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Field testing and monitoring of newly designed airblast sprayers in traditional olive orchards

Interprofesional del aceite de Oliva español

Antonio Miranda Fuentes. Dpt. Of Rural Engineering, University of Cordoba, Spain.

Antonio.Miranda@uco.es

GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA, INDUSTRIA Y COMPETITIVIDAD

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ETSIAM
Escuela Técnica Superior de Ingeniería Agronómica y de Montes

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Field testing and monitoring of newly designed airblast sprayers in traditional olive orchards

- ❑Introduction
- ❑Objectives
- ❑Materials and Methods
- ❑Results
- ❑Conclusions

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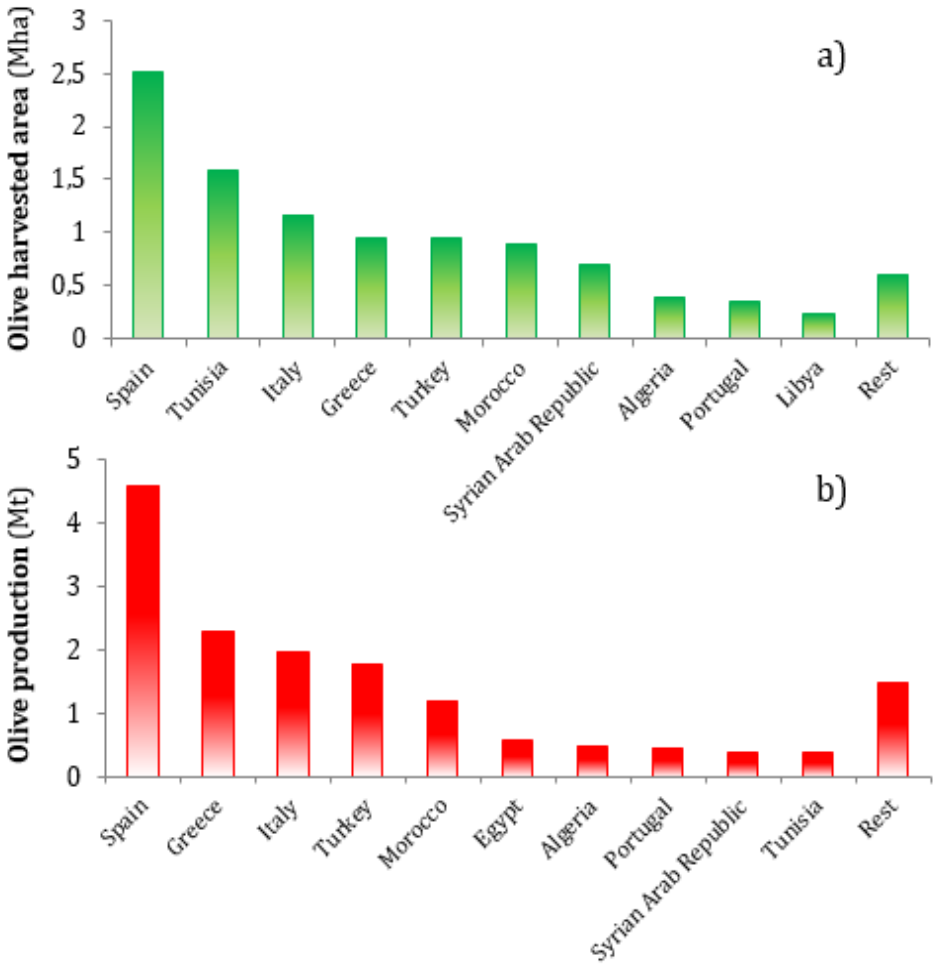
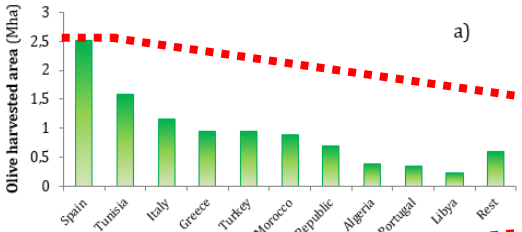
Olive distribution

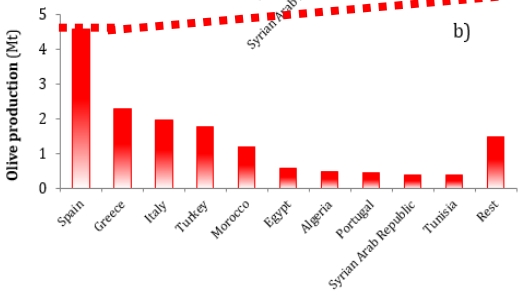
Olive harvested area (a) and olive production (b) in the main growing countries



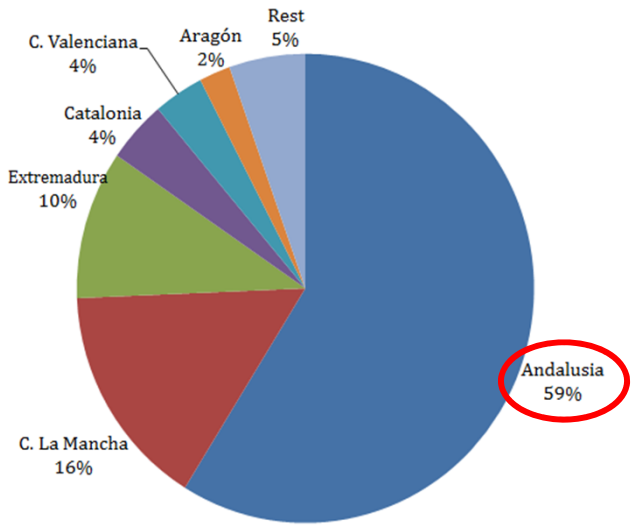
Source: FAO (2014)

Olive in Spain



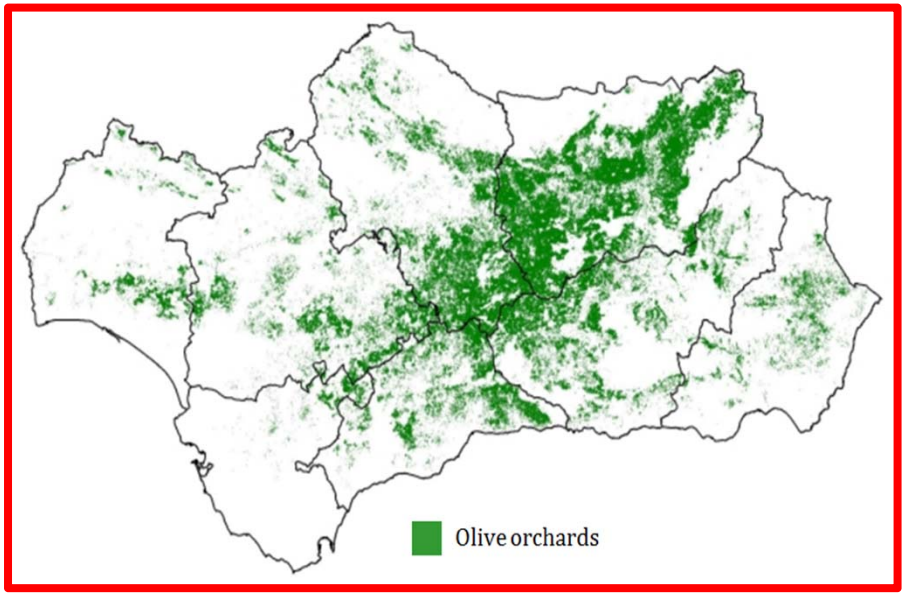


2.65 Mha
4.58 Mt



Olive harvested area per autonomous region in Spain (MAPAMA, 2015).

59%



Olive harvested area in Andalusia (Junta de Andalucía, 2002).

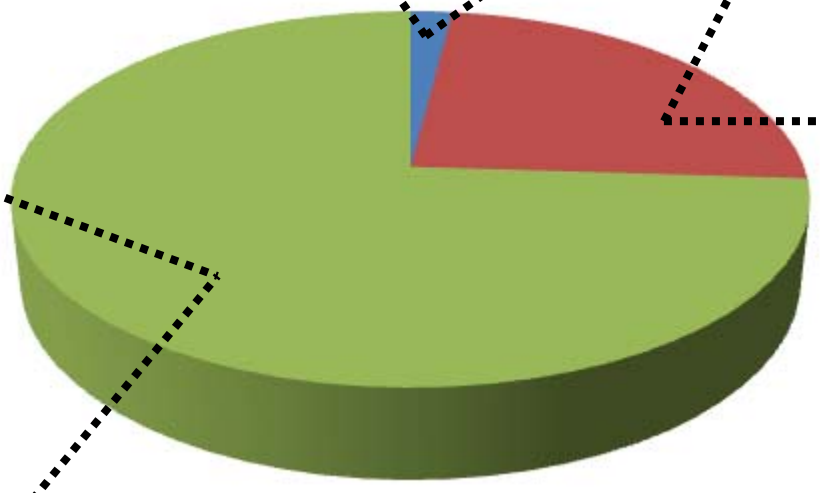
Olive in Spain

Olive plantation systems in Spain
(AEMO, 2012)

Superintensive

2 %

Intensive



24 %

74 %

Traditional

Olive distribution

Olive distribution

Public administration

Olive oil sector

Public research organism

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- ❑**Objectives**
- ❑Materials and Methods
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Objectives

- To assess the work capacity and performance of the sprayers.
- To determine the liquid saving of the prototypes as a consequence of the spray sectorization.
- To assess the coverage produced by the sprayers in the canopy.

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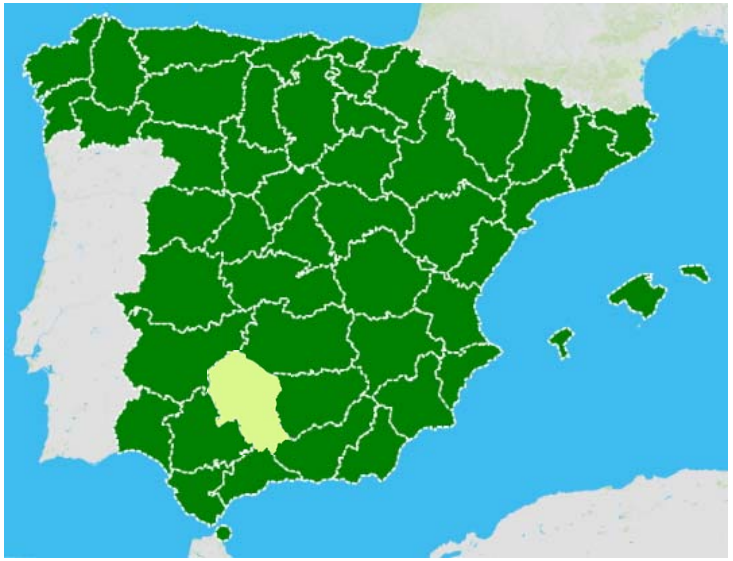
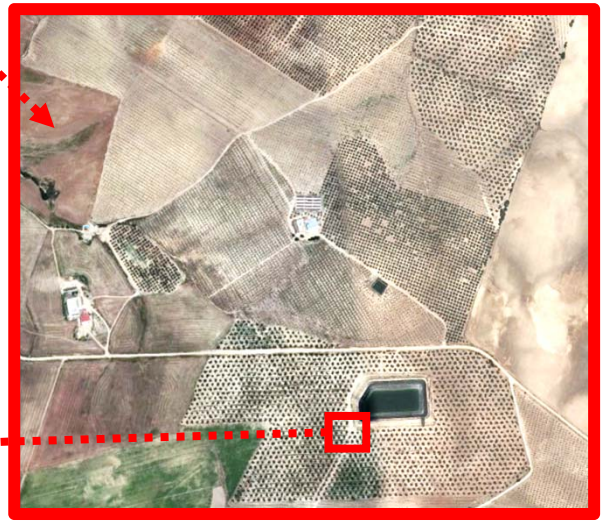
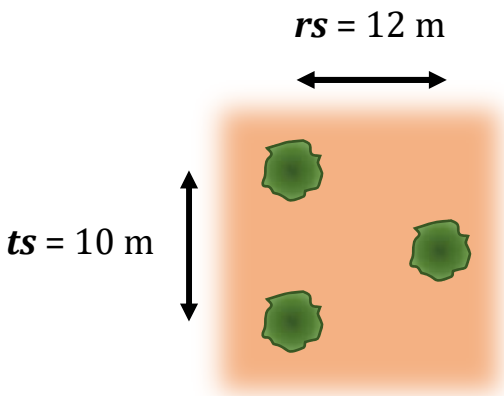
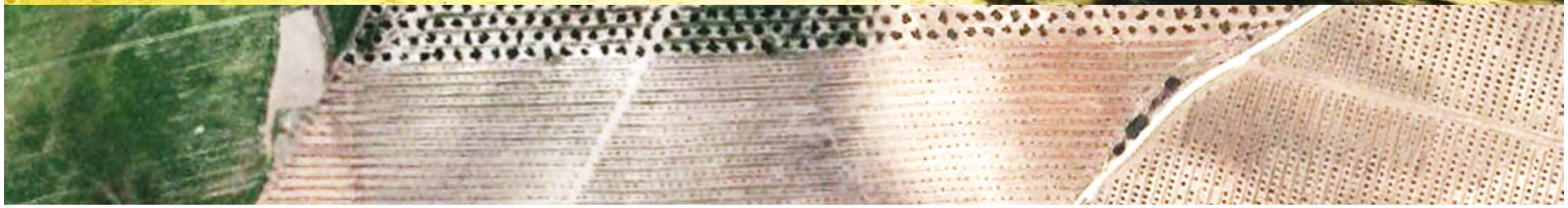
Experimental field







Experimental field



Sprayers used

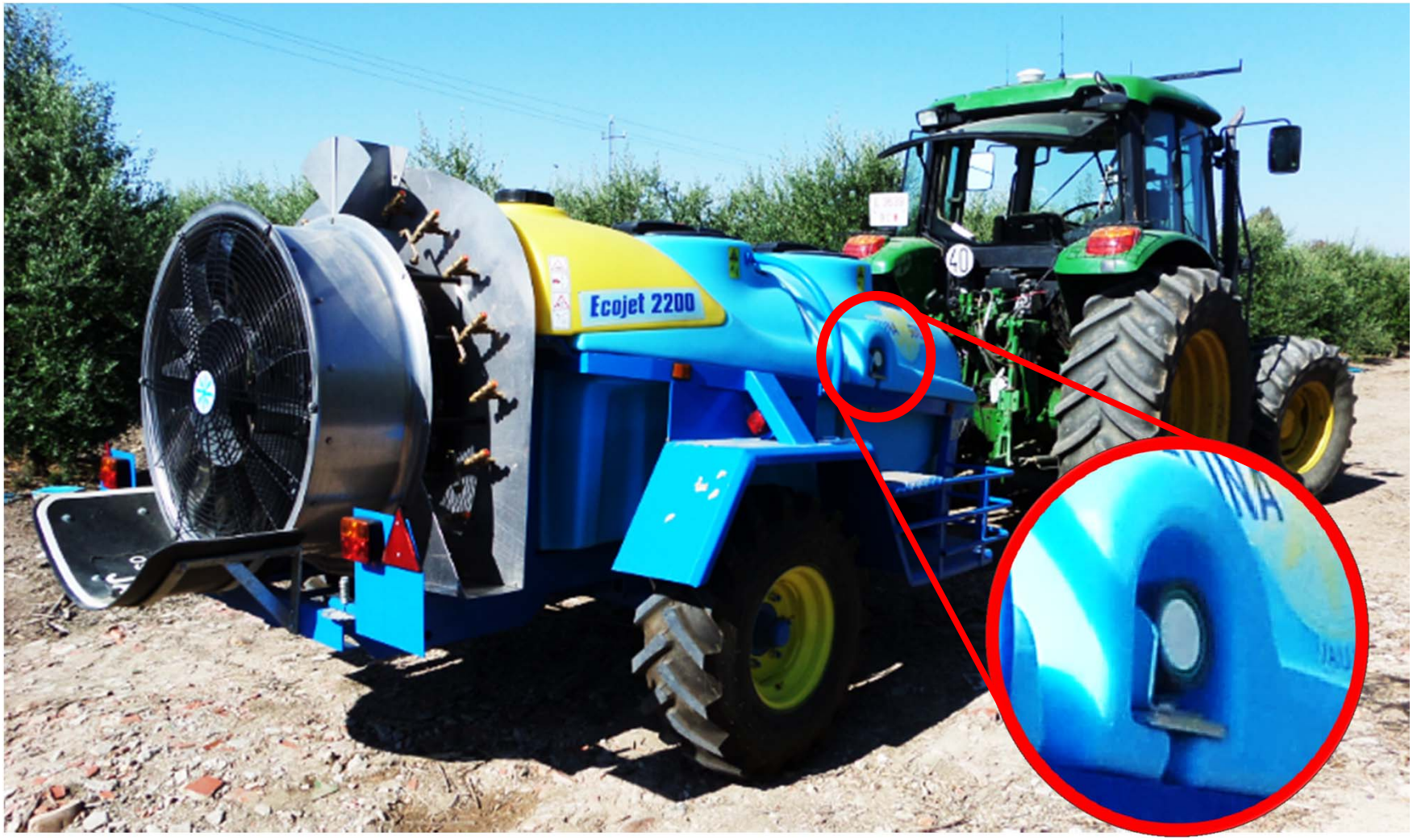
Conventional sprayer

Prototype P2

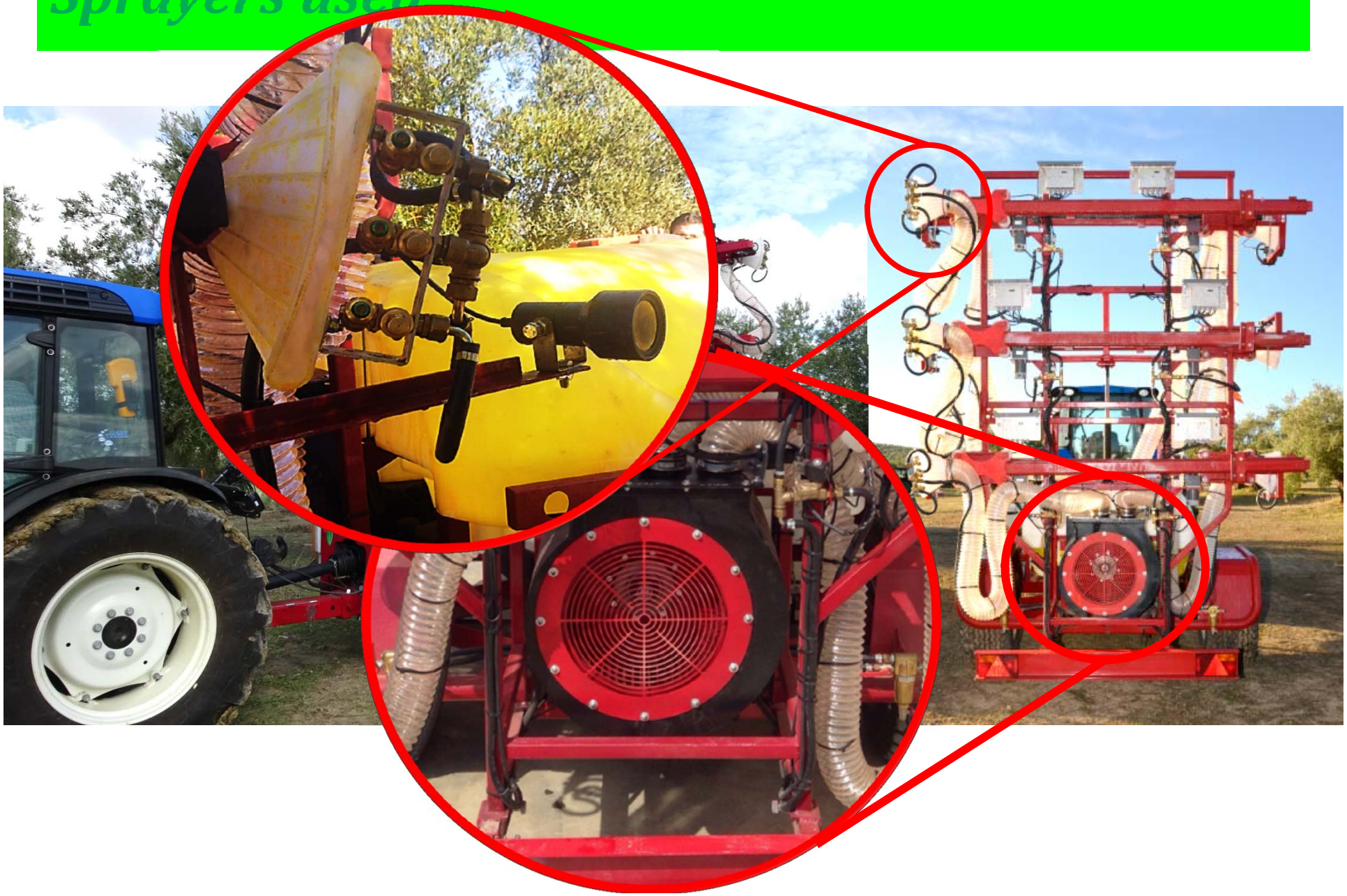
Prototype P1

Prototype P3

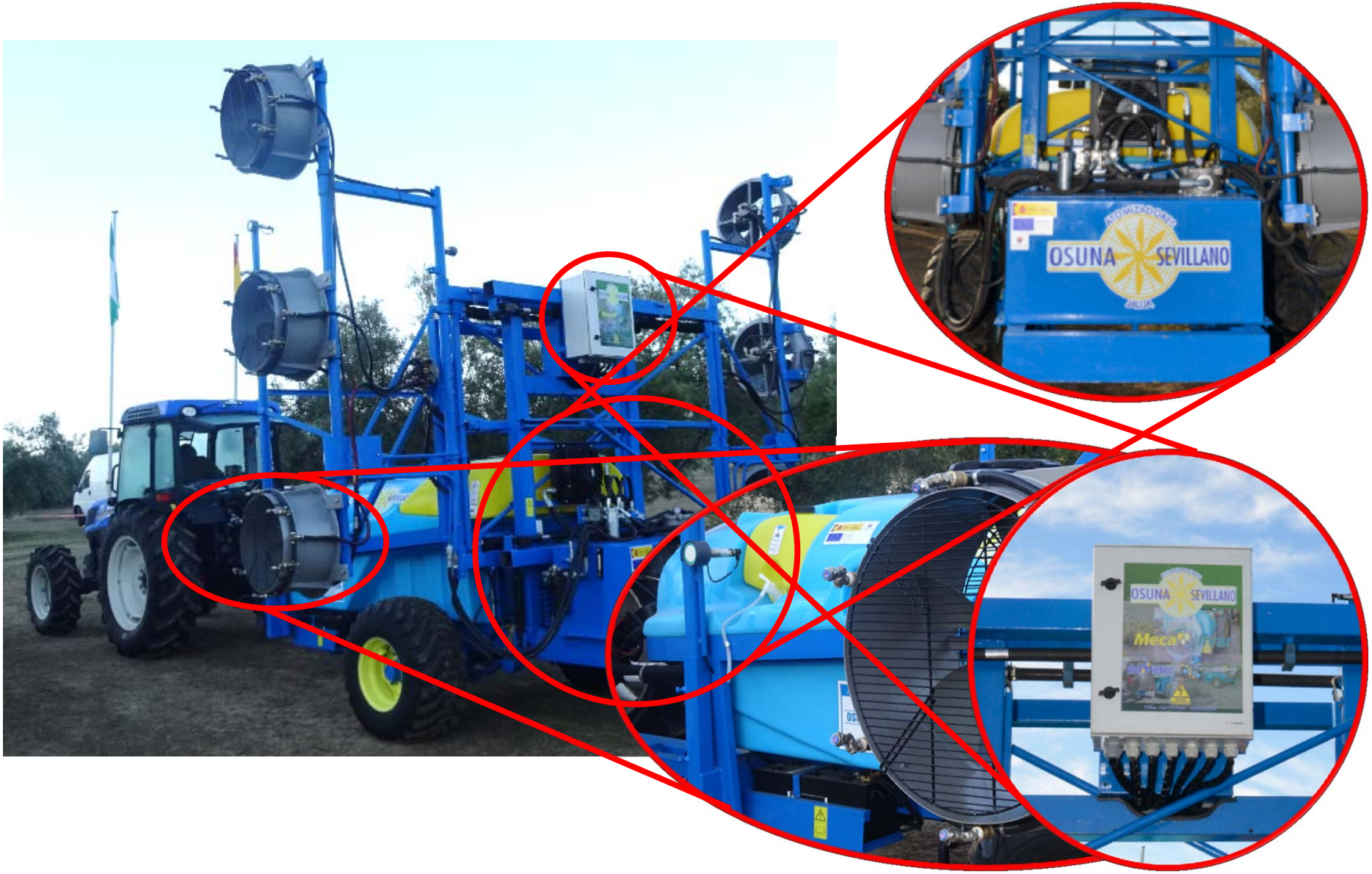
Sprayers used



Sprayers used



Sprayers used



Sprayers used

Sprayers used

Sprayers used

Sprayers used

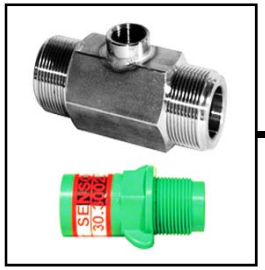
Sprayer monitoring

Electronic layout

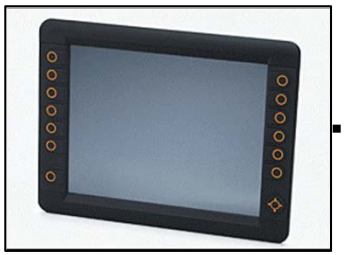
CR 3114 GPS/GSM modem

POLMAC SPRAYING EQUIPMENT

Rapid check flow meter



CR 0403 PLC



CR 1200 screen

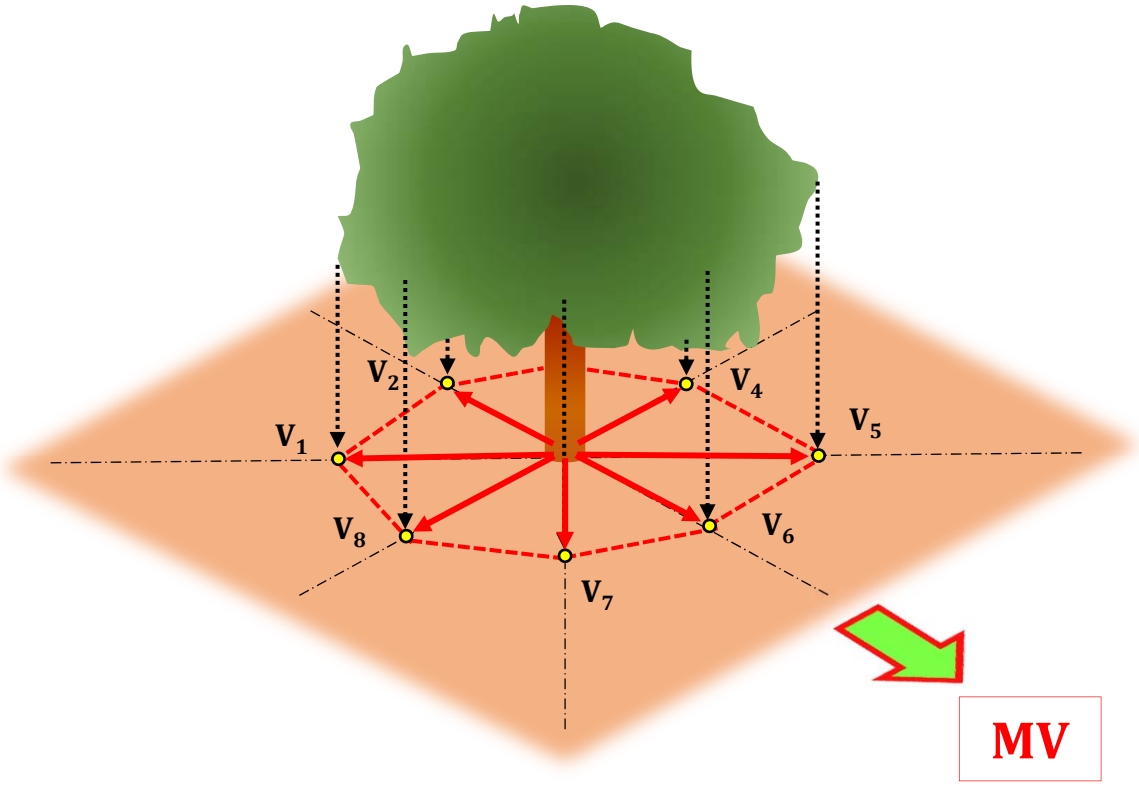
Laptop

PA 3060 pressure sensor

Sprayer monitoring

Canopy characterization

Mean Vector (MV) method*

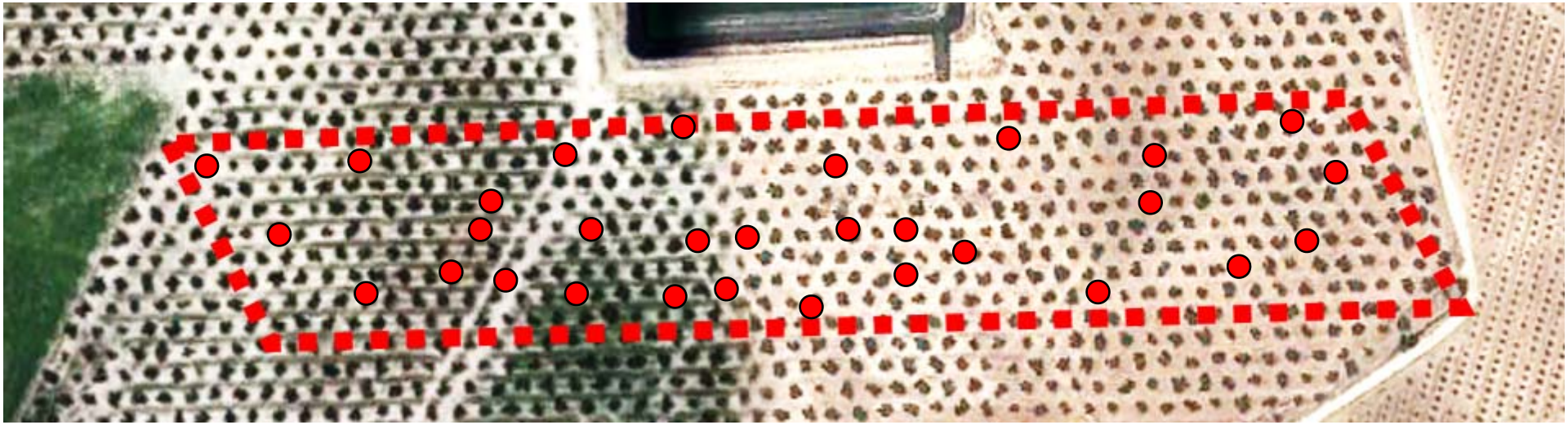


$$MV = \frac{1}{8} \times \sum_{i=1}^{8} V_i$$

* Miranda-Fuentes, A., Llorens, J., Gamarra-Diezma, J.L., Gil-Ribes, J. A., Gil, E., 2015. Towards an optimized method of olive tree crown volume measurement.

Canopy characterization

30 trees selected at random

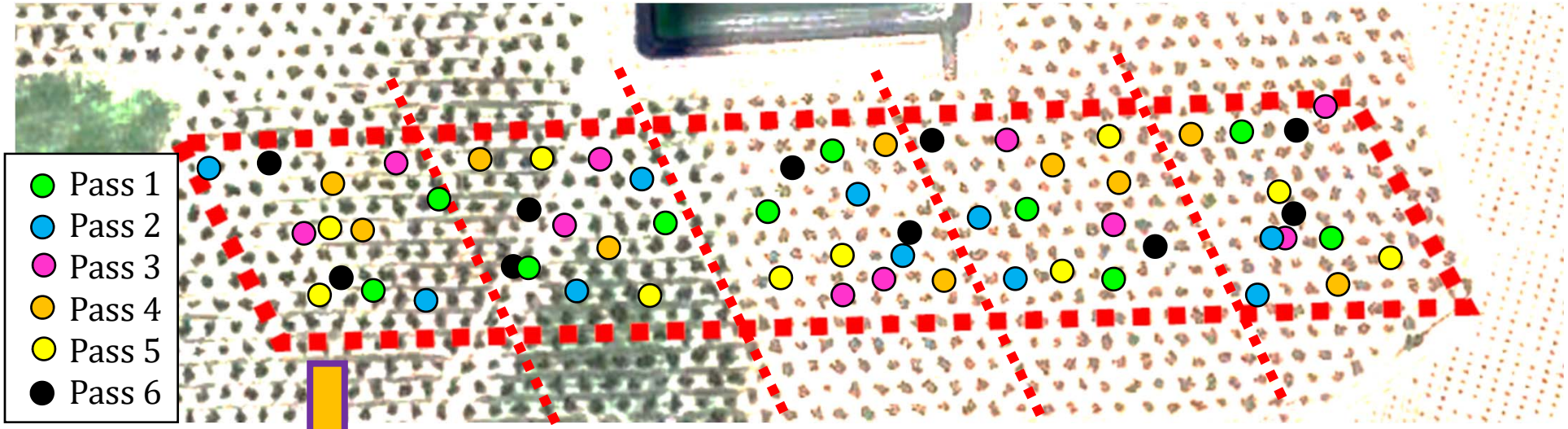


$$V_L = 47.364 \times MV - 56.666$$

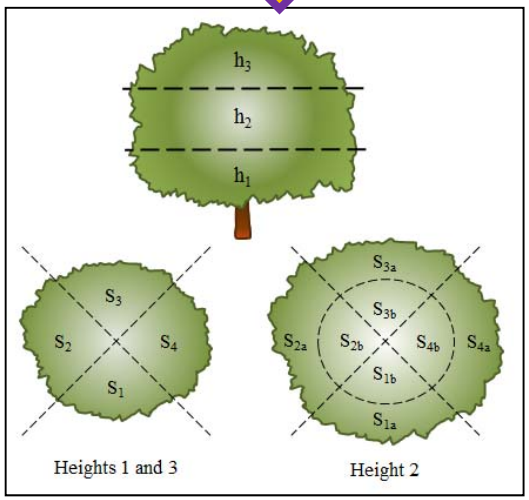
V_L → Canopy volume calculated from LiDAR point cloud (m^3)

MV → Mean vector (m)

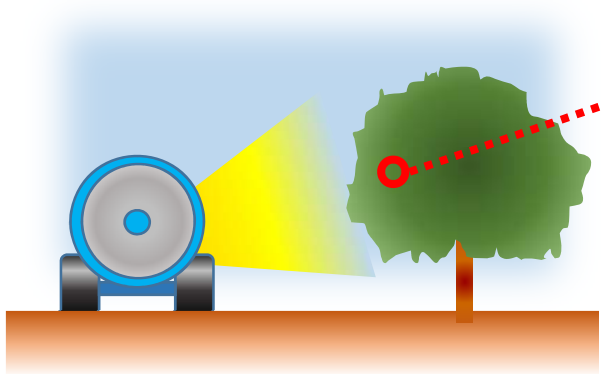
Canopy sampling

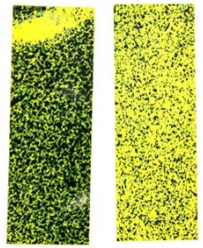


1 sampling position per tree (at random)



16 possible sampling positions per tree





Trial development

Trial development

Operational parameters

	Sprayer			
Parameter	P1	P2	P3	Commercial*
Nozzle colour*	Black	Orange	Orange	Green
Number of open nozzles	18 (2 x 9)	36 (2 x 18)	34 (2 x 17)	14 (2 x 7)
Pressure (bar)	15	15	16	15
Liquid flow rate ($L \cdot min^{-1}$)	60.5	60.8	59.2	59.8
Spray volume ($L \cdot ha^{-1}$)	**907**	**912**	**887**	**897**
Forward speed ($km \cdot h^{-1}$)	4.05	3.95	4.11	4.02
Air volumetric flow rate ($m^3 \cdot s^{-1}$)	2.8	12.7	12.7	12.7

Trial development

Weather conditions monitorization

Liquid flow rate regulation

Tank concentration sampling

Real forward speed measurement

Trial development

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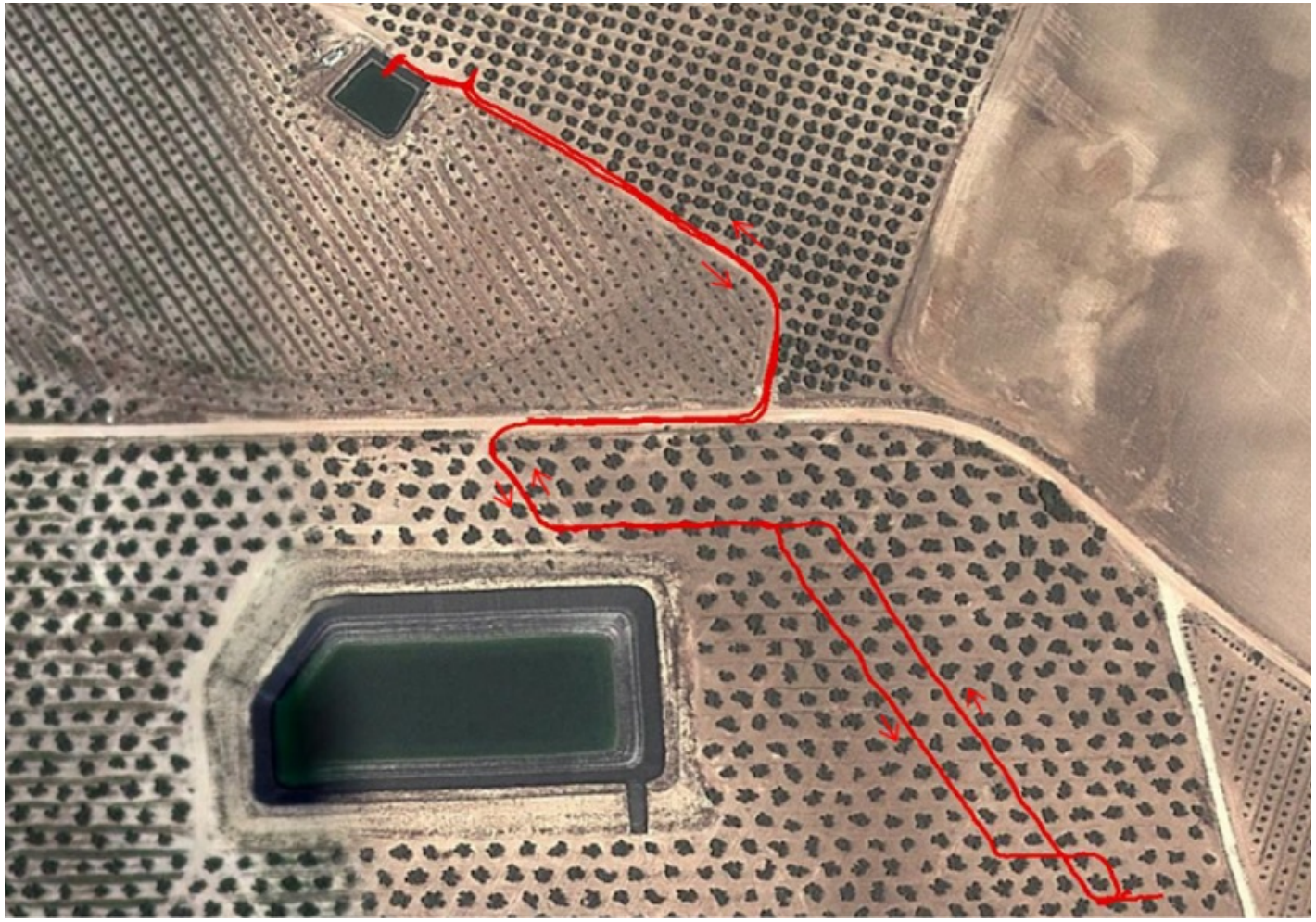
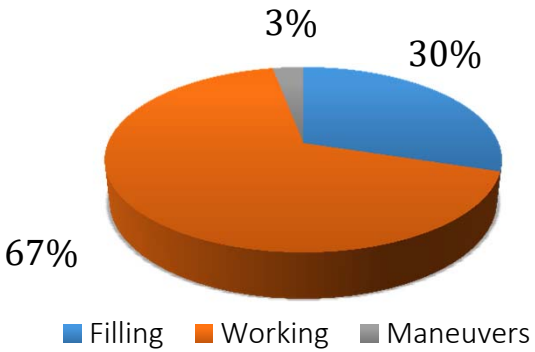
Assessment of the work capacity and performance



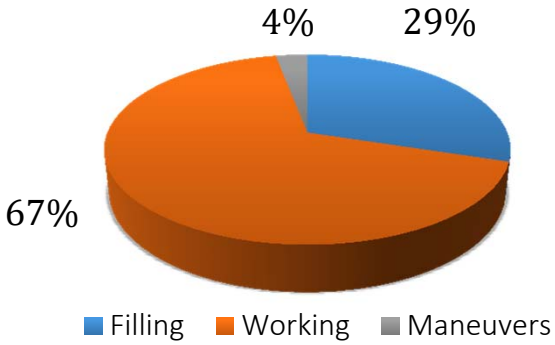
$$Work\ capacity = \frac{worked\ area}{working\ time}$$

$$Sprayer\ Performance = \frac{Effective\ working\ time}{Operation\ time}$$

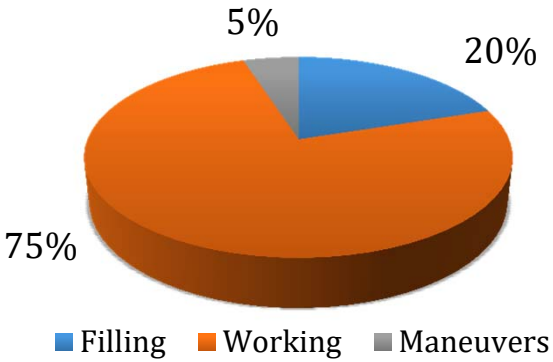
Assessment of the work capacity and performance



$WC = 2.7\ ha\ h^{-1}$



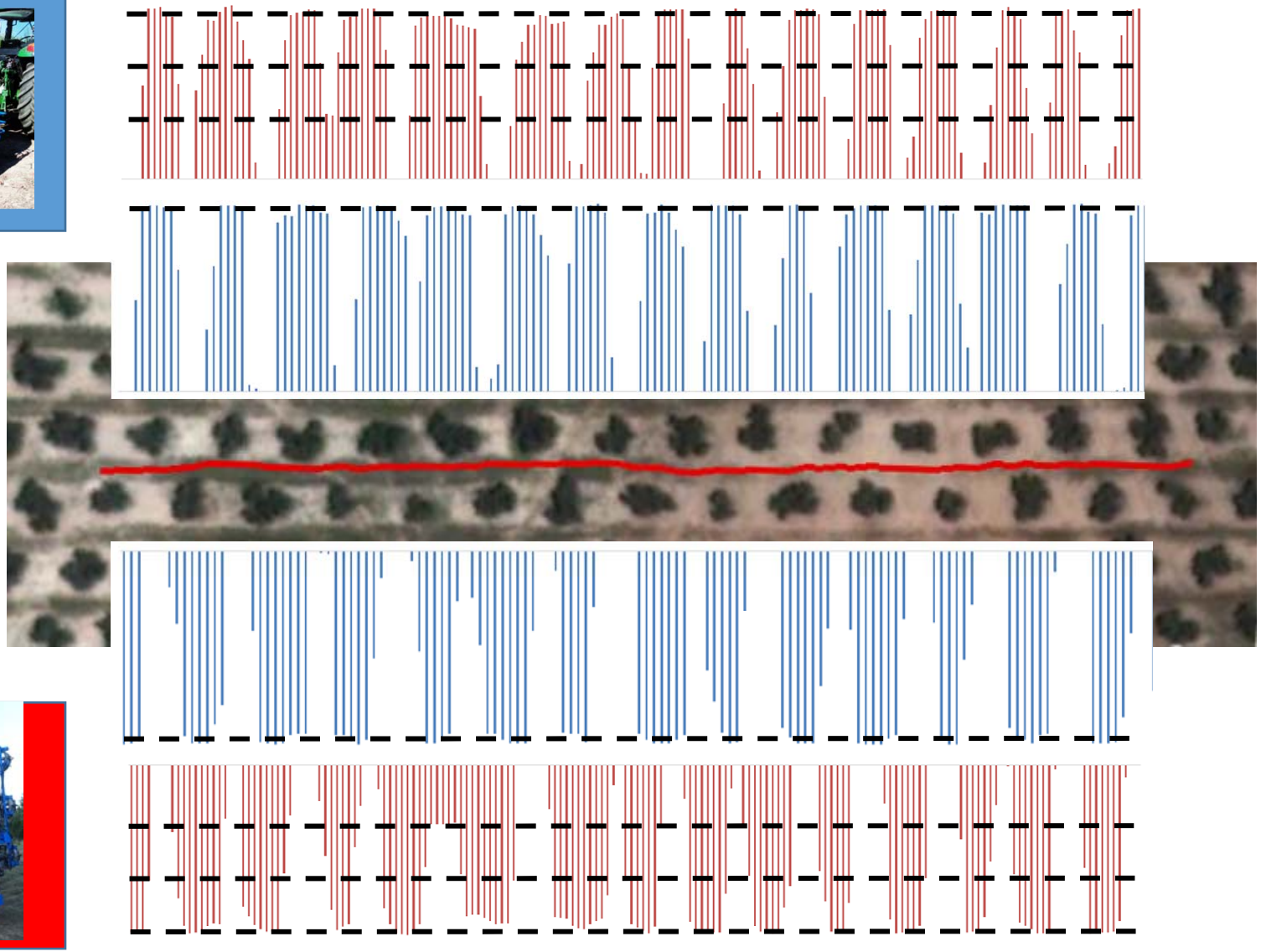
$WC = 2.7\ ha\ h^{-1}$



$WC = 3.0\ ha\ h^{-1}$

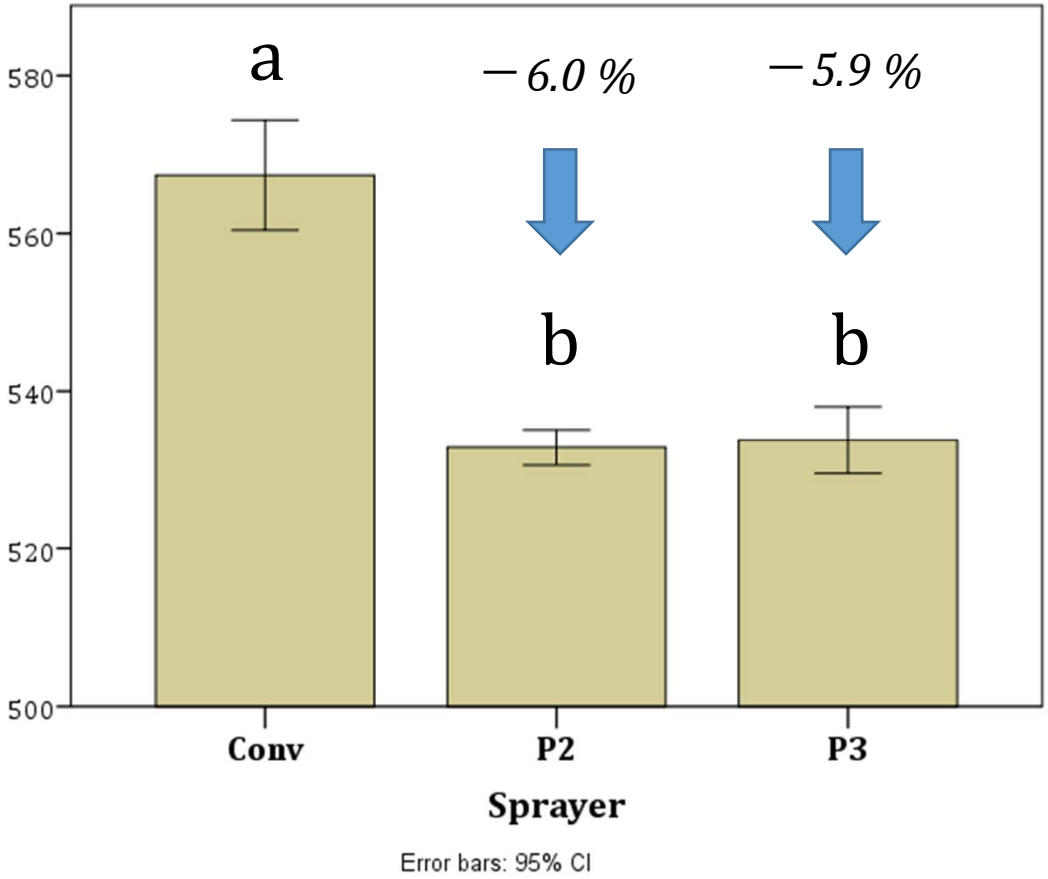
Liquid volume saving

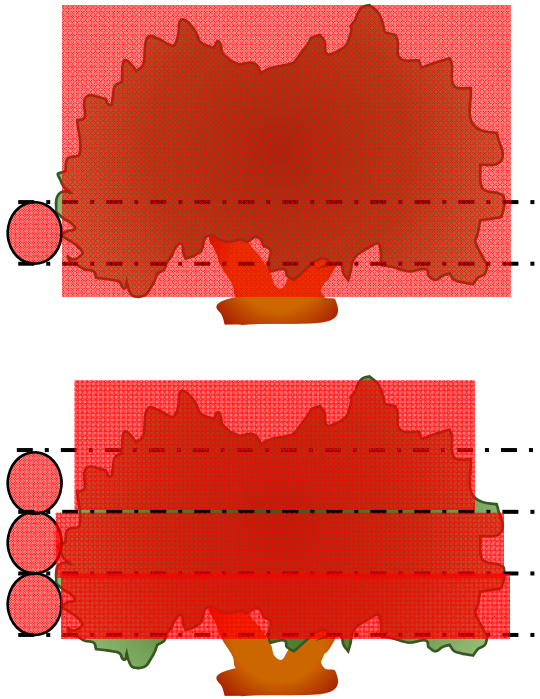
Liquid volume saving



Liquid volume saving

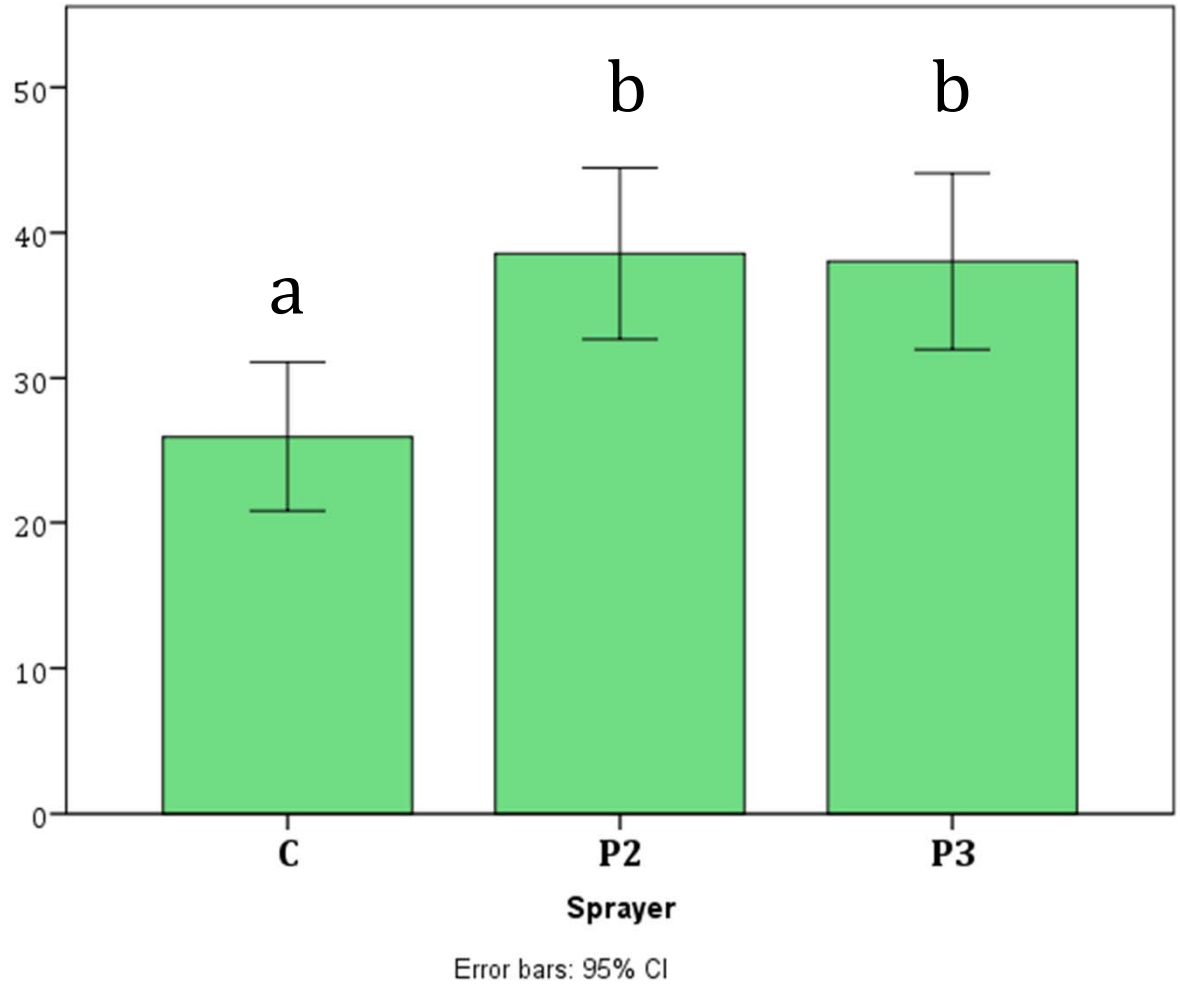
Applied volume (L ha^{-1})





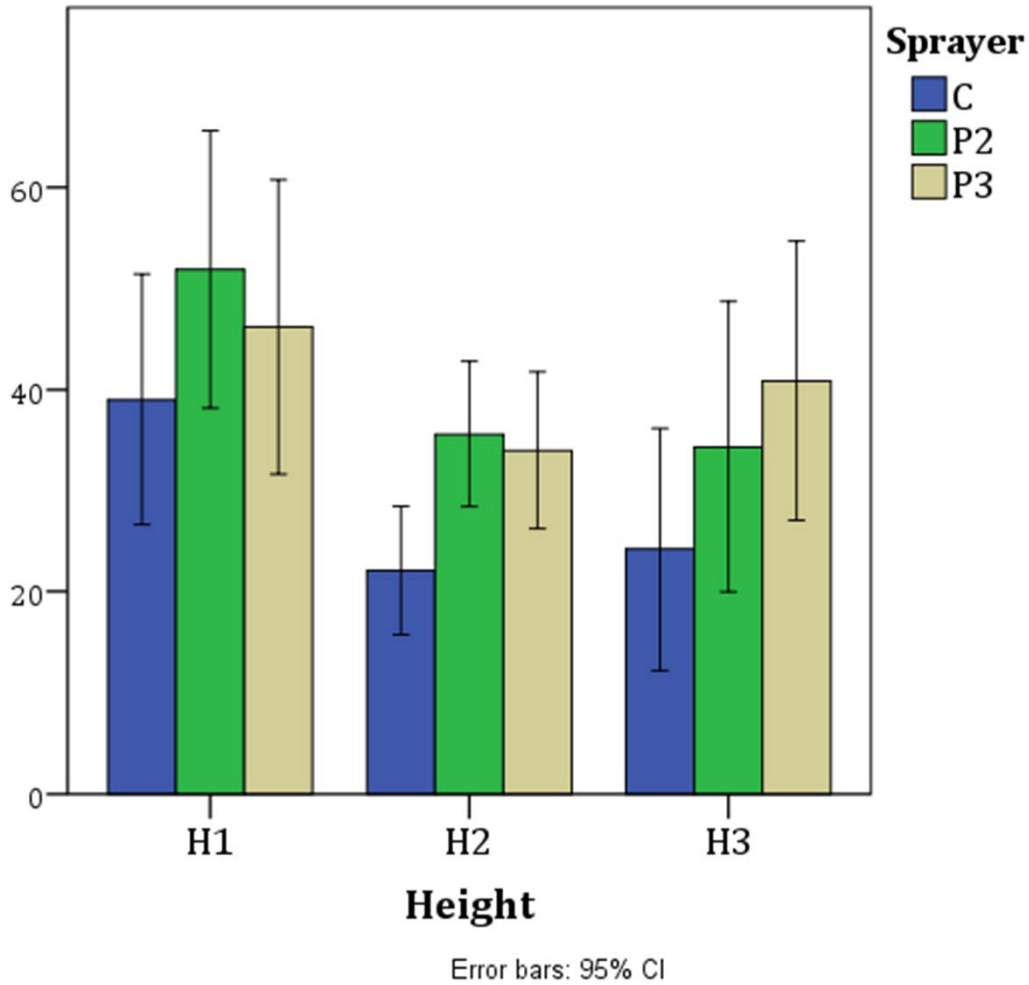
Spray coverage

Percentage coverage (%)



Spray coverage

Percentage coverage (%)



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Conclusions

- Good results in spray applications in olive require the adaptation of the spraying machinery.
- The developed prototypes could work in real field conditions over a 30 ha total area, showing their reliability.
- The P3 prototype increased the working capacity by reducing the filling time.
- The prototypes generated a significant volume save, but it was not very important in practice.
- The spray coverage was significantly increased by the prototypes, and specially in the upper positions.
- The proper adjustment of these sprayers can be a first step to improve pesticide applications in olive, but variable application technology must be added.

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Thanks for your attention!

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