



**Workshop on harmonized dose expression for the zonal evaluation of
plant protection products in high growing crops**

Olive research trials



Antonio Miranda Fuentes
Universidad de Córdoba
antonio.miranda@uco.es



Vienna, 19 October 2016

Trial summary

- Introduction
- Superintensive orchard
- Intensive orchard
- Traditional orchard

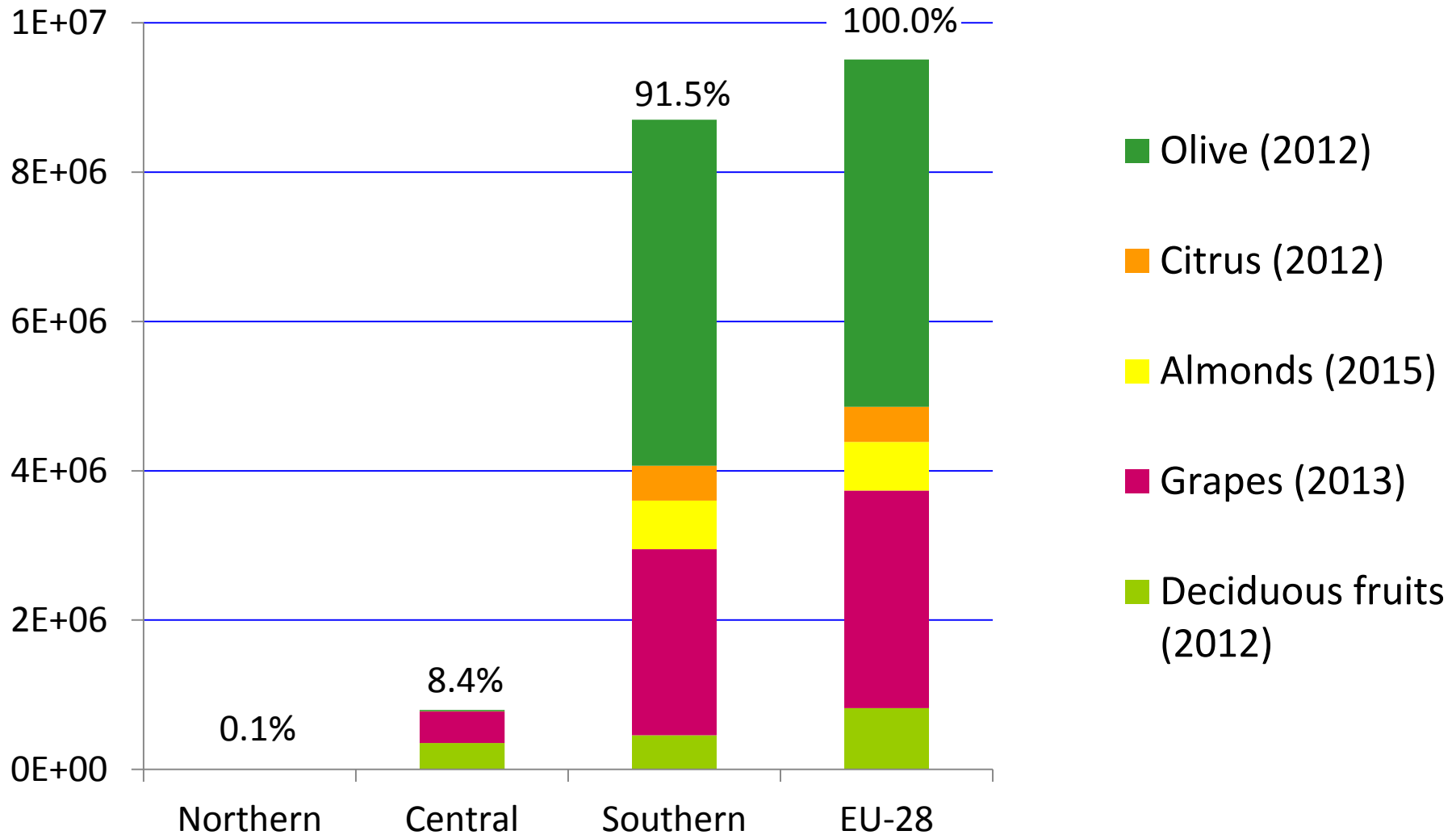


Trial summary

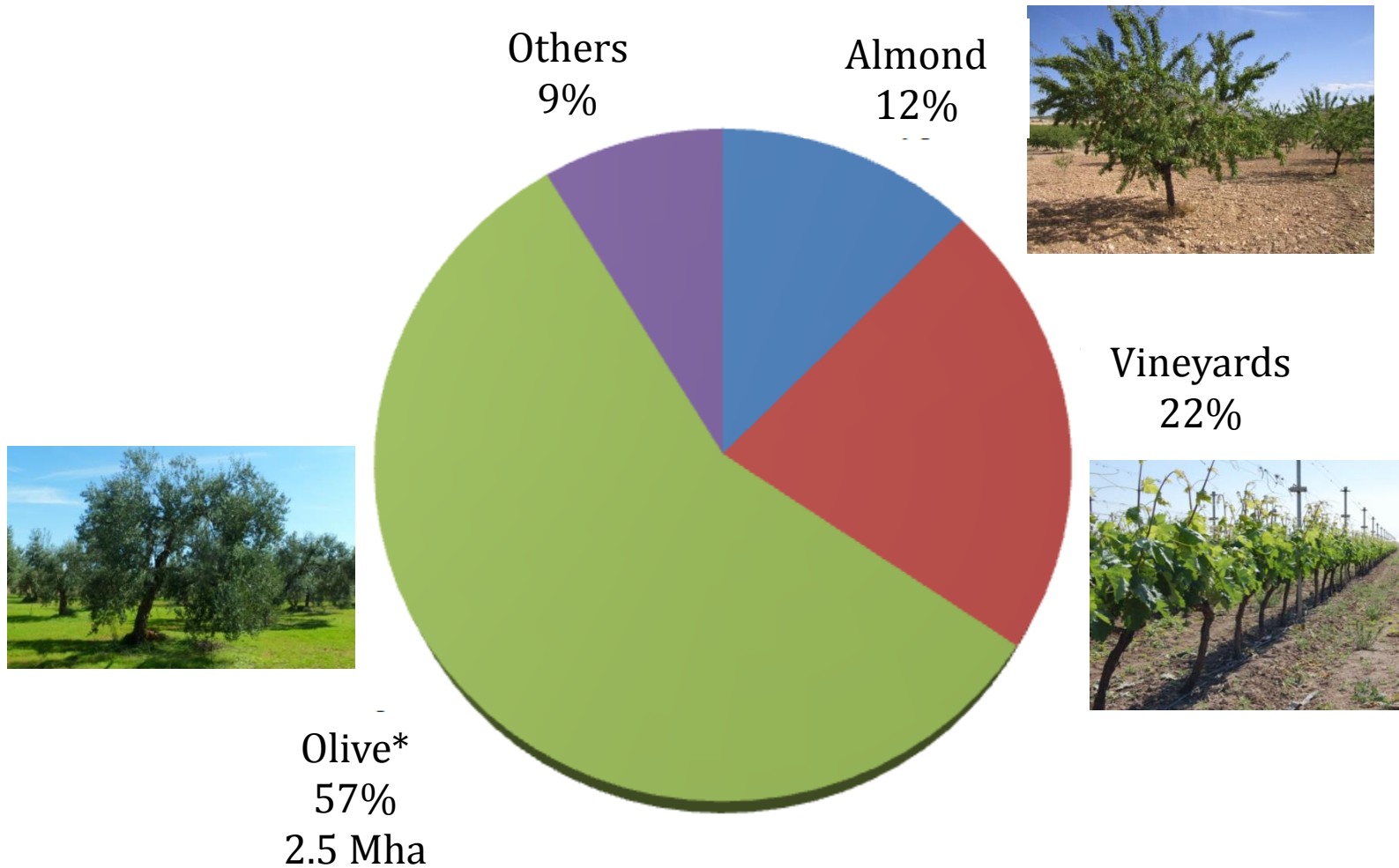
- **Introduction**
- Superintensive orchard
- Intensive orchard
- Traditional orchard



EU crop distribution



Spain crop distribution



* Data referred to the harvested area in Spain (FAO, 2012)

Main characteristics of the olive orchards in Spain

Olivar types

Superintensive system

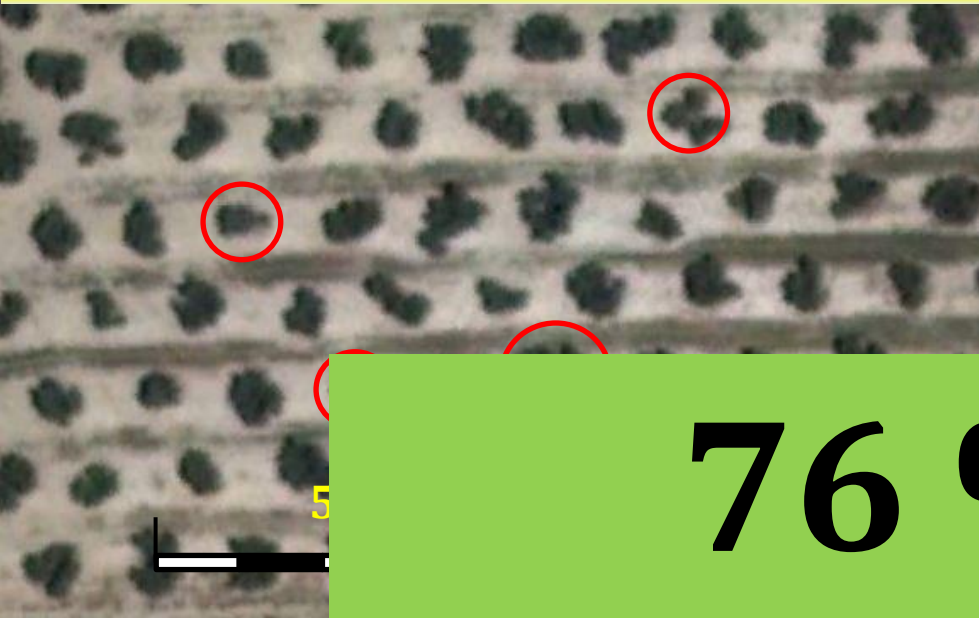


Intensive system



* Data referred to the harvested area (AEMO, 2012)

Main characteristics of the olive orchards in Spain



76 % *
*** AEMO, 2012**



Main characteristics of the olive orchards in Spain



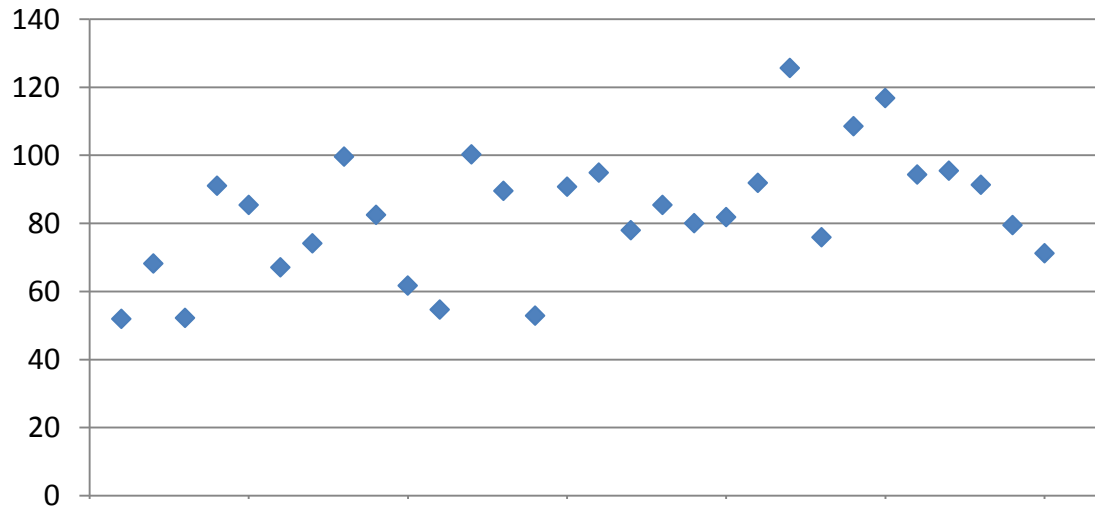
Traditional system

- Plantation density: 69 ha⁻¹
- Number of trunks: 2 – 4
- Average height: 4.58 m
- Average diameter: 6.34 m
- Average volume: 98.08 m³

Main characteristics of the olive orchards in Spain



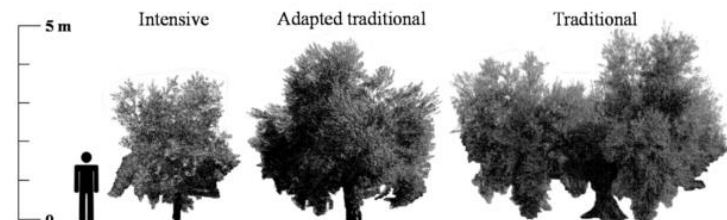
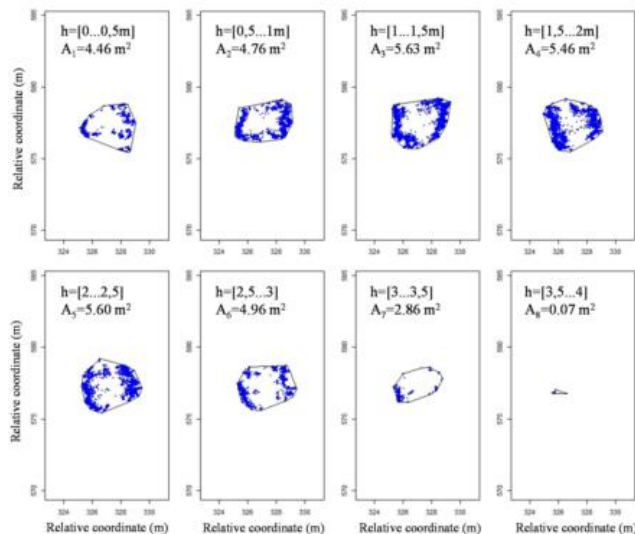
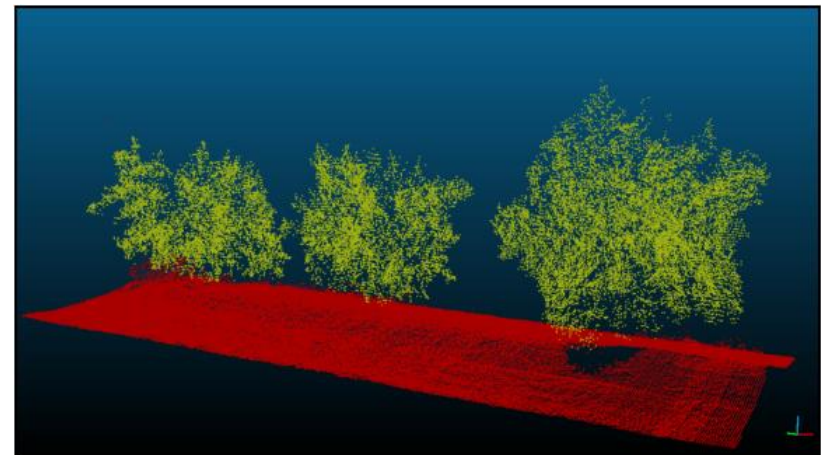
Canopy volume (m³)



Olive volume assessment



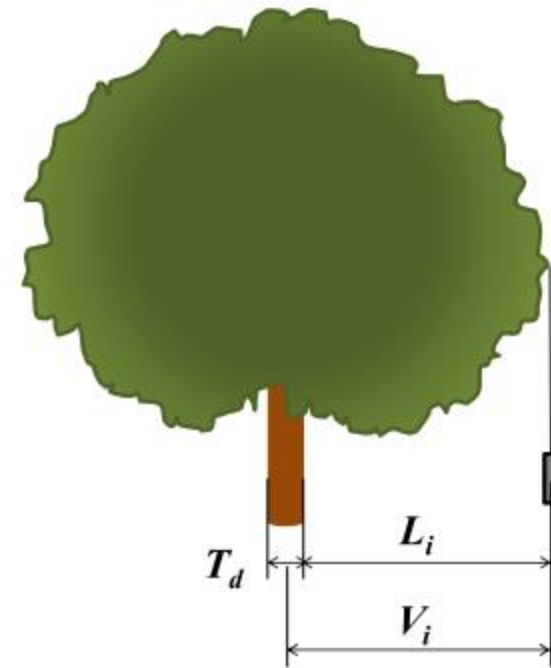
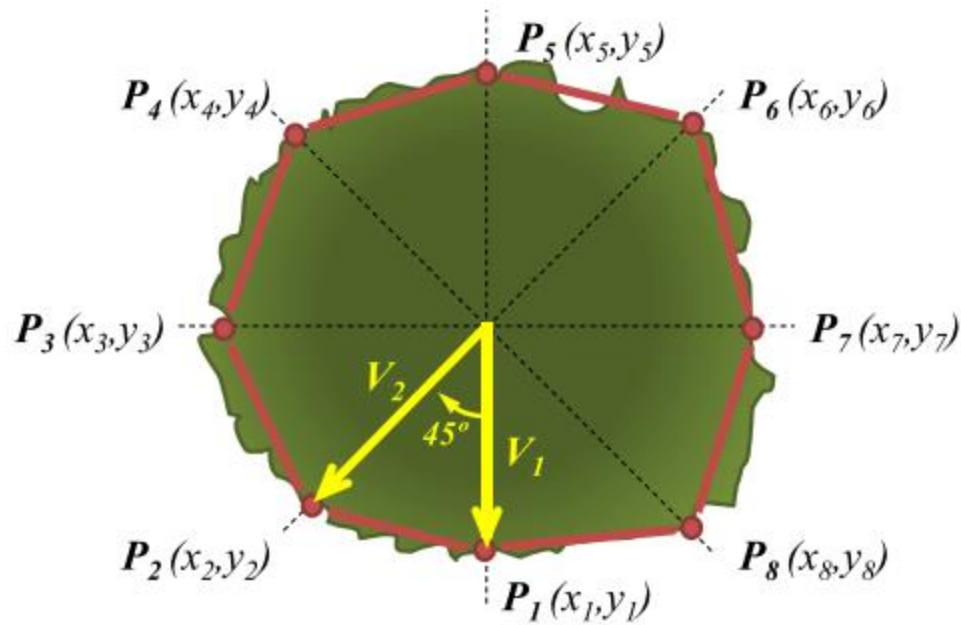
Volume measurement with LiDAR scanner



Towards an optimized method of olive tree crown volume measurement (Miranda-Fuentes et al., 2015)

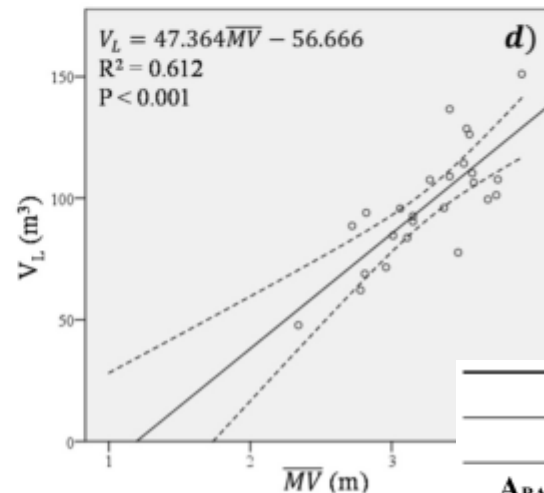
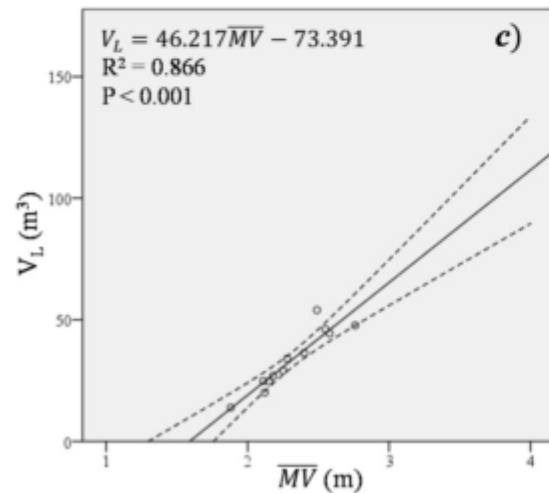
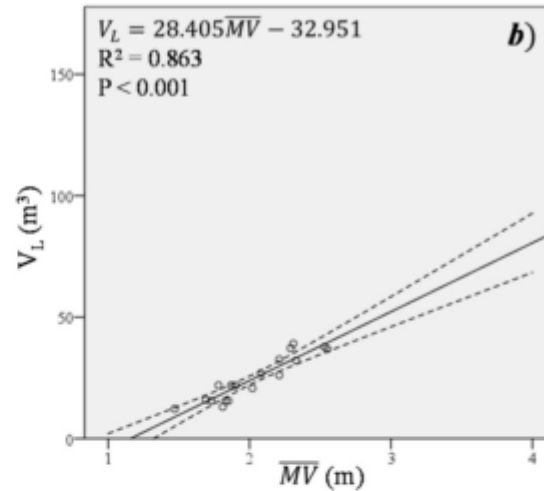
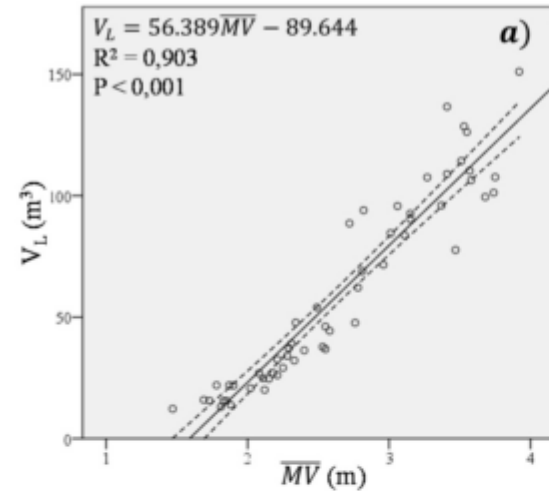
Olive volume assessment

Mean Vector * volume estimation method



* Miranda-Fuentes et al., 2015

Main characteristics of the olive orchards in Spain

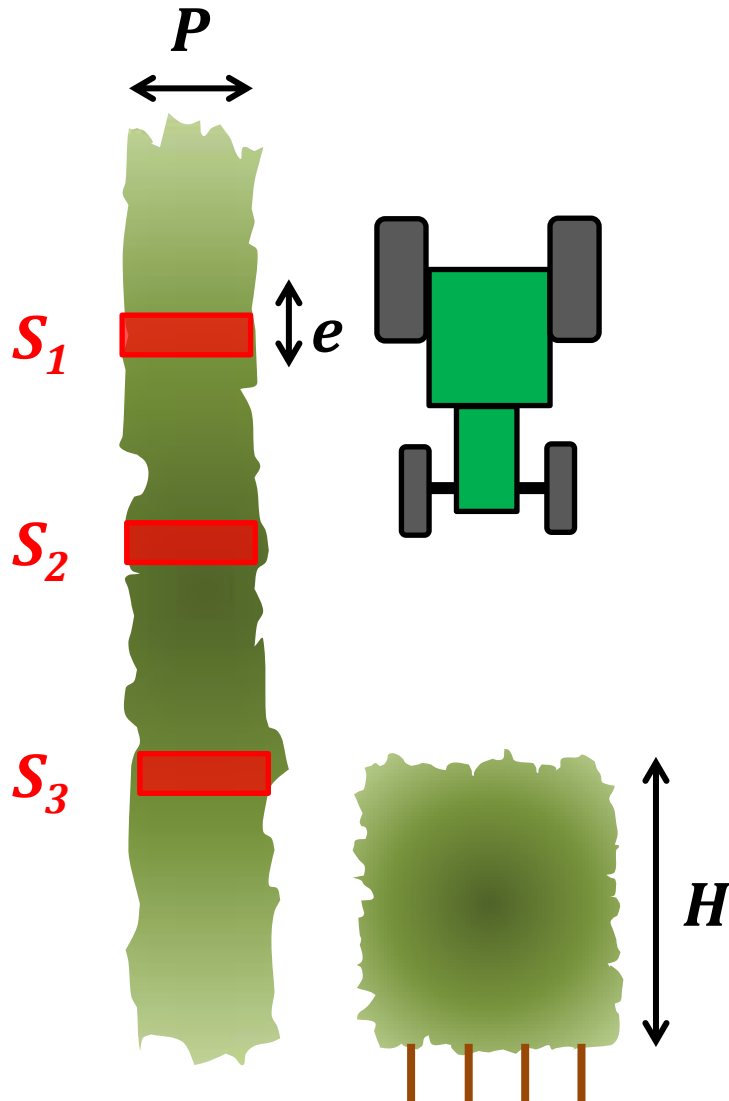


- a) All trees
- b) Intensive
- c) 1-trunk Traditional
- d) Traditional

	Intensive	Adapted Traditional	Traditional
	V_L (m ³)		
A_{PA} (m ²)	0.860 **	0.835 **	0.242 *
V_E (m ³)	0.755 **	0.760 **	0.399 **
V_{TS} (m ³)	0.792 **	0.903 **	0.275 **

* for $p < 0.05$ and ** for $p < 0.01$

Dosing systems



TRV

$$V_1 = H_1 \times P_1 \times e_1$$

$$V_2 = H_2 \times P_2 \times e_2$$

$$V_3 = H_3 \times P_3 \times e_3$$

LWA

$$A_1 = H_1 \times e_1$$

$$A_2 = H_2 \times e_2$$

$$A_3 = H_3 \times e_3$$

Superintensive orchard:

$$e_1 = e_2 = e_3$$

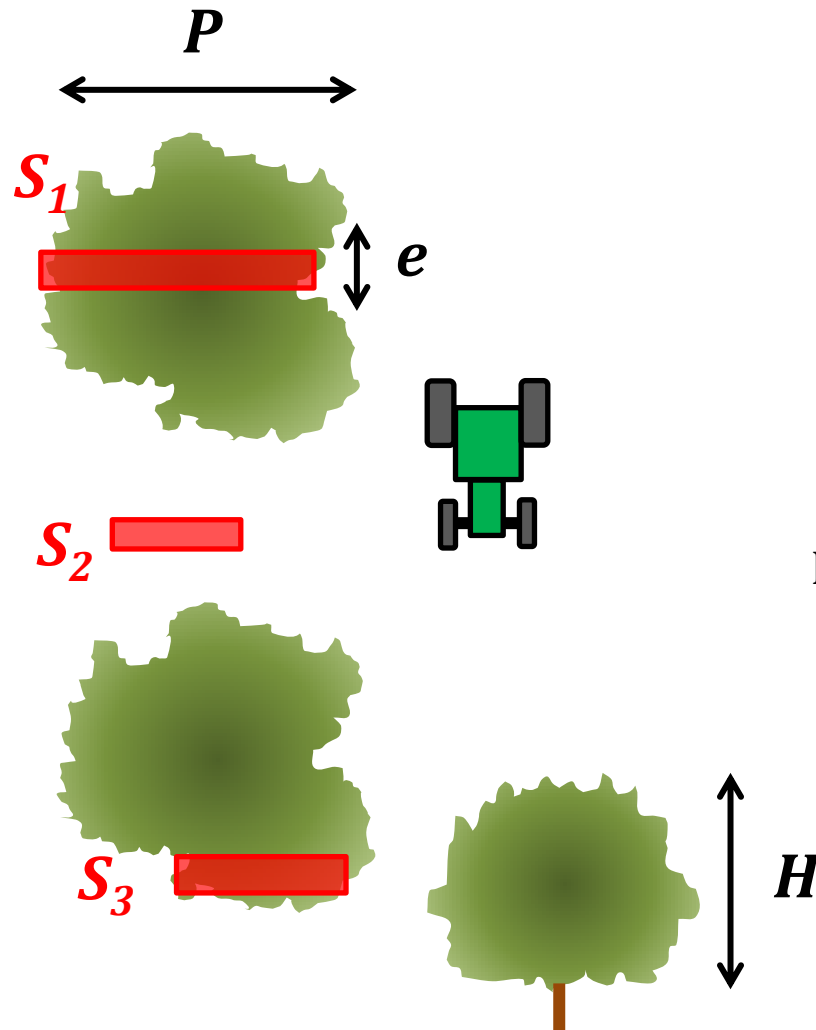
$$P_1 = P_2 = P_3$$

$$H_1 = H_2 = H_3$$



1 LWA unit equals 1 TRV unit

Dosing systems



TRV

$$V_1 = H_1 \times P_1 \times e_1$$

$$V_2 = H_2 \times P_2 \times e_2$$

$$V_3 = H_3 \times P_3 \times e_3$$

LWA

$$A_1 = H_1 \times e_1$$

$$A_2 = H_2 \times e_2$$

$$A_3 = H_3 \times e_3$$

Intensivo and traditional orchards:

$$e_1 = e_2 = e_3$$

$$P_1 \neq P_2 \neq P_3$$

$$H_1 \neq H_2 \neq H_3$$



1 LWA unit **does not** equal 1 TRV unit

Dosing systems: UCO proposal

$$SV = V_L \times C_V$$

SV = Sprayed water volume (L / tree)

V_L = Tree crown volume (m³ / tree)

C_L = Specific spray volume (L / m³)

$$V_L = m \times \overline{MV} + k$$

Intensive → m = 28.405 ; k = -32.951

1-trunk traditional → m = 46.217 ; k = -73.391

Traditional → m = 47.364 ; k = -56.666

$$C_L = 0.12 L \cdot m^{-3} *$$

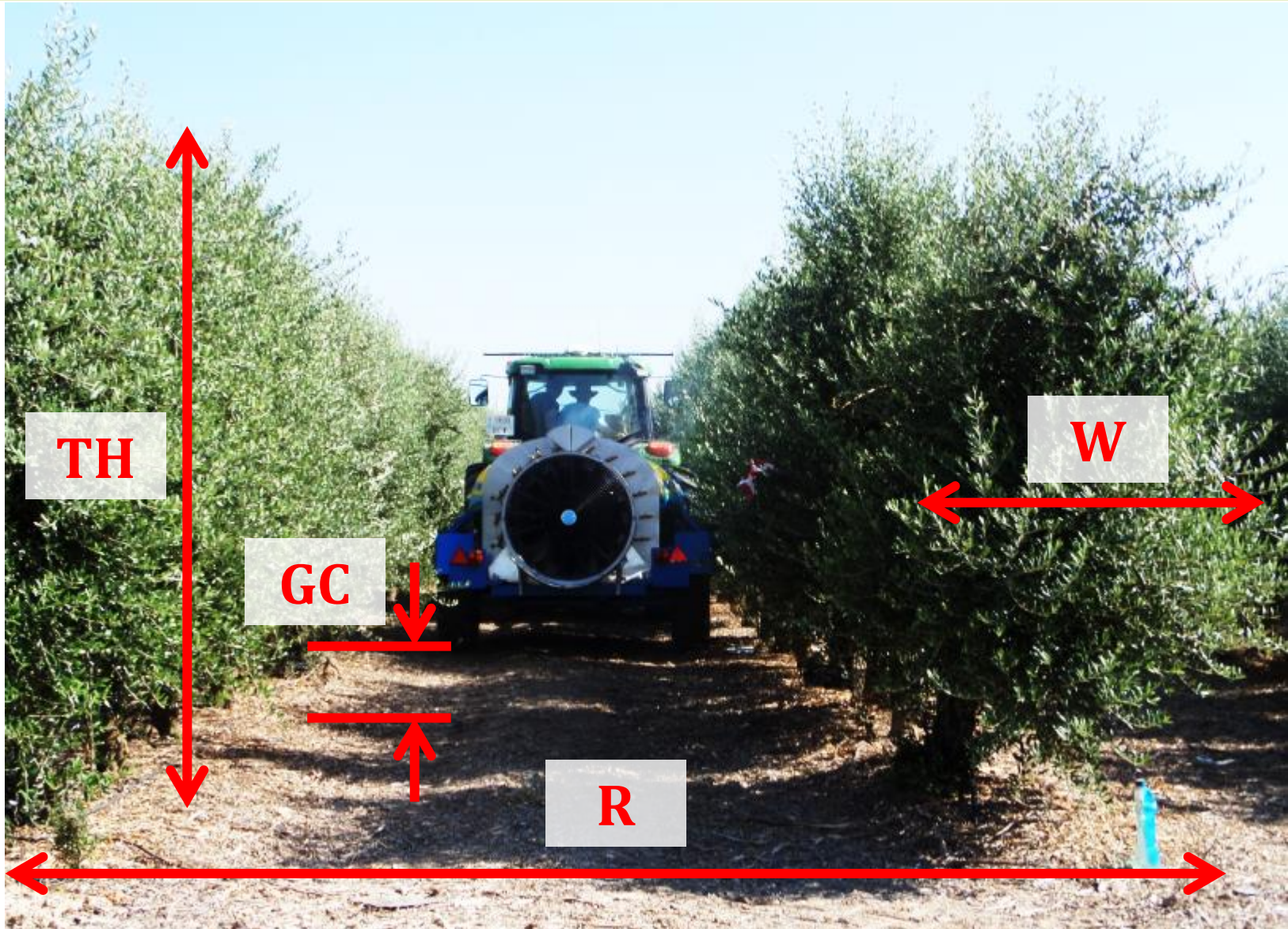
* Assessing the optimal spray volume rate on isolated olive trees according the canopy volume (Miranda-Fuentes et al., 2016, Aceptado para publicación en *Science of the Total Environment*).

Trial summary

- Introduction
- **Superintensive orchard**
- Intensive orchard
- Traditional orchard

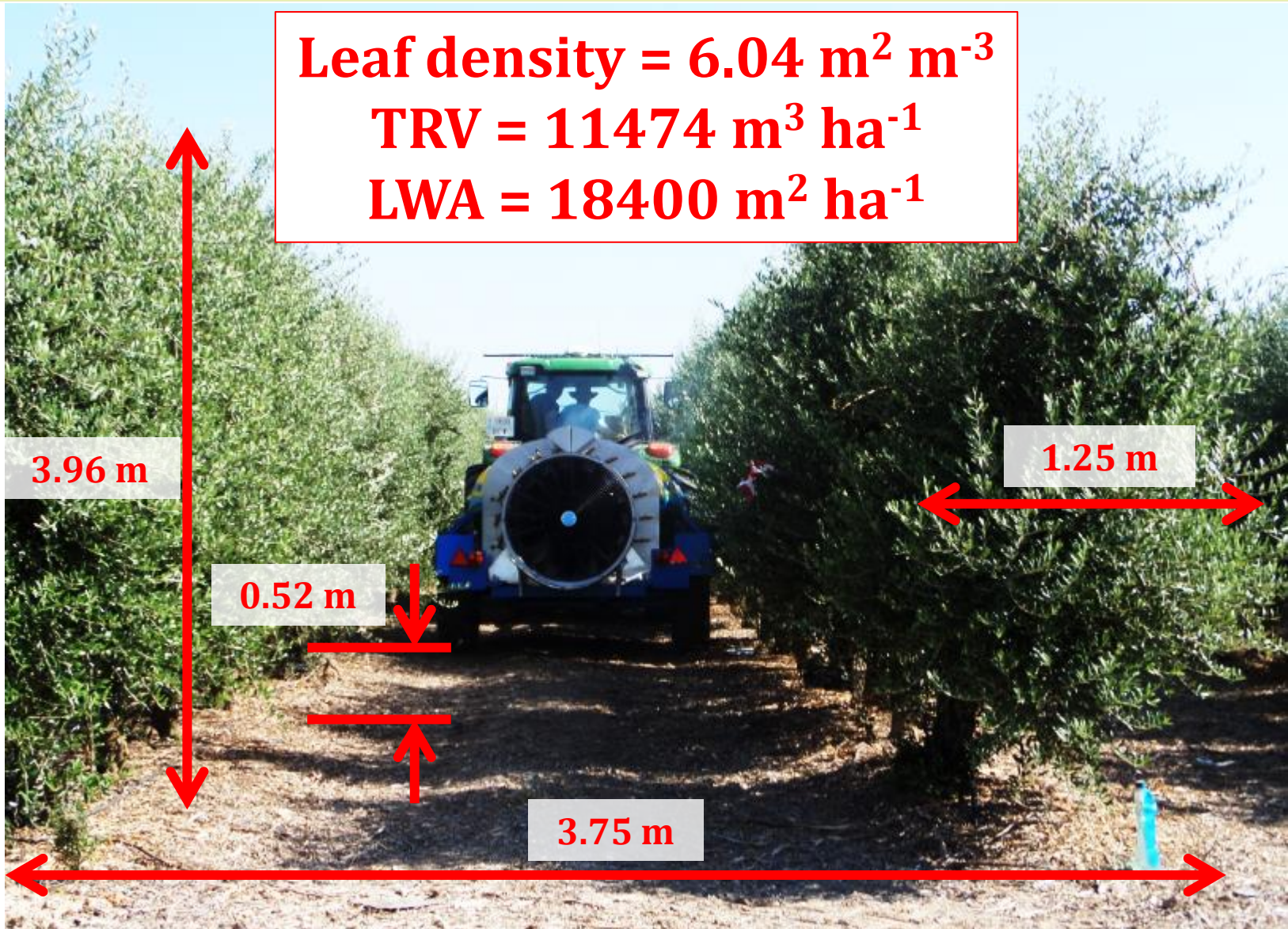


Superintensive orchard



Superintensive orchard

Leaf density = $6.04 \text{ m}^2 \text{ m}^{-3}$
TRV = $11474 \text{ m}^3 \text{ ha}^{-1}$
LWA = $18400 \text{ m}^2 \text{ ha}^{-1}$

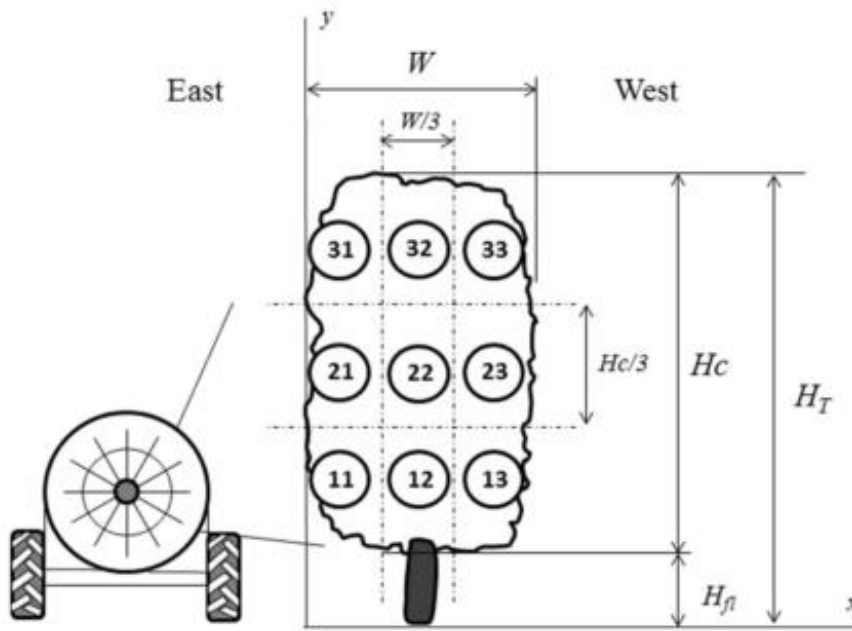


Superintensive orchard

- Spray mix: tracer (tartrazine) 8 g L^{-1}
- Sampling positions:



TRV = $11474 \text{ m}^3 \text{ ha}^{-1}$
LWA = $18400 \text{ m}^2 \text{ ha}^{-1}$



➔ **Spray deposit**



← **Percentage coverage**
Impacts · cm^{-2}

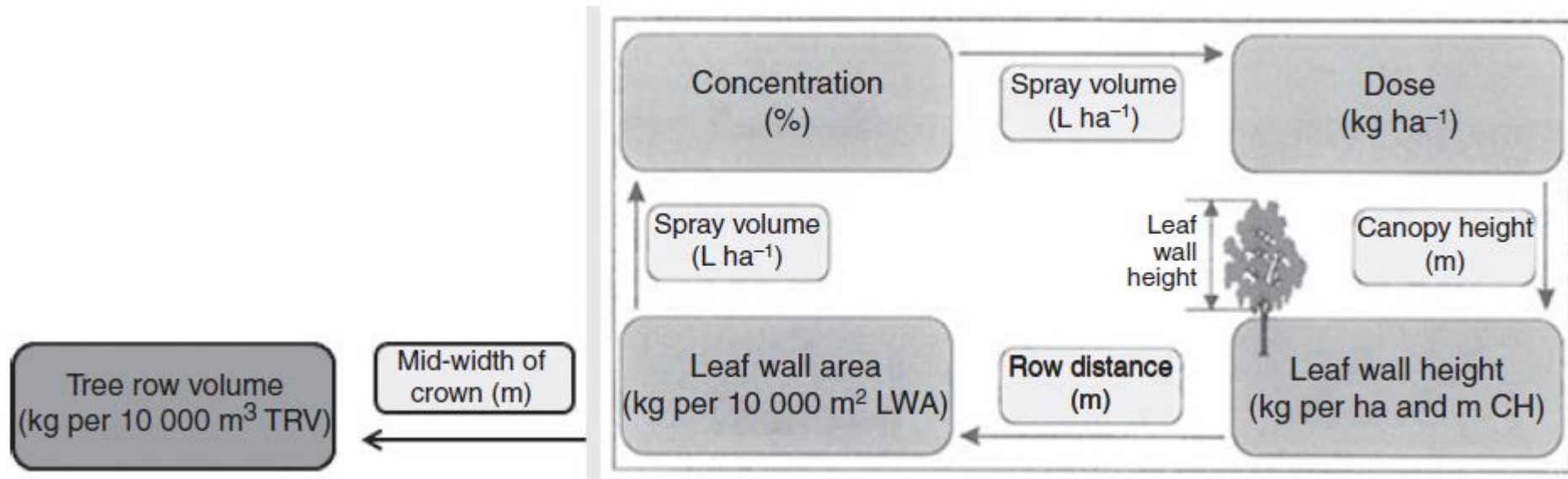
Superintensive orchard



TRV = 11474 m³ ha⁻¹
LWA = 18400 m² ha⁻¹

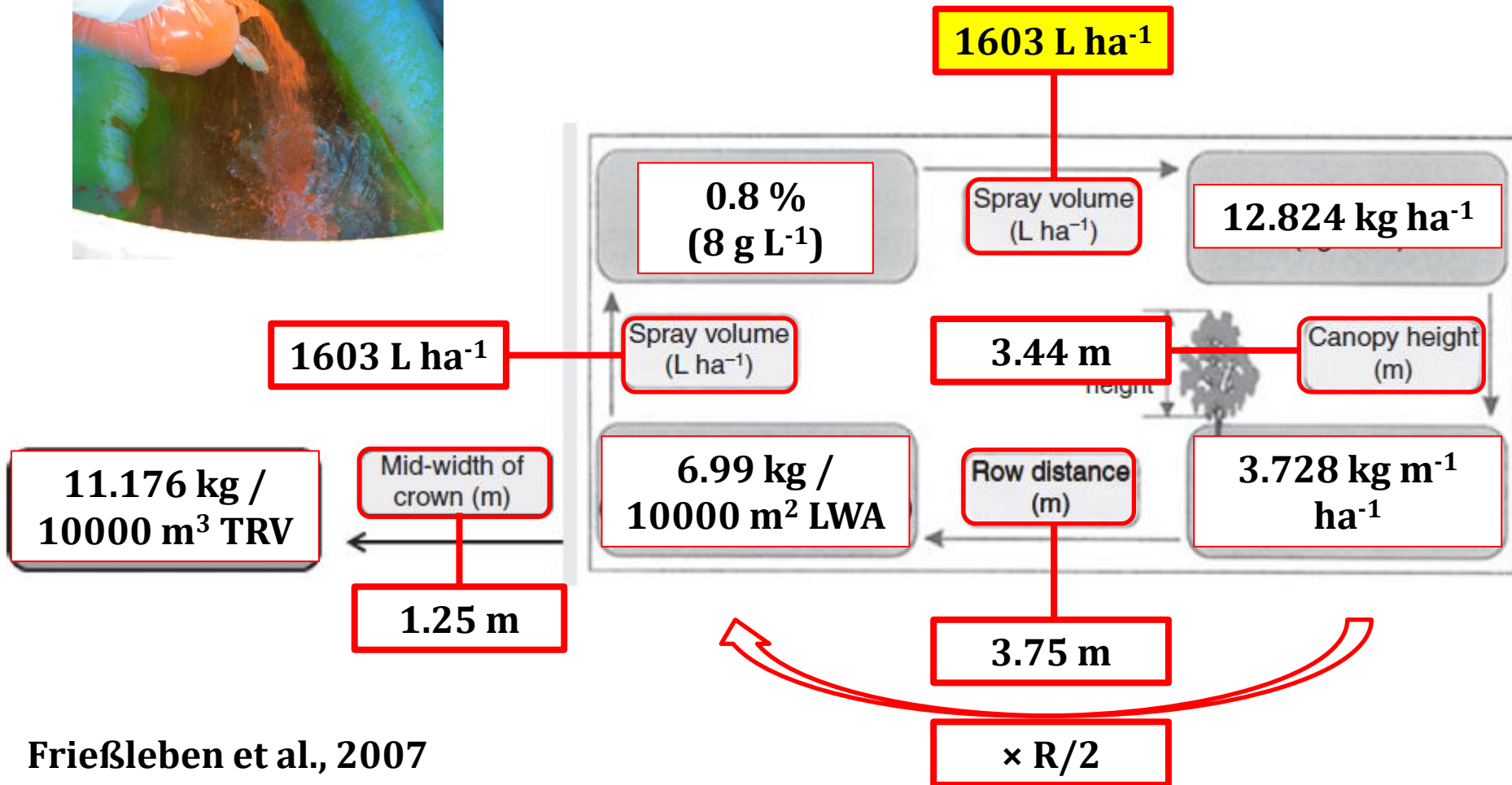
Spray volume (L ha⁻¹)	1603	619	182
TRV (m³ ha⁻¹)	11474	11474	11474
LWA (m² ha⁻¹)	18400	18400	18400
Volume TRV (L m⁻³)	0.14	0.05	0.02
Volume/10000 LWA (m³)	871.2	336.4	98.9
Mean deposition (μg cm⁻²)	5.08	2.98	1.74
Deposit CV (%)	54.0	39.8	36.4
Penetration inside canopy (%)	79.4	113.6	123.8
Mean leaf coverage (%)	33.25	19.42	6.60

Superintensive orchard



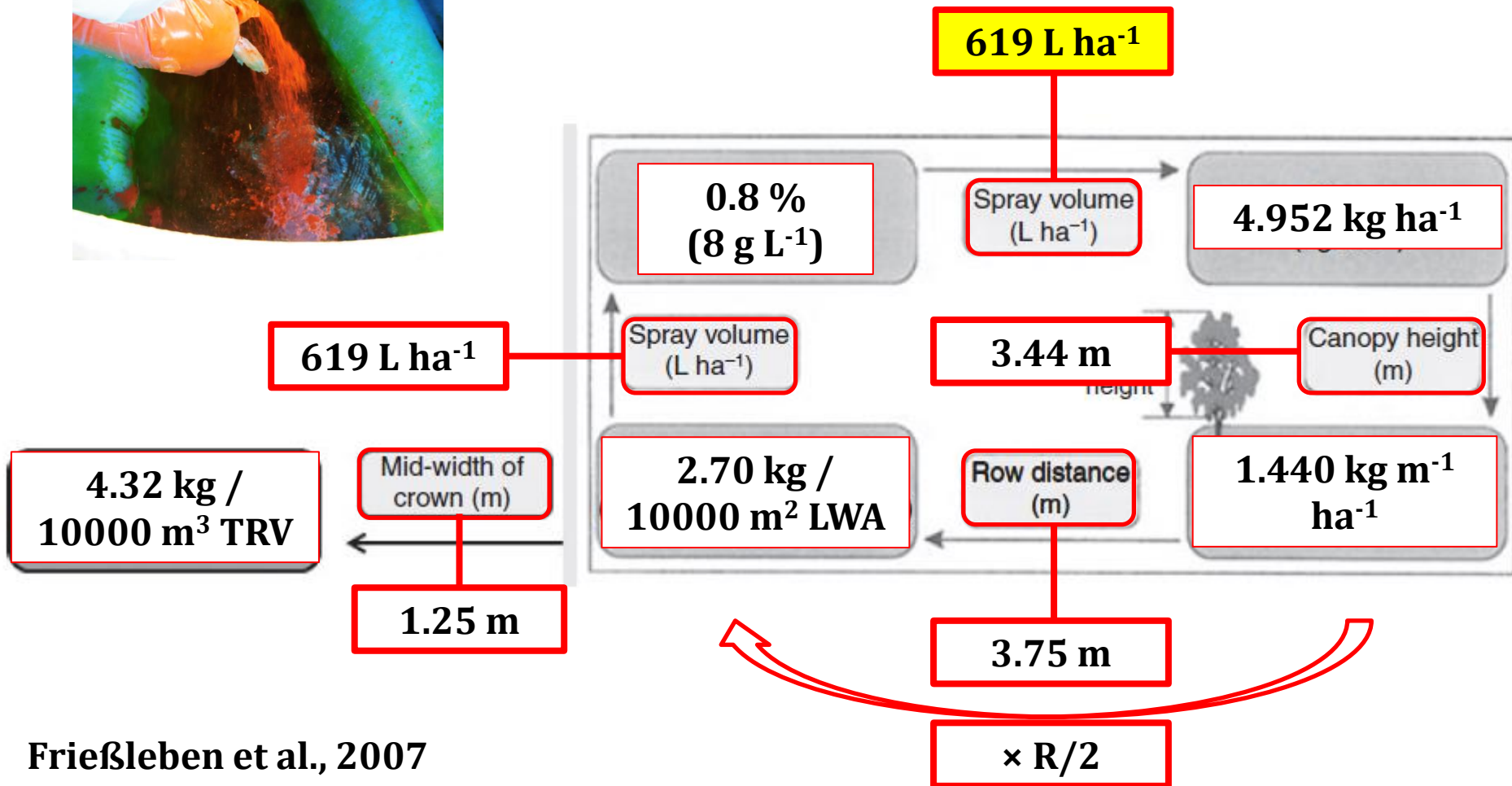
Superintensive orchard

Research trial
Ingredient: spray tracer



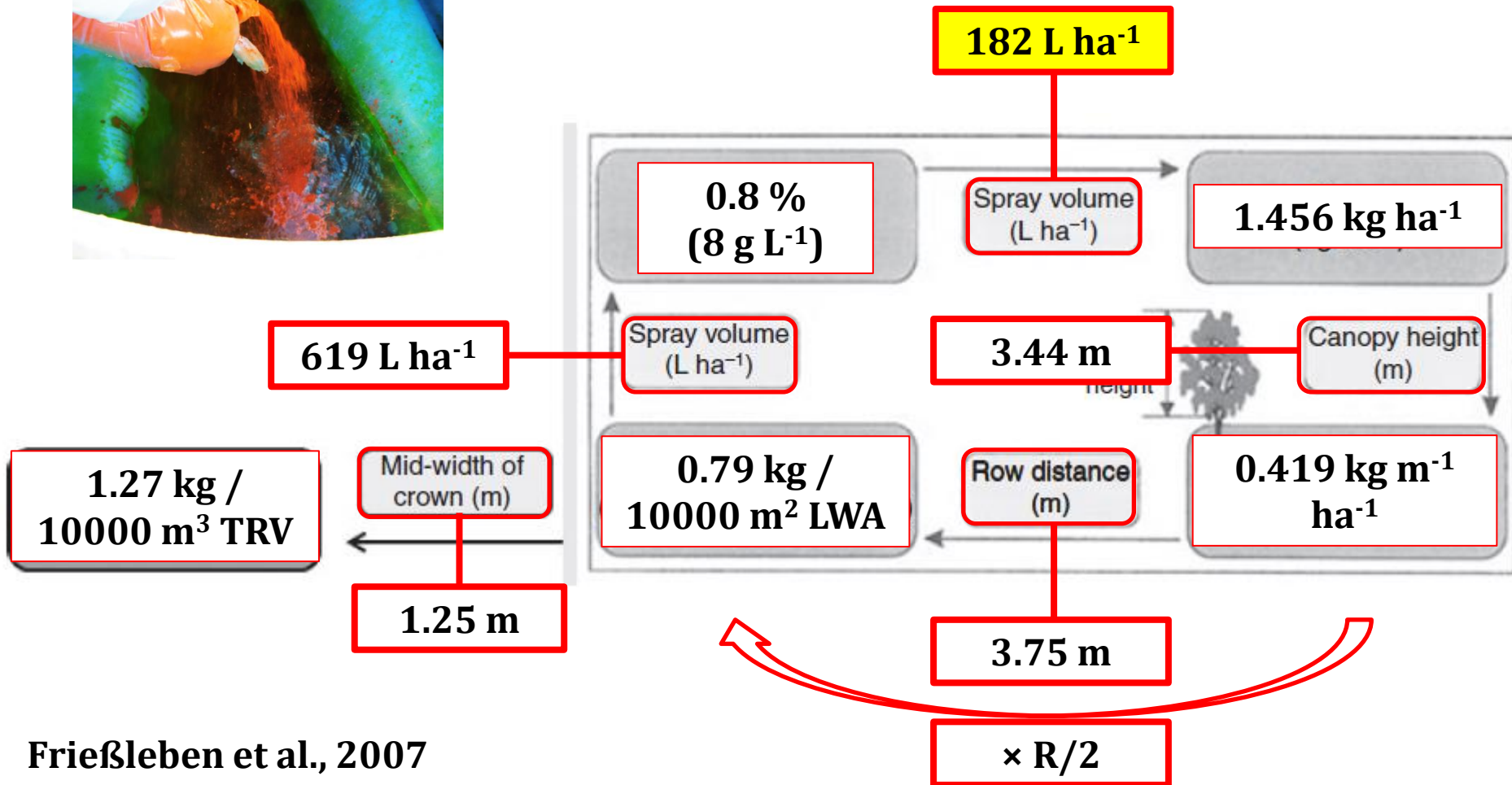
Superintensive orchard

Research trial
Ingredient: spray tracer



Superintensive orchard

Research trial
Ingredient: spray tracer

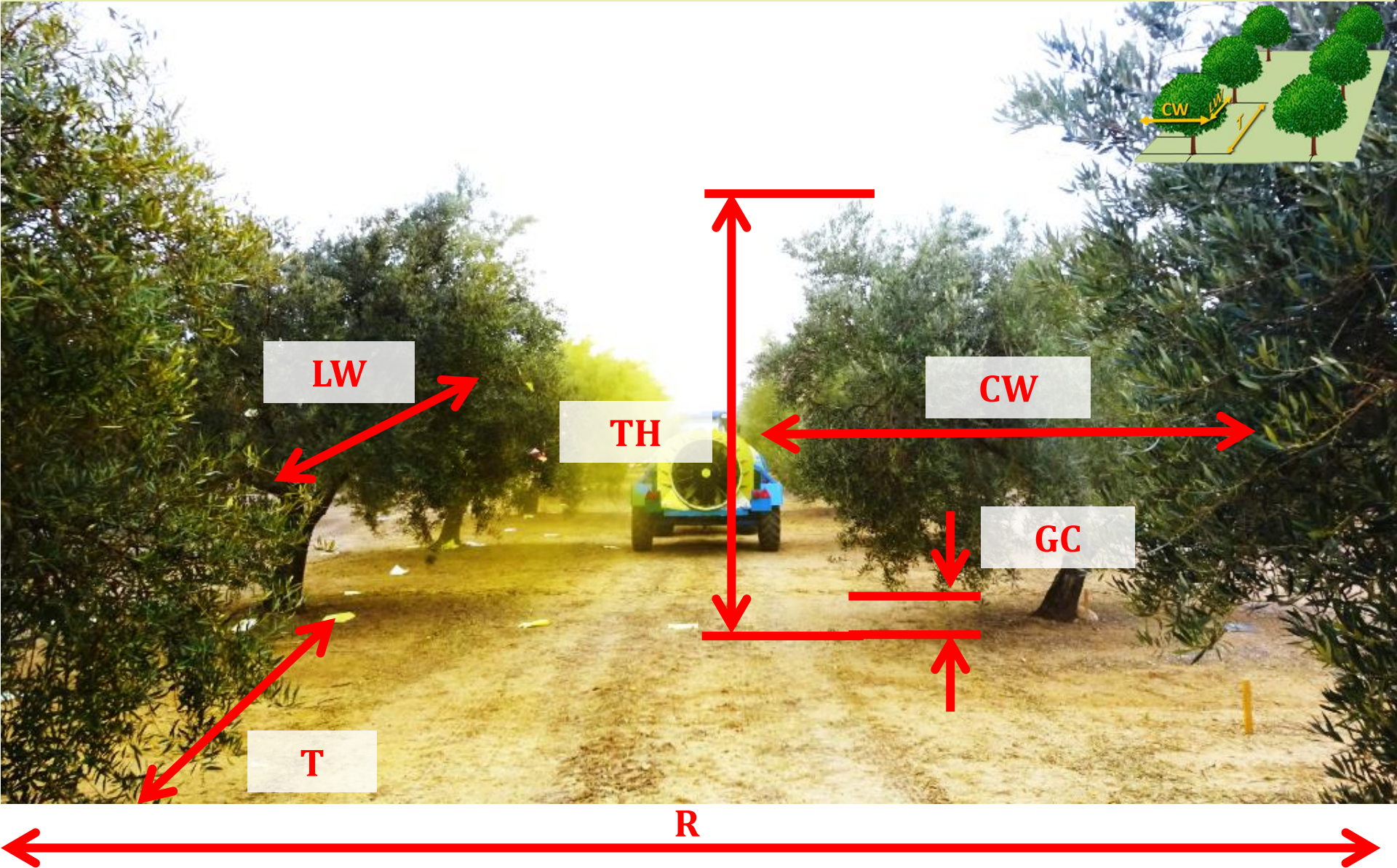


Trial summary

- Introduction
- Superintensive orchard
- **Intensive orchard**
- Traditional orchard

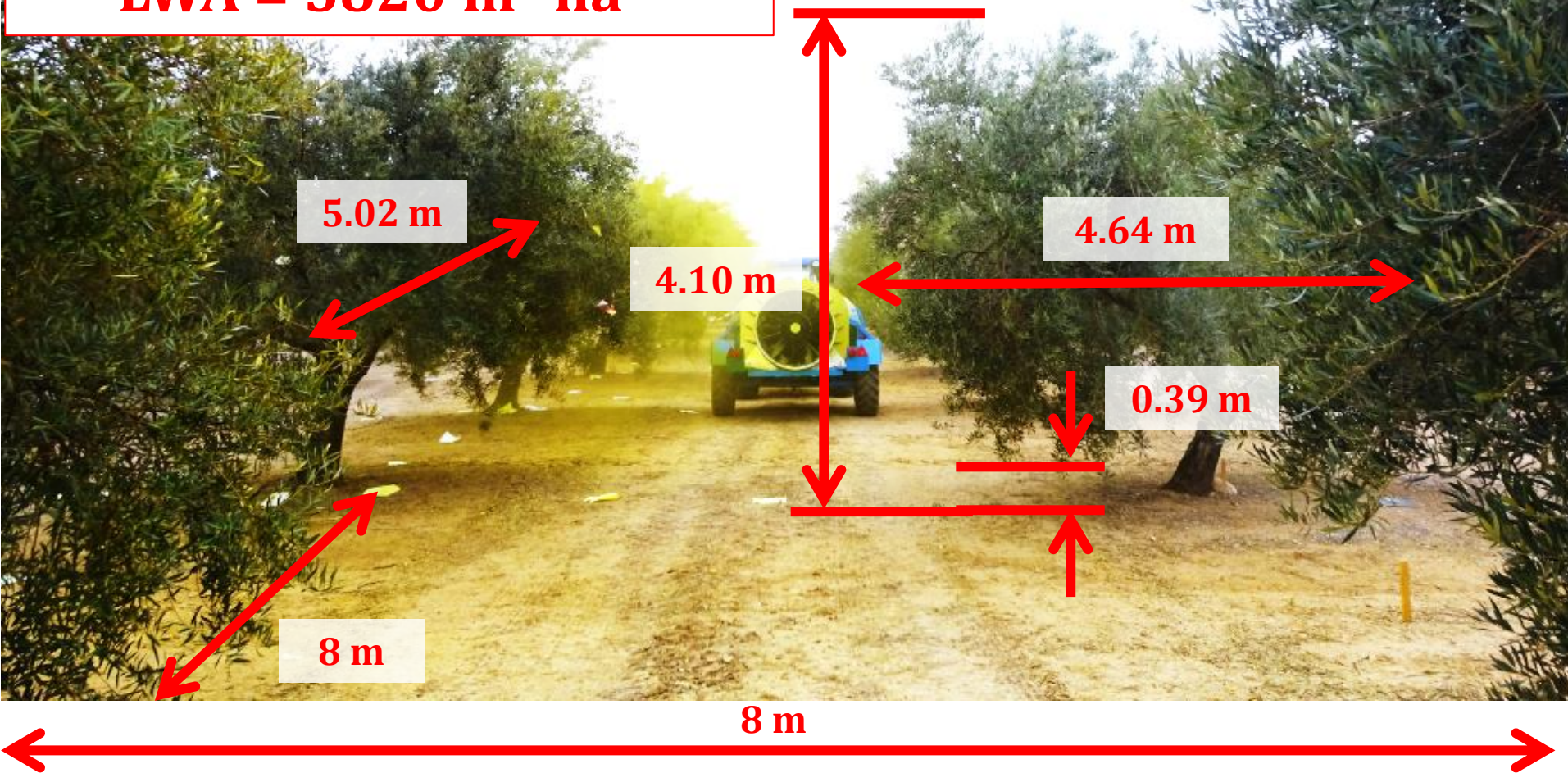
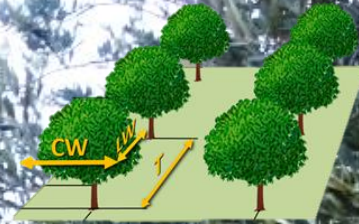


Intensive orchard



Intensive orchard

Leaf density = $3.69 \text{ m}^2 \text{ m}^{-3}$
TRV = $13503 \text{ m}^3 \text{ ha}^{-1}$
LWA = $5820 \text{ m}^2 \text{ ha}^{-1}$



Intensive orchard

DOSE-ISO

Select CROP

Select GROWTH STAGE

ENTER data rearding crop structure:

TREE HEIGHT (total) - TH [m]

GROUND-to-CANOPY distance - GC [m]

ROW spacing - R [m]

TREE spacing - T [m]

Crosswise Mid-WIDTH of CANOPY - CW [m]

Lengthwise Mid-WIDTH of CANOPY - LW [m]

$$LWA = \frac{2 * (TH-GC) * LW * 10000}{R * T}$$

$$TRV = \frac{(TH-GC) * CW * LW * 10000}{R * T}$$

RESET

ENTER data regarding PPP application:

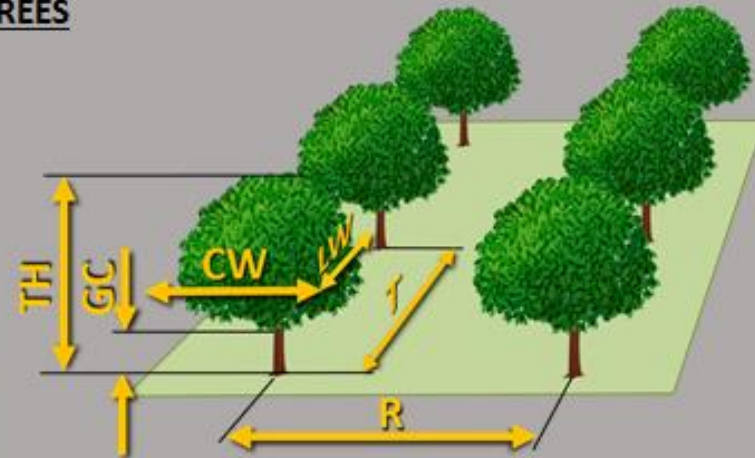
Area to be sprayed - P [ha]

Spray volume - Q [l/ha]

Sprayer tank capacity - V [l]

RESET

ISOLATED TREES



CH - Canopy Height [m]	3,71
------------------------	------

LWA - Leaf Wall Area [m ² /ha]	5.820,06
---	----------

TRV - Tree Row Volume [m ³ /ha]	13.502,55
--	-----------

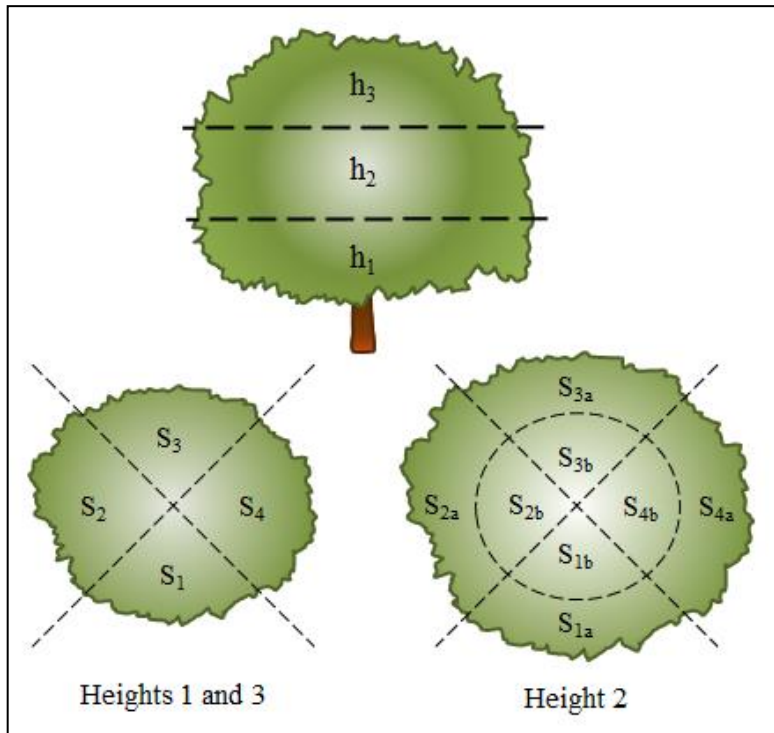
Dose calculator

CANOPY FACTOR - CF *

Correct dose by CANOPY FACTOR

Intensive orchard

- Spray mix: tracer (tartrazine) 8 g L⁻¹
- Sampling positions:



TRV = 11474 m³ ha⁻¹
LWA = 18400 m² ha⁻¹



➔ **Spray deposit**



Percentage coverage
Impacts · cm⁻² ←

Intensive orchard

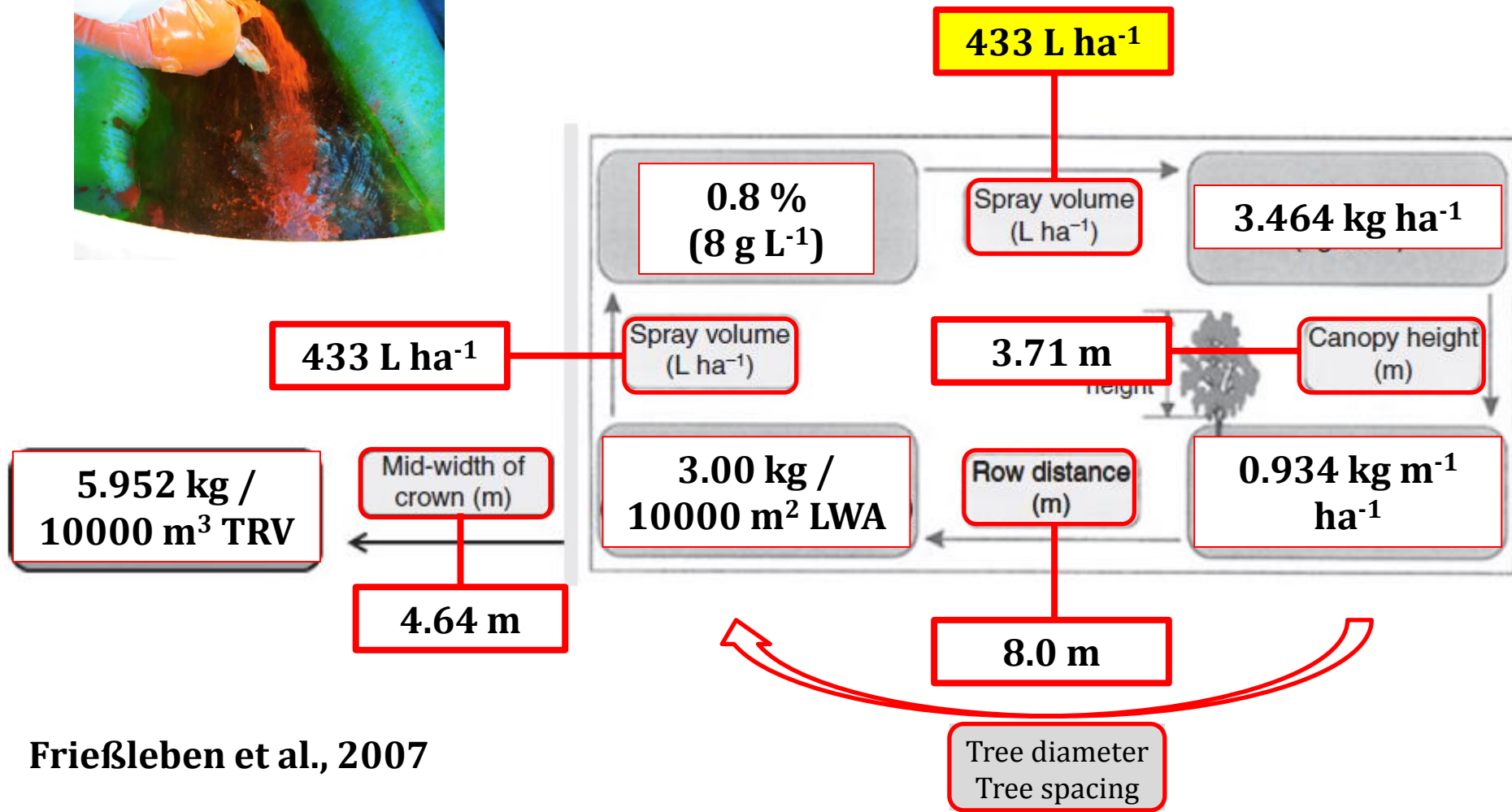
Specific applied volume* (L m ⁻³)	0.08	0.10	0.12
Spray volume (L ha ⁻¹)	433	541	650
TRV**	5820	5820	5820
LWA**	11503	11503	11503
Volume TRV (L m ⁻³)	0.074	0.093	0.112
Volume/10000 LWA	376.5	470.3	565.2
Mean deposition (μg cm ⁻²)	12.04	15.49	20.51
Deposit CV (%)	72.0	71.2	61.7
Penetration inside canopy (%)	64.4	60.3	69.2
Mean leaf coverage (%)	16.1	17.5	25.7

* Applied to the crown volume estimated by the Mean Vector method (Miranda-Fuentes et al., 2015)

** Calculated with the calculator for isolated trees (Doruchowski, 2016).

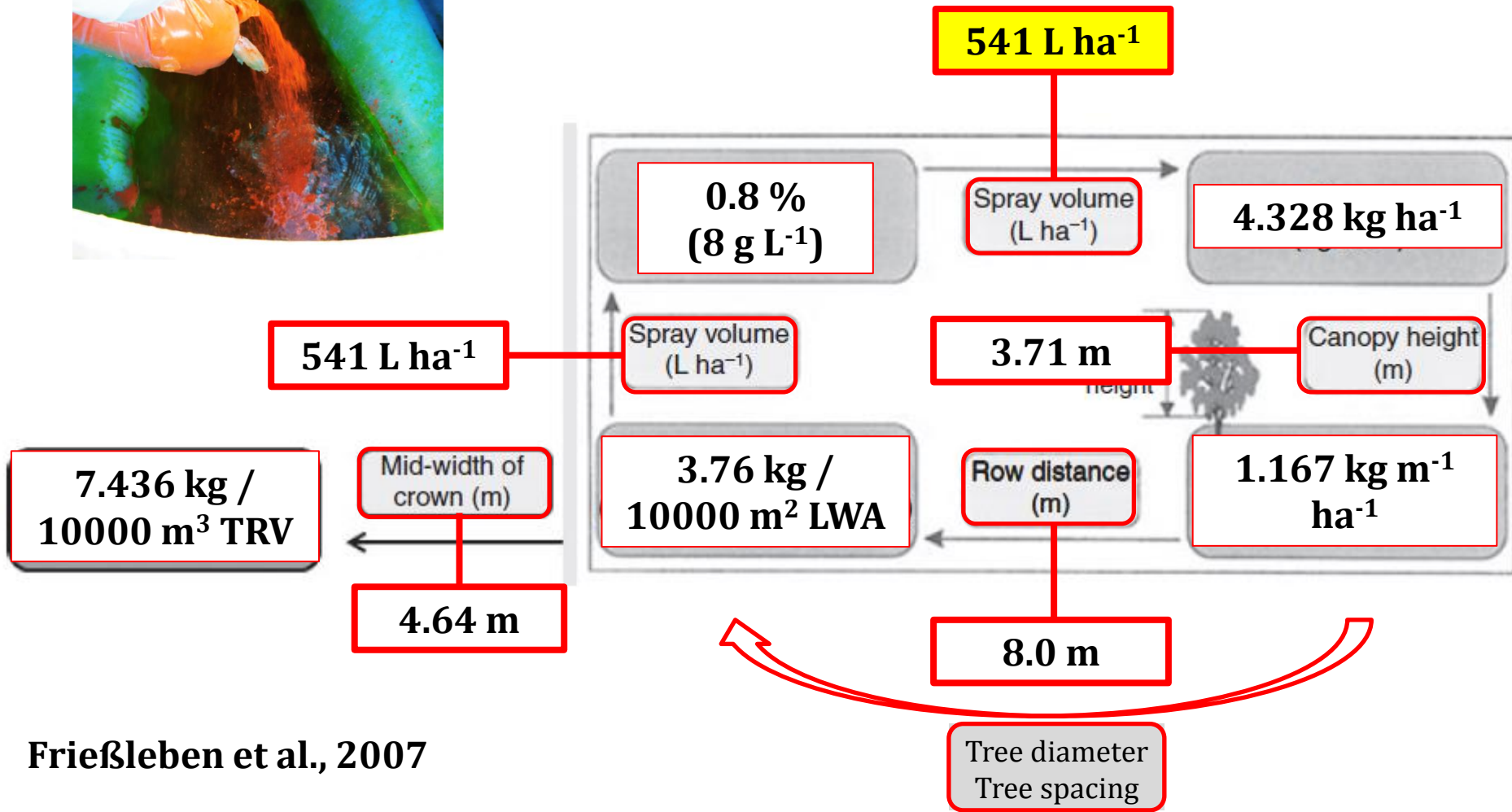
Intensive orchard

Research trial
Ingredient: spray tracer



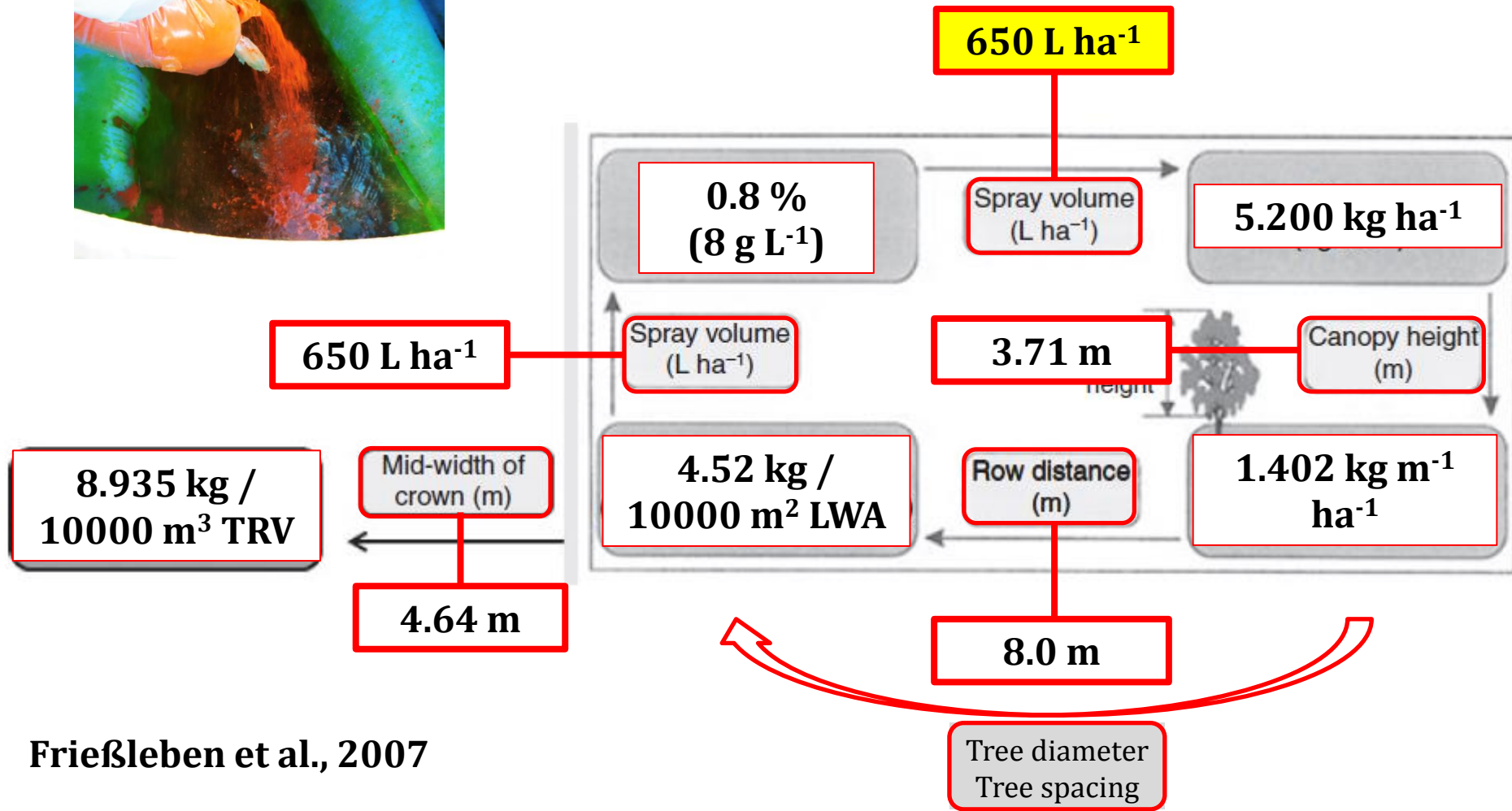
Intensive orchard

Research trial
Ingredient: spray tracer



Intensive orchard

Research trial
Ingredient: spray tracer



Intensive orchard

Efficacy trial against **olive leafspot** (*Cycloconium oleagina* L.)

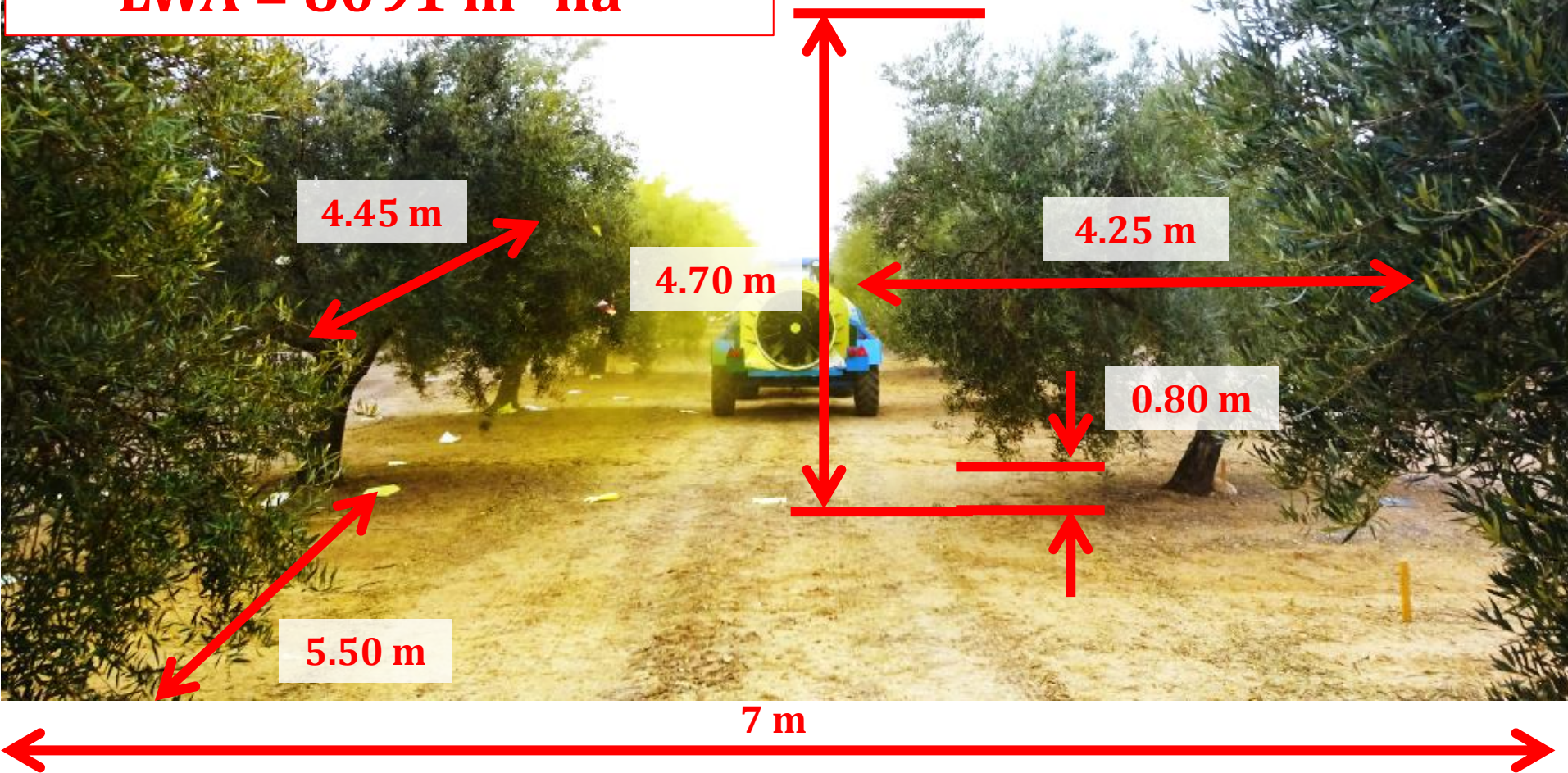
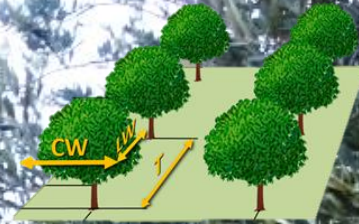
(Data provided by Patricia Chueca, IVIA).

- Testing the minimum effective dose of a certain product against two reference products (Control 1 and Control 2).
- 5 applied doses given by 5 different concentrations: 0.8, 1.5, 2.0, 2.75 and 6.0 L/hl.
- Control products were applied at 2.0 L/hl.
- A total of 6 efficacy evaluations were done.
- Abbott's efficacy parameter was determined.



Intensive orchard

Leaf density = n.a.
TRV = 17193 m³ ha⁻¹
LWA = 8091 m² ha⁻¹



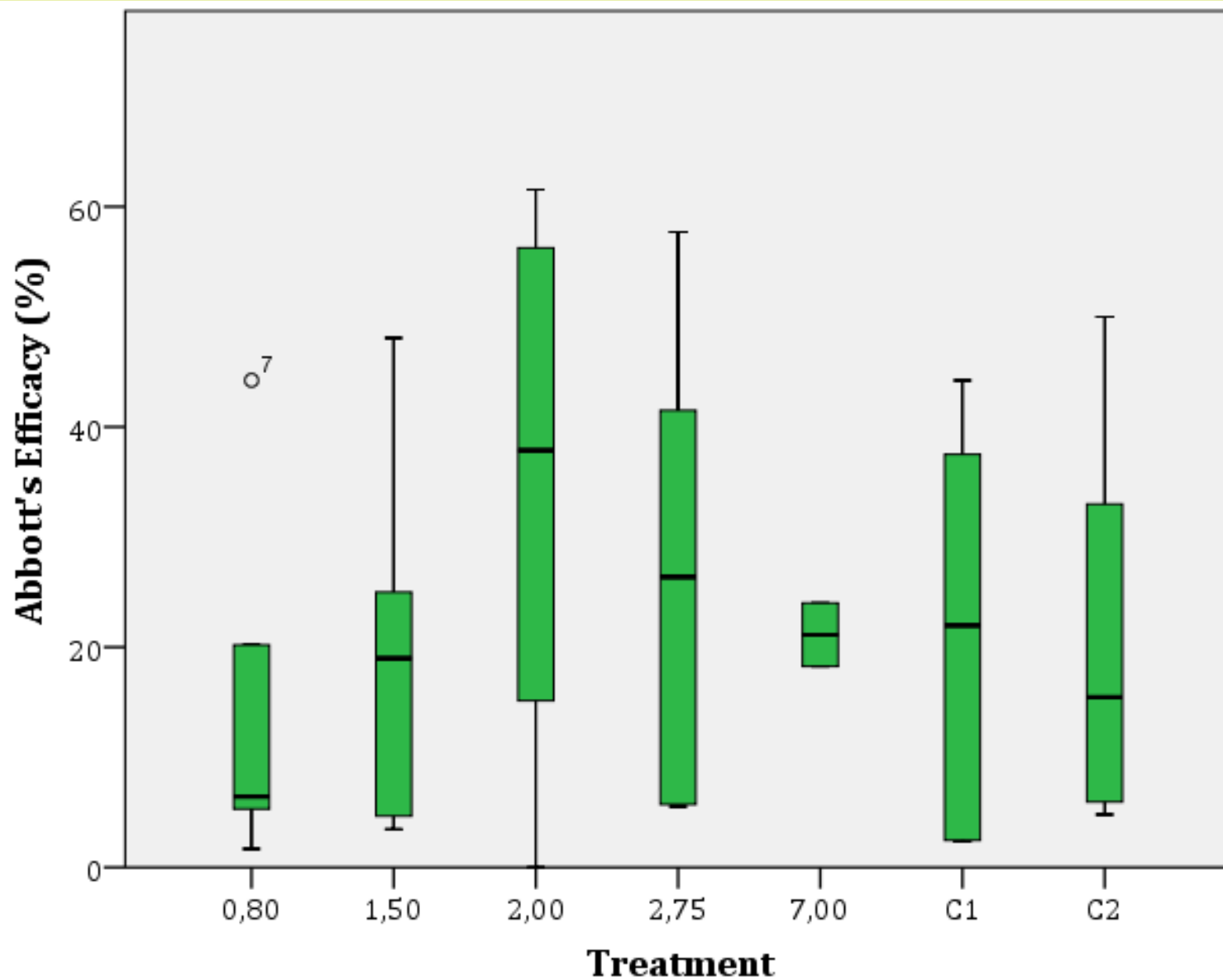
Intensive orchard

Efficacy trial
Ingredient: copper salt



Product	Ground applied dose	L per height unit and ha	L per 10000 m ² LWA	L per 10000 m ³ TRV
	(L ha ⁻¹)	(L m ⁻¹ ha ⁻¹)	(L)	(L)
test	0,80	0,23	0,99	0,47
test	1,50	0,43	1,85	0,87
test	2,00	0,57	2,47	1,16
test	2,75	0,79	3,40	1,60
test	6,00	1,71	7,42	3,49
Control 1	2,00	0,57	2,47	1,16
Control 2	2,00	0,57	2,47	1,16

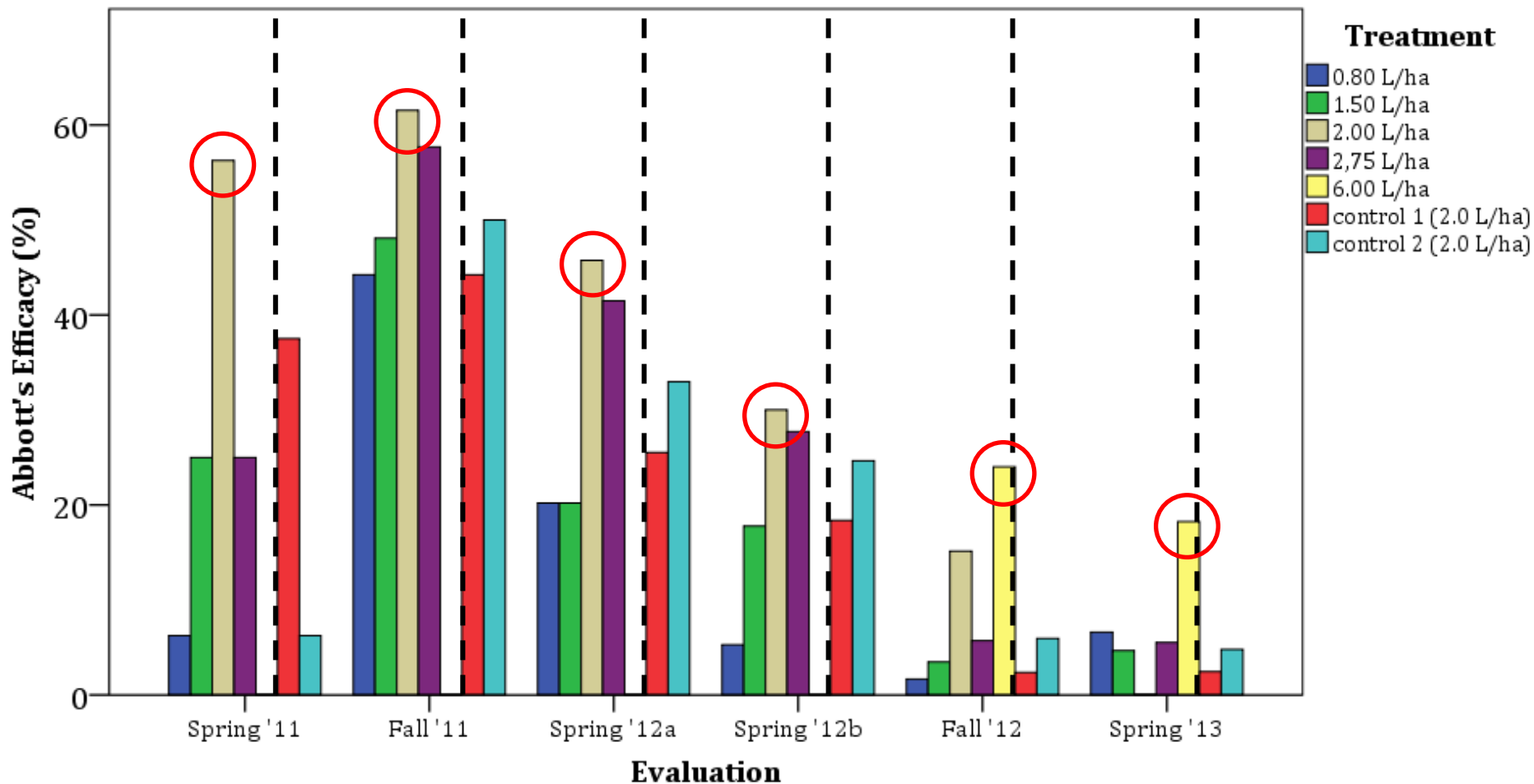
Intensive orchard



Intensive orchard



UNIVERSIDAD DE CORDOBA

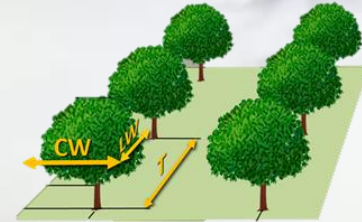


Trial summary

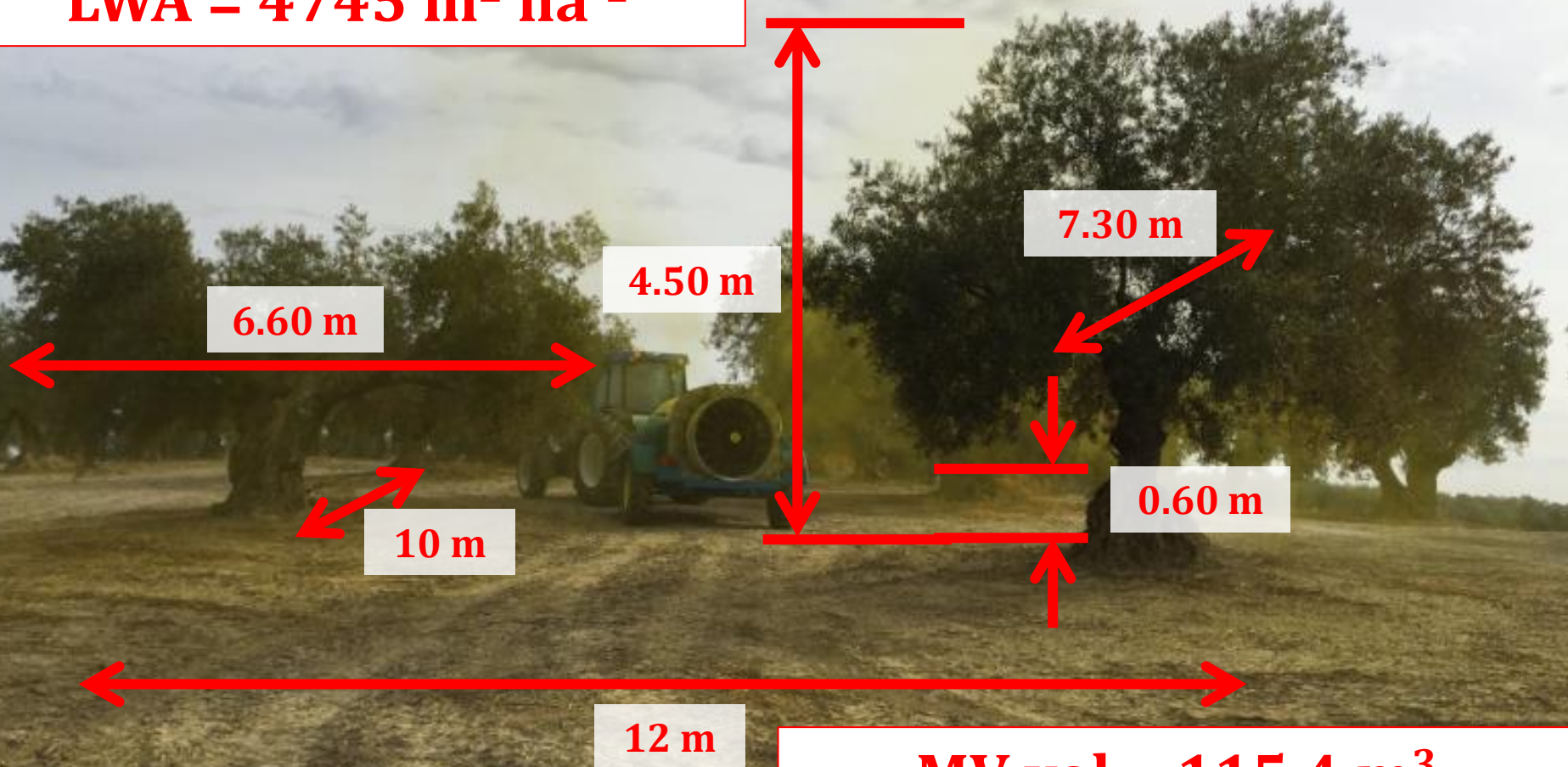
- Introduction
- Superintensive orchard
- Intensive orchard
- **Traditional orchard**



Traditional orchard



Leaf density = $3.69 \text{ m}^2 \text{ m}^{-3}$
TRV = $15659 \text{ m}^3 \text{ ha}^{-1}$
LWA = $4745 \text{ m}^2 \text{ ha}^{-1}$



MV vol = 115.4 m^3

Traditional orchard

DOSE-ISO

Select CROP

Select GROWTH STAGE

ENTER data rearding crop structure:

TREE HEIGHT (total) - TH [m]

GROUND-to-CANOPY distance - GC [m]

ROW spacing - R [m]

TREE spacing - T [m]

Crosswise Mid-WIDTH of CANOPY - CW [m]

Lengthwise Mid-WIDTH of CANOPY - LW [m]

$$LWA = \frac{2 * (TH-GC) * LW * 10000}{R * T}$$

$$TRV = \frac{(TH-GC) * CW * LW * 10000}{R * T}$$

RESET

ENTER data regarding PPP application:

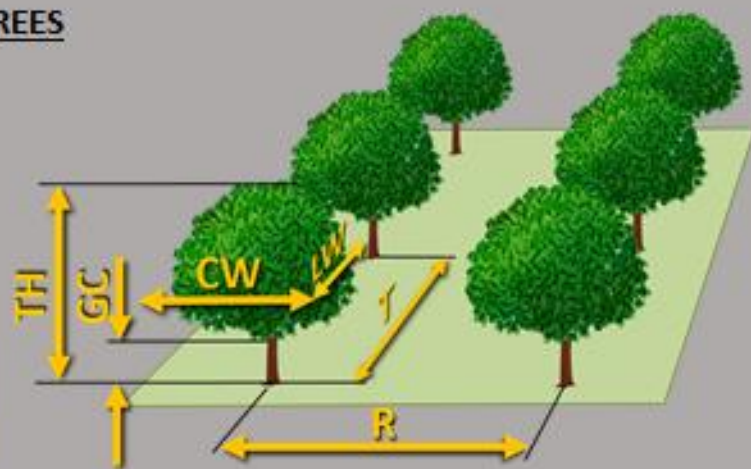
Area to be sprayed - P [ha]

Spray volume - Q [l/ha]

Sprayer tank capacity - V [l]

RESET

ISOLATED TREES



Dose calculator

CANOPY FACTOR - CF*

Correct dose by CANOPY FACTOR

CH - Canopy Height [m]	LWA - Leaf Wall Area [m ² /ha]	TRV - Tree Row Volume [m ³ /ha]
3,90	4.745,00	15.658,50

Traditional orchard

Specific applied volume (L m⁻³)	0.12
Spray volume (L ha⁻¹)	1045
TRV*	15659
LWA*	4745
Volume TRV (L m⁻³)	0.067
Volume/10000 LWA	2202.3
Mean deposition (μg cm⁻²)	16.25
Deposit CV (%)	81.9
Penetration inside canopy (%)	58.3
Mean leaf coverage (%)	21.3

LWA comparison between systems

Cultivation system	Traditional	Intensive
Specific applied volume (L m ⁻³)	0.12	0.12
Spray volume (L ha ⁻¹)	1045	650
TRV*	15659	5820
LWA*	4745	11503
Volume TRV (L m ⁻³)	0.067	0.112
Volume/10000 LWA	2202.3	565.2
Mean deposition (μg cm ⁻²)	16.25	20.51
Deposit CV (%)	81.9	61.7
Penetration inside canopy (%)	58.3	69.2
Mean leaf coverage (%)	21.3	25.7



Workshop on harmonized dose expression for the zonal evaluation of
plant protection products in high growing crops

Olive research trials



Antonio Miranda Fuentes
Universidad de Córdoba
antonio.miranda@uco.es



Vienna, 19 October 2016