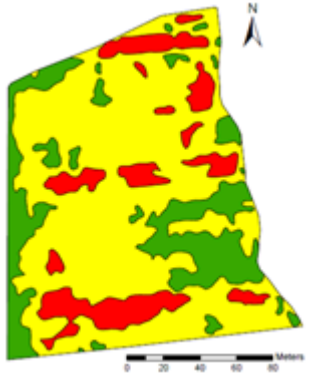
Characteristics of the field

- Location : Torrelavit (Barcelona, Spain)
- Vine variety : Chardonnay
- Surface area : 2,21 ha
- Planting pattern : 2,2 m x 1,2 m
- Vegetative state : BBCH 77 to 79

Process to acquire and use data

UAV loaded with a multiespectral camera

Classified vigour map (NDVI)

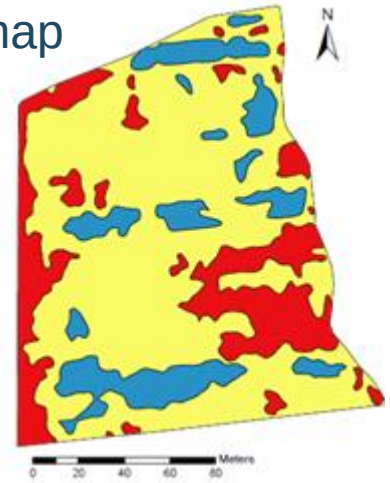


Legend
Classified Vigour
Bajo
Medio
Alto

Characterization of vegetation

DSS DOSAVIÑA®

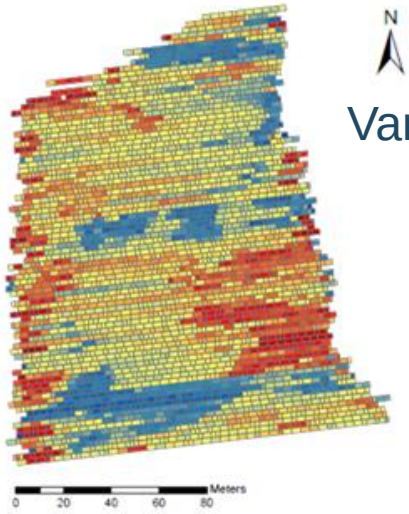
Prescription map (L/ha)



Legend
Dose (L.ha^{-1})
257
315
372

Variable rate application

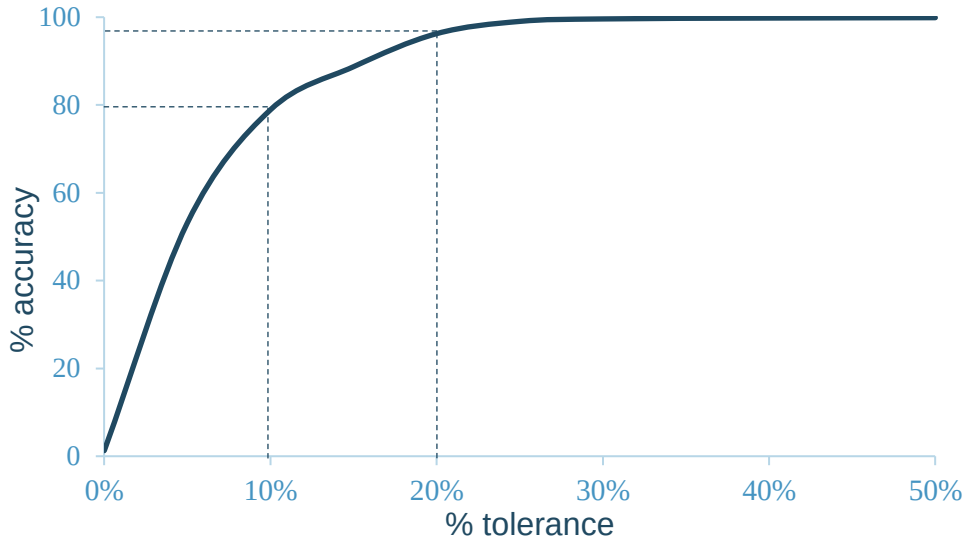
Variable application map (L/ha)



Legend
Dose (L.ha^{-1})
132
494

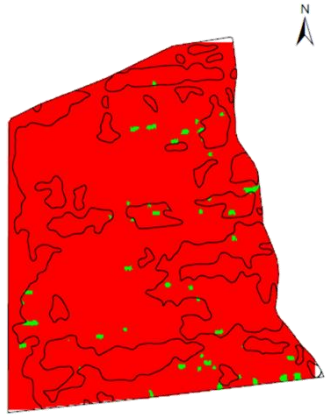
Accuracy of the system

- Accuracy depends on the tolerance threshold
- Physical parameters need transitions
- The need to determine an optimal tolerance

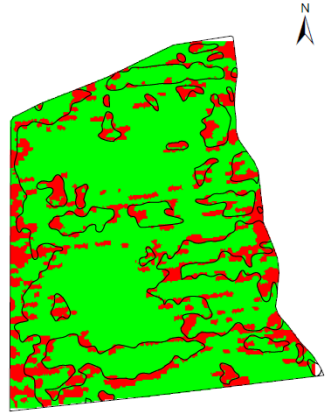


Inside the tolerance

Outside the tolerance



0% tolerance

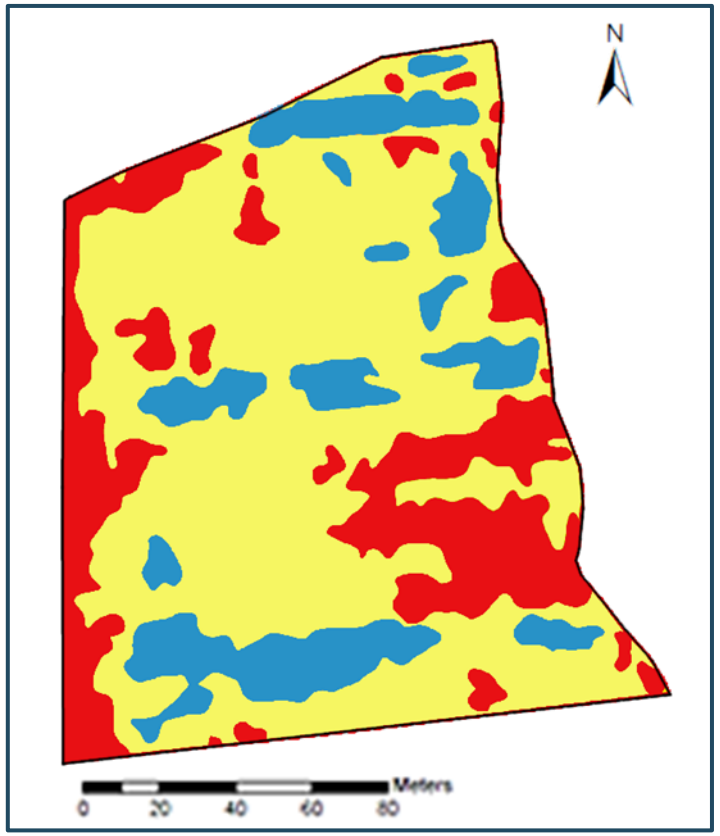


10% tolerance

20% tolerance

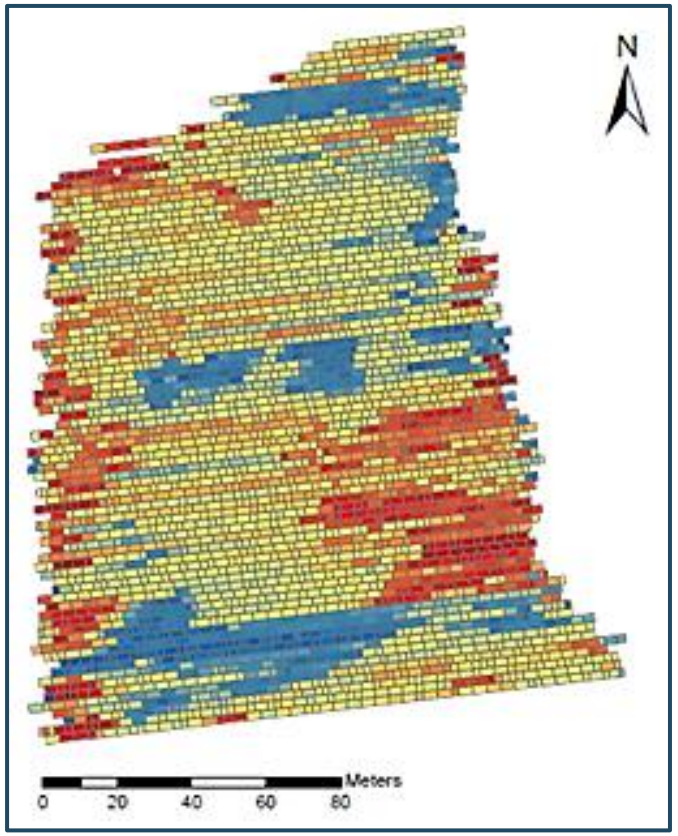
Accuracy of the system

Prescription map



10% of tolerance
76% of correct application
Better transition between vigours

Variable application map



Saving analysis

- Significant water savings
- Economic issues
- Less environnemental impact

2019		Jean Leon			Fransola
Costs	**Units**	**CONV**	**VRC**	**Savings**	**Savings**
Crop protection product	€/ha per year	63,5	63,5	0%	0%
Diesel	€/ha per year	23,9	23,5	2%	6%
Operational cost	€/ha per year	48,9	47,7	2%	9%
SUBTOTAL	€/ha per year	136,3	134,7	1%	2%
VRC cost	€/ha per year	-	55,6	-	
TOTAL	€/ha per year	136,3	190,3	-40%	-40%

2019	Units	Jean Leon			Fransola
		CONV	**VRC**	**Savings**	**Savings**
Water	m3/year	66	56	15%	35%
CO_2	kg CO_2/ha per year	18,9	18,6	2%	6%
Time	h / ha per year	4,4	4,3	2%	9%

03

OPTIMA

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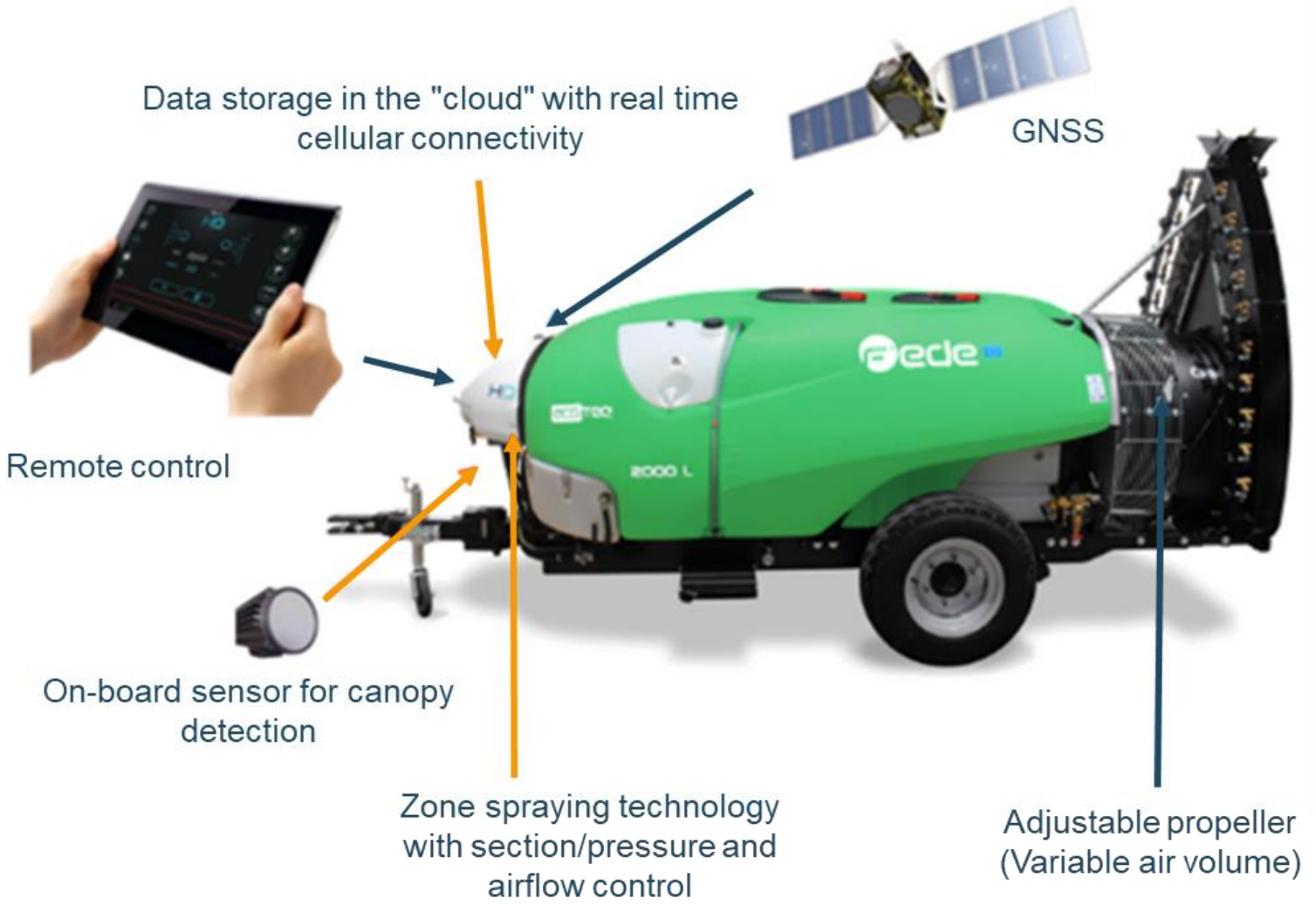
What is OPTIMA ?

- European Horizon 2020 project : Italy, France and Spain

- Exeperimentations in Aragon, Spain : 11% of Spain apple orchard surface

- Objectives of the project :
  - Development of new thechnologies in precision agriculture
  - Experimentation in real conditions
  - Optimization of the treatment against apple scab
  - Determination of environnemental and economic impacts

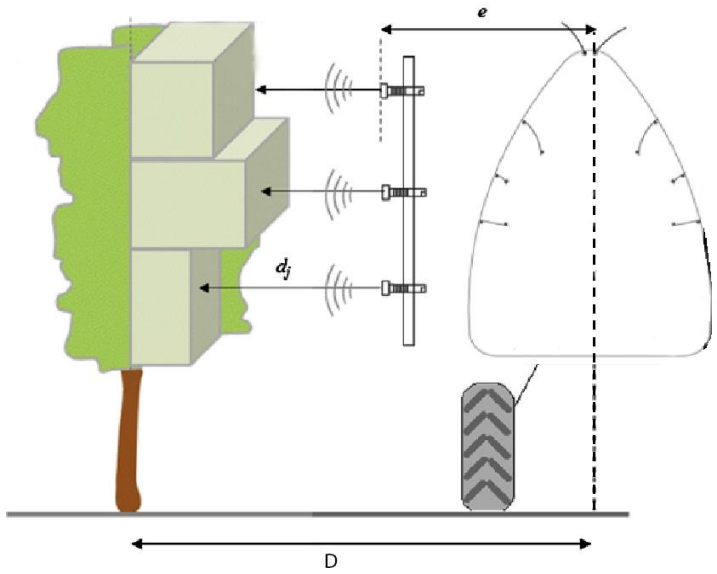
Characteristics of the sprayer



H3O sprayer

Developped in OPTIMA

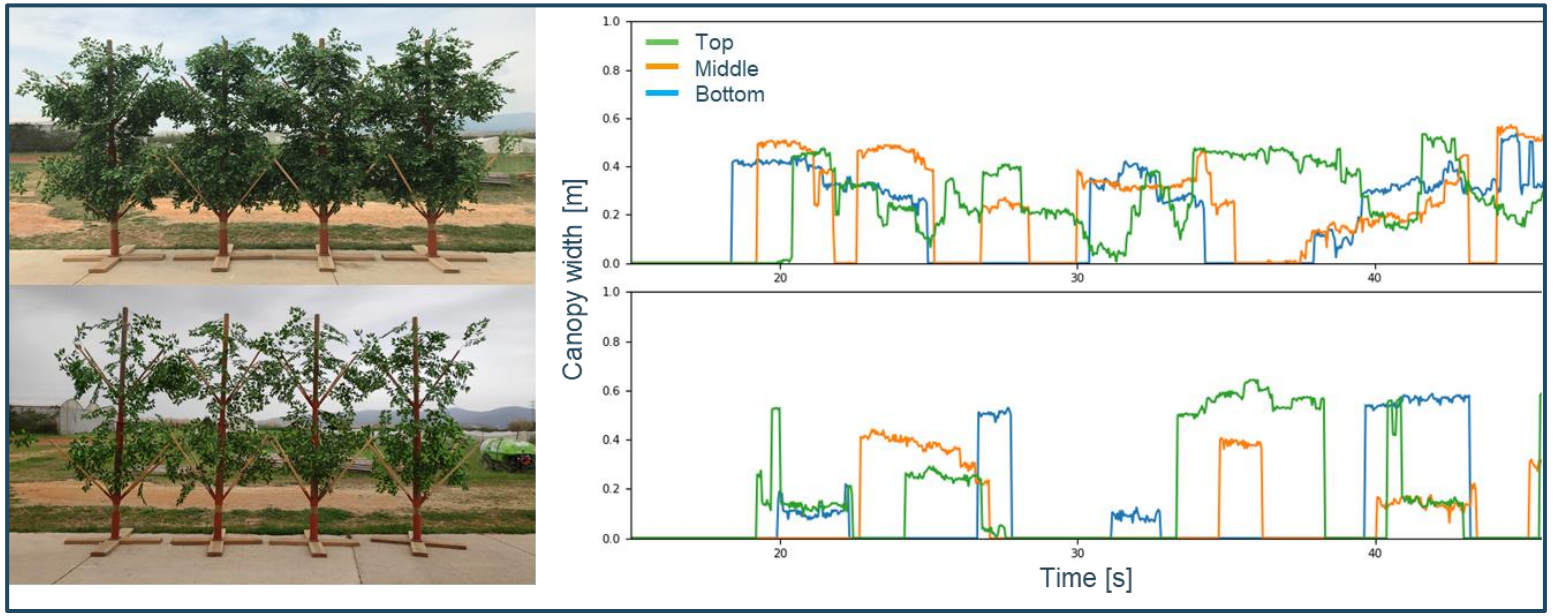
Ultrasound sensors data



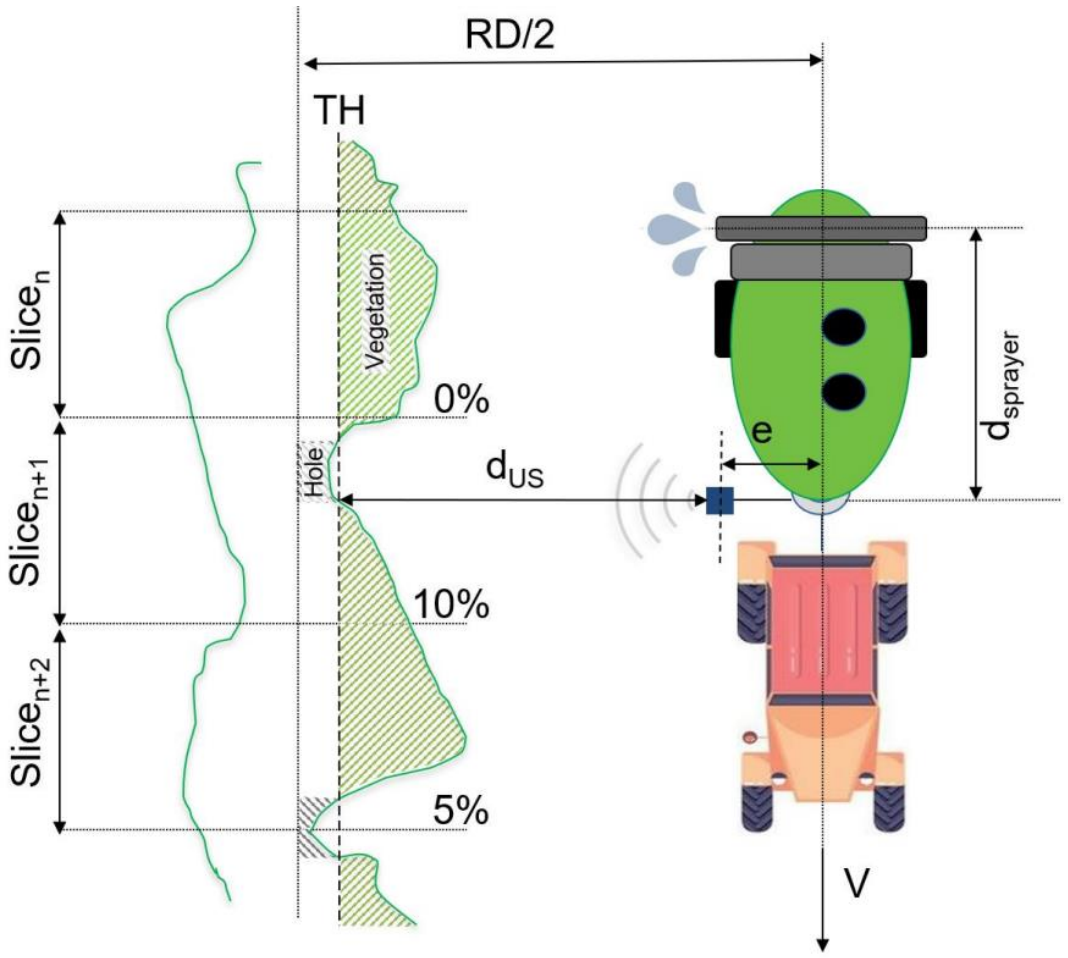
- Three sections per side with :
  - Ultrasound sensor
  - Motor valve
  - Pressure sensor
  - 3 or 4 nozzles

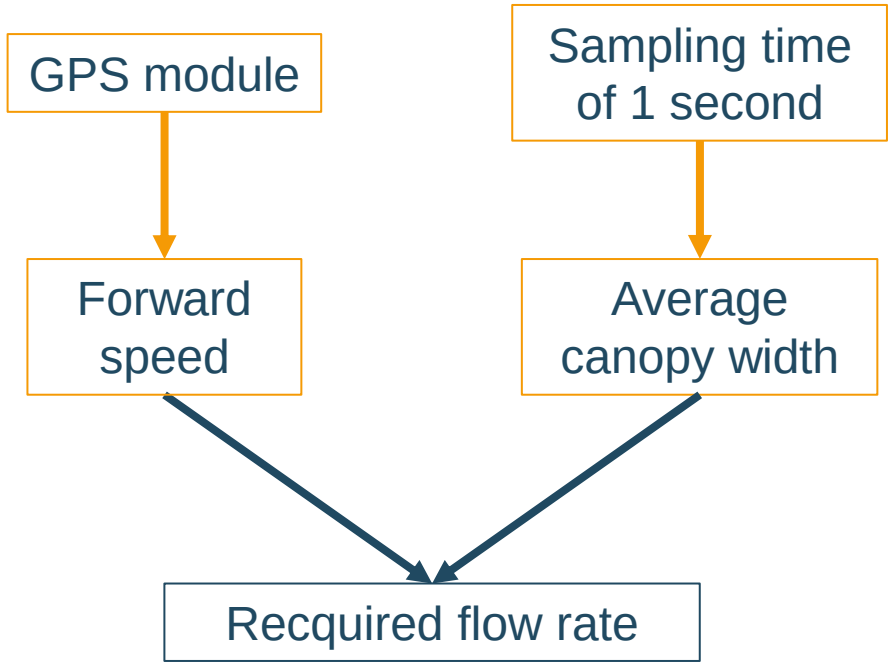
- Onboard electronic translates data using this formule :

$$q(\mathrm{l\,min^{-1}}) = \frac{[D - d_i - e_i](\mathrm{m}) \times h/3(\mathrm{m}) \times v(\mathrm{km\,h^{-1}}) \times i(\mathrm{l\,m^{-3}}) \times 1000}{60}$$



Real time dose adjustment





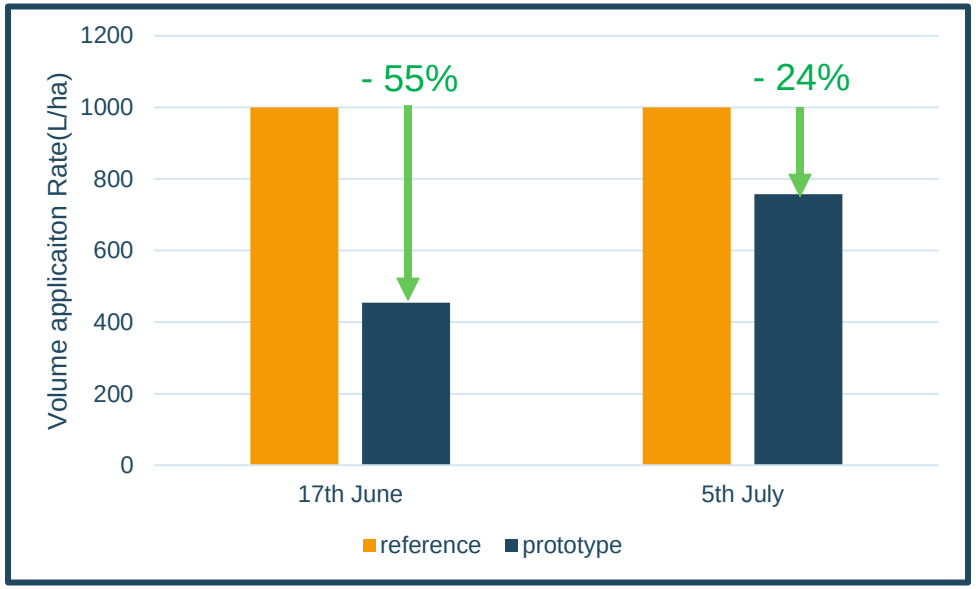
Trial location and sprayers

- Fields located at Begues, Barcelona, Spain
- Planting pattern 3,6 m x 1,2 m
- Same conditions for both trials

	Reference sprayer	Prototype
Brand	Makato	Pulverizadores Fede
Tank capacity	1000L	2000L
Air fan	Axial fan without air deflectors	Axial fan with tower air deflector
Nozzles	14 Albuz ATR nozzles combined (green, red and Orange)	20 Lechler IDK nozzles combines 01 and 015 (ISO colour code)
Forward speed	4 km/h	4.2 km/h
Pressure	18 bar	Variable from 7 to 15 bar)

Results

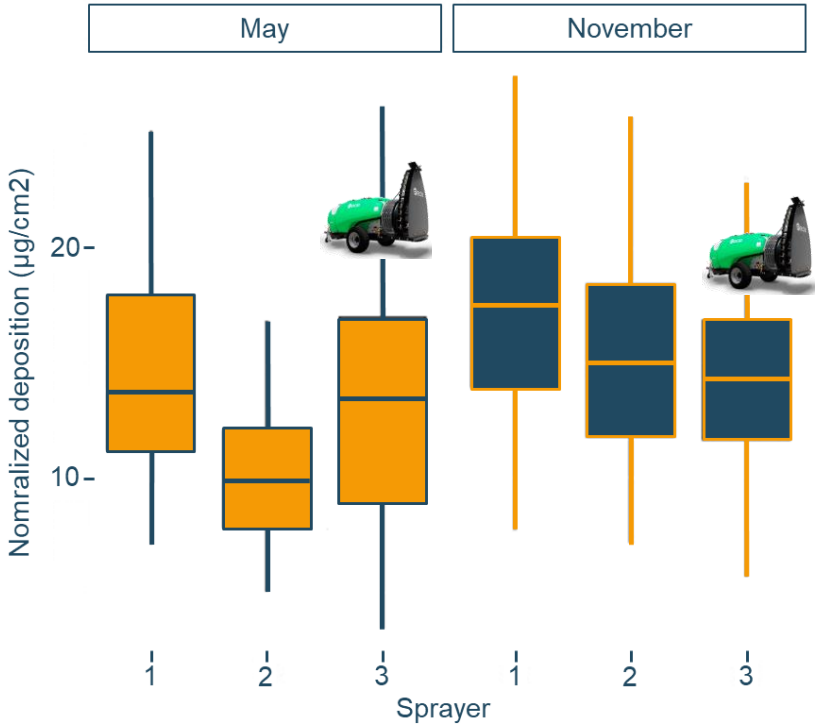
- Significant savings
- Lower environmental impact



Date	Active ingredient	**Prototype** (amount of product used per hectare)	**Reference** (amount of product used per hectare)	Savings
17/06/2022	Clorur oxiychloride 50%	1,5 Kg	3 Kg	55%
	Spinosad 48%	12 mL	25 mL	55%
	Potasic soap	14 L	30 L	55%
05/07/2022	Clorur oxiychloride 50%	2,3 Kg	3 Kg	24%
	Potasic soap	30 L	40 L	24%
18/07/2022	Spinosad 48%	19 mL	25 mL	24%

Results

- Same disease control on the apple scab
- Better savings with the prototype



Date	Type of sprayer	Volume Rate (L/ha)	% reduction
May 2021	Conventional	881	0%
	Best Management Practices	773	12%
	Prototype	475	46%
November 2021	Conventional	877	0%
	Best Management Practices	769	12%
	Prototype	462	47%

04

Which future for these technologies ?

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Adapting technologies and fields

- Development of autonomous robots

- Different sorts of technologies :
  - Cameras for visual recognition
  - Ultrasound sensors
  - Laser
  - PWM valves

PIVOS project – PWM system

BAKUS S – Vitibot

- Mutual adjustment between agronomic characteristics and technologies involved

QUESTIONS & ANSWERS