Dose adjustment in citrus and olive orchards: two-year validation of the DOSA3D system

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SuproFruit 2019

East Malling, 17 July 2019

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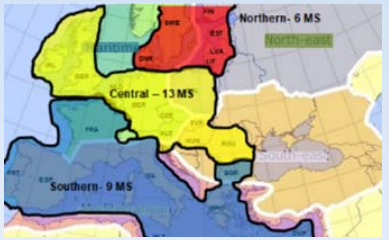
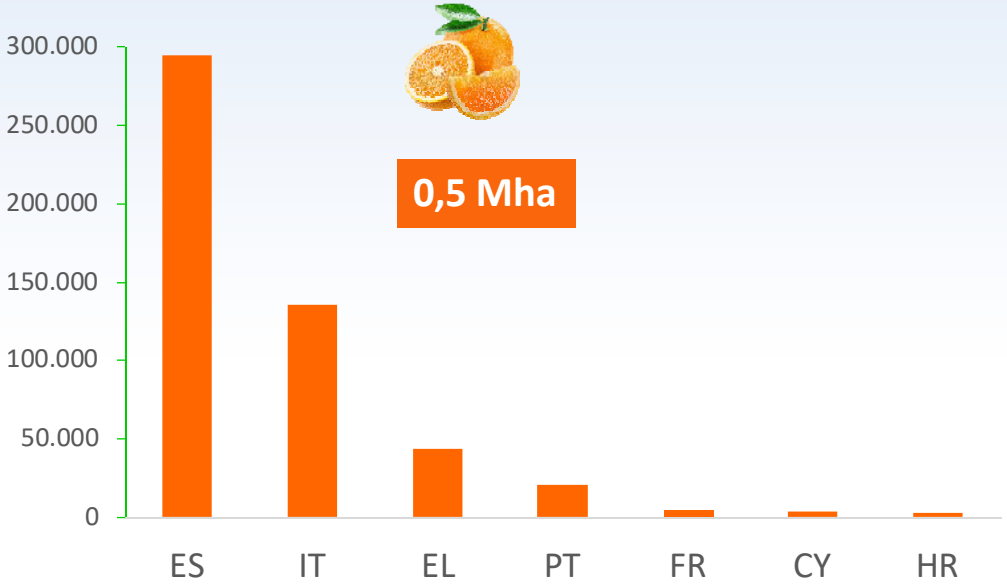
IRTA

DOSA3D

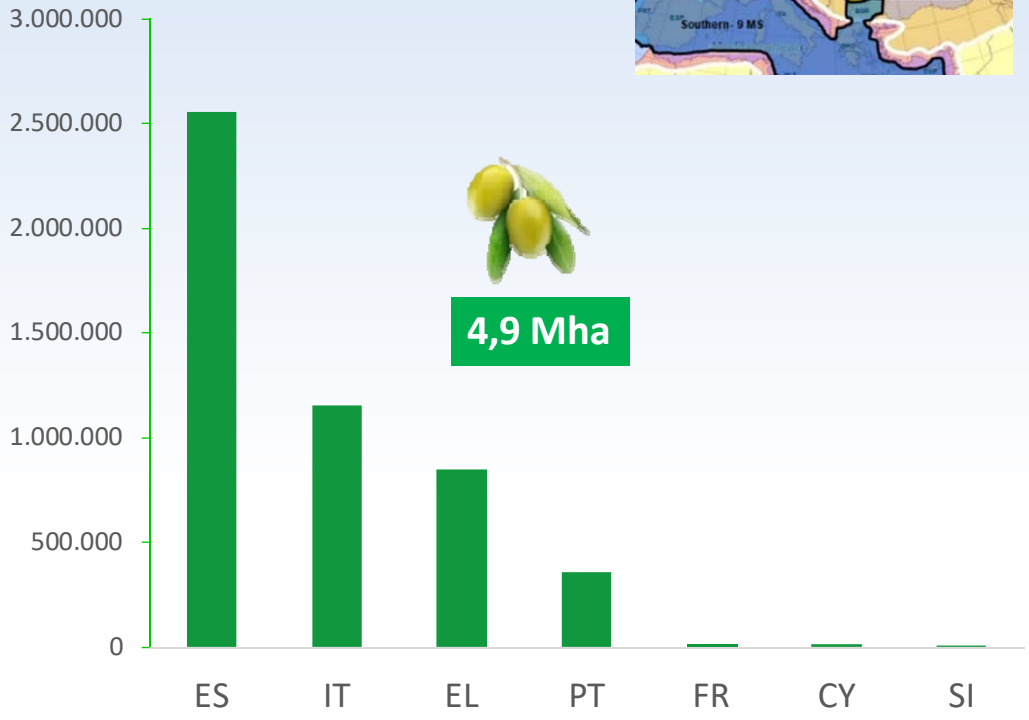
2018 – Citrus and olive production area for EU Member States (ha)

SZ 100%





0,5 Mha



4,9 Mha

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Last update	30.10.18
Extracted on	04.11.18
Source of data	Eurostat

DOSA3D

(2010)

- **Deciduous trees (near constant canopy volume, increasing leafiness)**

(2015)

EUCLID

- **Vine & Vegetables (increasing canopy volume and leafiness)**

(2017)

IRTA

- **Evergreen trees (near constant canopy volume and leafiness)**

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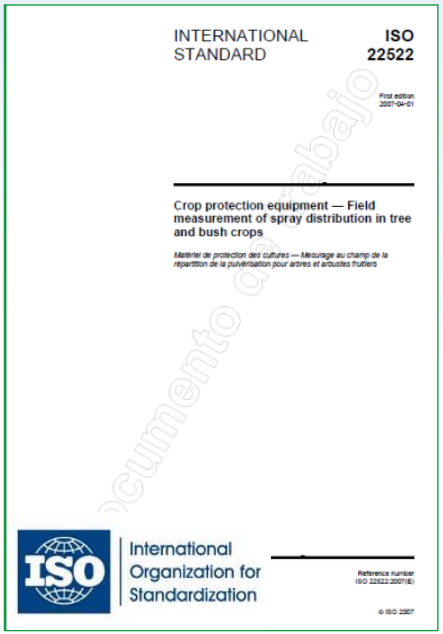
Alcanar (1992)

Santa Bàrbara (2003)



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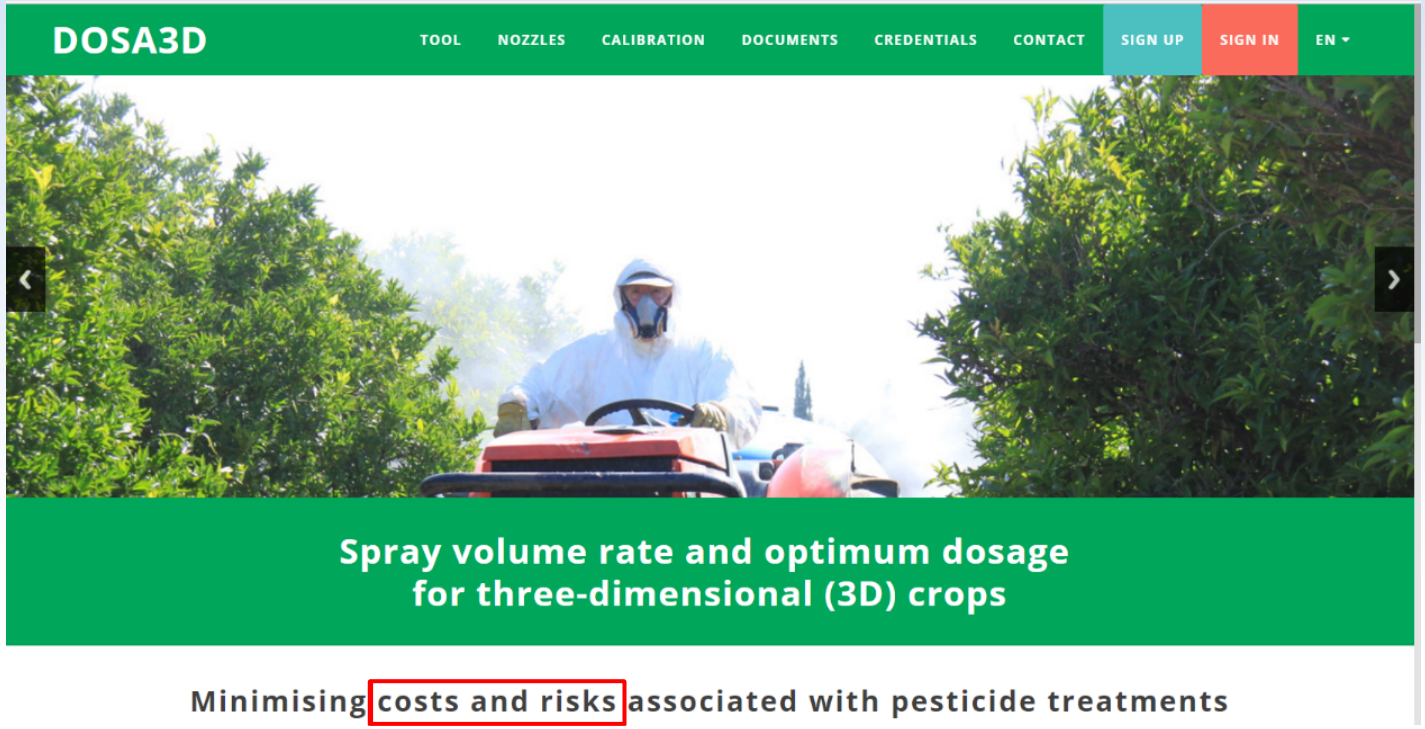
smartpones

Google Play

www.dosa3d.cat



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AgVance

EUCLID

Lindau Bodensee, 2015

The new concept of dose adjustment in tree crops

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Key words: Dose adjustment, Spraying pesticides, Tree orchards, LIDAR

Introduction

The lack of a harmonized method to establish the suitable dose in accordance to the real orcha conditions is one of the most important constraints affecting the sustainability of the use of pes cides in tree crops. Several attempts to introduce new dosing methods, such as canopy height LWA (Wolhlauser, 2009) have appeared in high density fruit orchards and vineyards. Neverthe less when trees are conducted in wide canopies these methods are not adopted. This affects the production of apple, pear, peach, nectarine, citrus, almond and vine in the main fruit regions lo cated worldwide.

For these conditions, the above mentioned dosing methods seem too much simplified and risky because canopy structures determining leaf density aren't, in any case, comparable to the low hedgerows where the new methods have been developed. Consequently, the concentration of the spraying liquid remains as the common dosing method and the amount of applied pesticide is directly linked to the volume sprayed. But, which volume rate (l·ha^{-1}) has to be sprayed for an efficient and effective control of pests? The objective of the present paper is to present DOS-AFRUT, as a new concept of dose adjustment and the results of the validation tests carried out in recent years.

Material and Methods

After considerable experimental work using ground-based LIDAR sensors, a simple, practical, and reliable method for estimating leaf area index (LAI) has been developed (Sanz et al., 2013). This estimative method takes into account the canopy solid housing (refers to the surface of the two vertical planes and the top horizontal plane closing the canopies) (Figure 1). Further im provements are being implemented based on additional field tests and latest sensor advances conducted in 2014 and 2015.

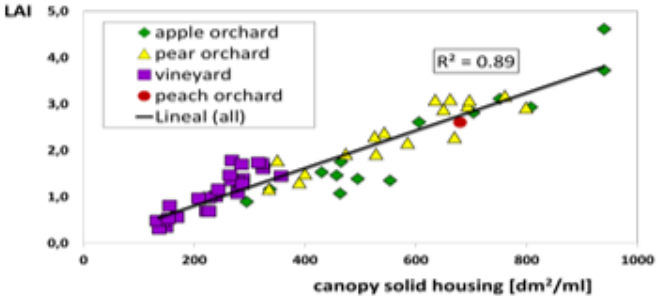

Figure 1. Correlation between the orchard structure (obtained with the LIDAR sensor) and the LAI for four tree crops.

Barcelona, 2018

DOSA3D system for adjusting doses in fruits & grapes orchards

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ABSTRACT

Approximately 10 M ha of fruit orchards and vineyards are located in Europe, mainly in the Southern Zone (93%). In this zone these 3D crops are usually grown in a wider and, frequently, higher canopy than is usual in the Northern and Central zones.

Recently, leaf wall area (LWA) is being promoted as harmonized method for dose expression. Nevertheless, it seems to be too simplified and uncertain for the Southern canopy dimensions to ensure the minimum (safe) but sufficient (efficient) amount of chemicals are sprayed in order to comply with the SUD Directive (2009/128/EC).

In these cases, canopy width, growth stage and the spraying efficiency operation should be considered to keep advisers and farmer's confidence. For three growth stages, the LAI is robustly estimated in a straightforward way by the solid housing parameter (height and thickness minus the porosity). The DOSA3D system assumes the labeled concentration (%) and calculates the pesticide dose (kg or L ha-1) determining the optimized spray volume rates (L ha-1) considering the above mentioned variables.

The system has been extensively validated in deciduous fruits and more recently for grapes. The DOSA3D system can be used with all kinds of air-assisted sprayers operating in continuous-row fruit orchards and vineyards. It is extensive to other Southernn hedgerow tree crops as almonds, olives and citrus or also isolated trees orchards (in goblet). In the recent times, an easy tool to operate is worldwide accessible at www.dosa3d.es, being also available on mobile app.

DOSA3D is going to be considered as a useful tool for minimizing costs and risks associated with pesticide treatments in 3D crops.

Acknowledgements

This work was supported in part by the Spanish Ministerio de Economía y Competitividad under the AgVANCE project (Grant AGL2013-48297-C2-2-R) and the EU Horizon 2020 program under the EUCLID project http://www.euclidpm.org (Contract No 633999).

References

Planas S, Camp F, Solanelles F, Escolà A, Sanz R, Rosell-Polo JR (2013) Advances in pesticide dose adjustment in tree crops. Proc. European conference on Precision Agriculture. Lleida. 541-545.

Planas S, Román C, Sanz R, Rosell-Polo, JR (2016) A proposal for dose expression and dose adjustment in the EU-Southern zone (DOSA3D system). Proc. Workshop on harmonized dose expression for the zonal evaluation of plant protection products in high growing crops. EPPO. Viena. http://archives.eppo.int/MEETINGS/2016_confer-ences/dose_expression.htm

Sanz R, Llorens J, Escolà A, Arnó J, Planas S, Román C, Rosell-Polo JR (2018) LIDAR- and non-LIDAR-based canopy parameters to estimate the leaf area in fruit trees and vineyard. Agricultural and Forest Meteorology (Ref: AGRFORMET-D-17-00952R2).

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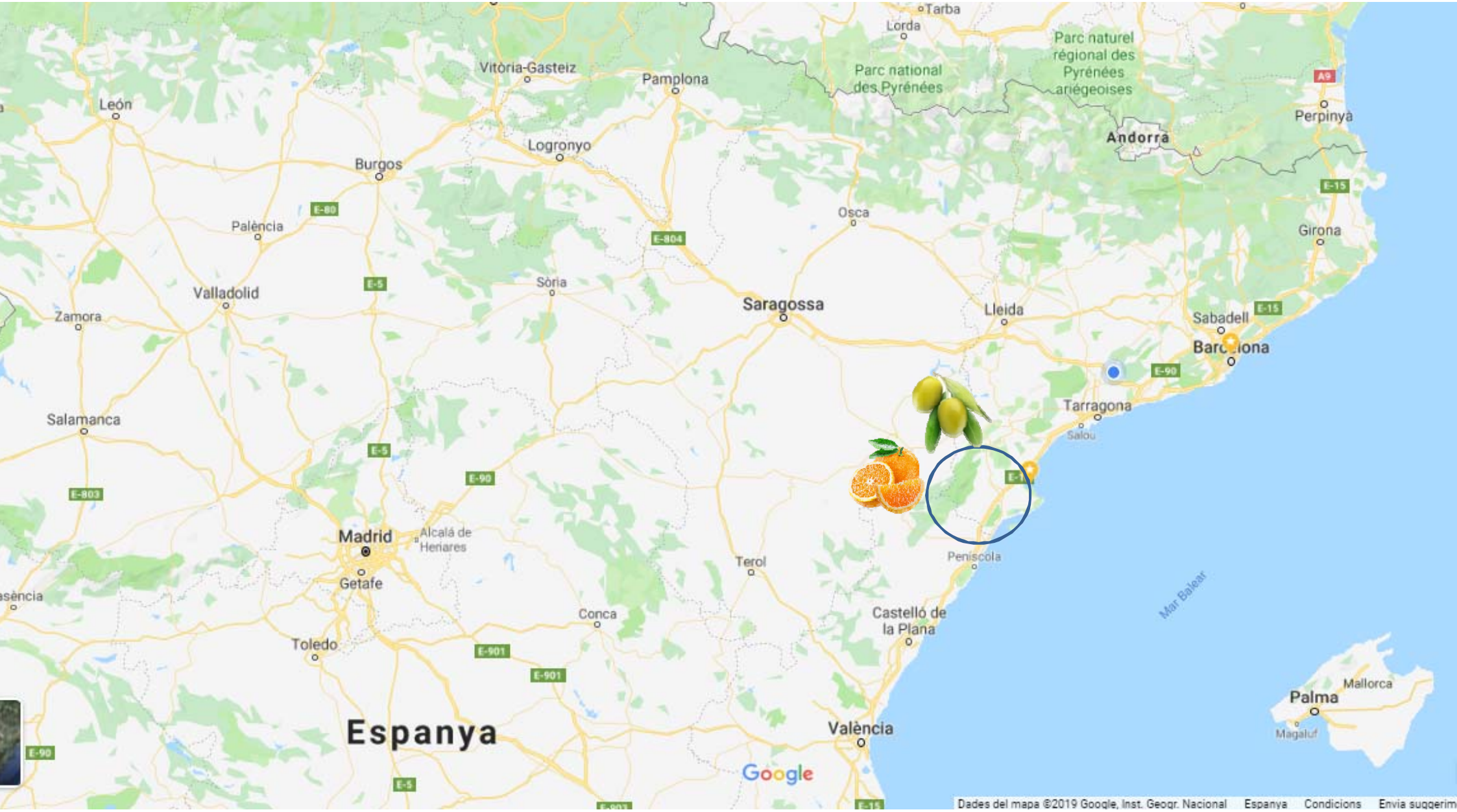
Tarba
Lorda
Parc naturel régional des Pyrénées ariégeoises
Parc national des Pyrénées
Vitòria-Gasteiz
Pamplona
León
Logronyo
Burgos
Andorra
Perpinyà
Palència
Osca
Girona
Valladolid
Sòria
Saragossa
Lleida
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Envia suggerim

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- **Citrus (mandarins)**

  Micro irrigated intensive orchards

- **Olive: dry lands**

  Isolated trees

  80 – 100 m^2/tree

Previous works: calibration

Dose decision

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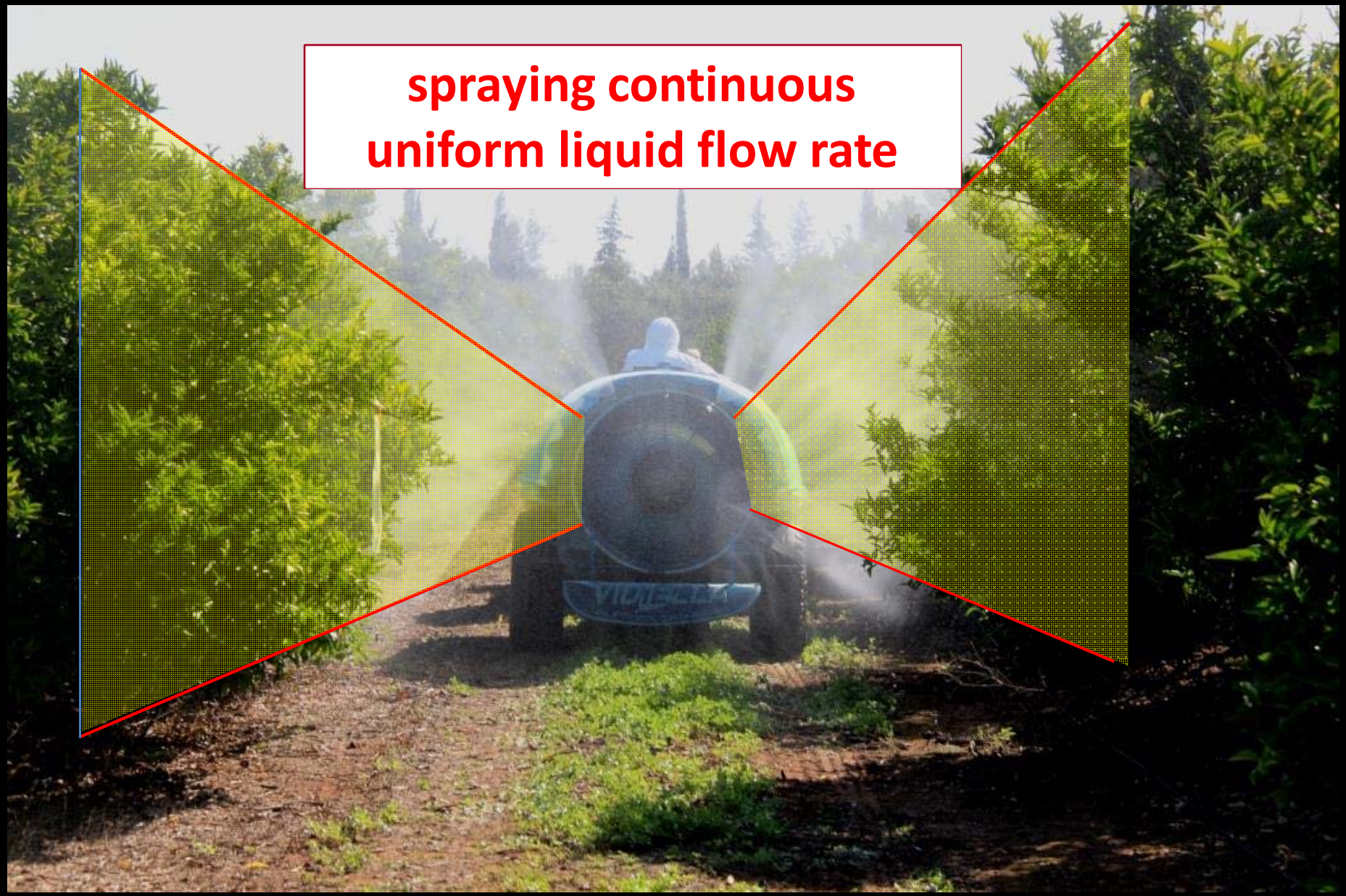
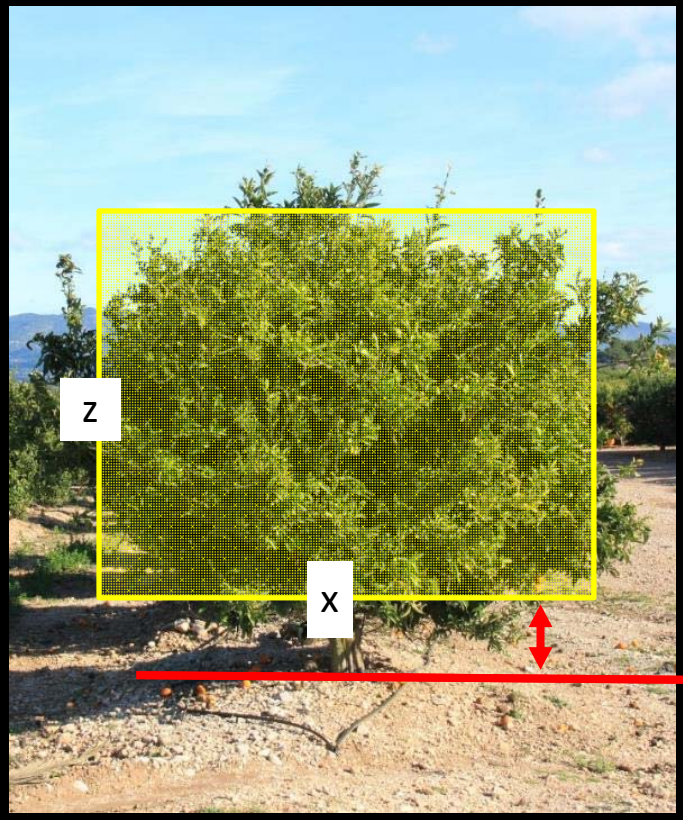
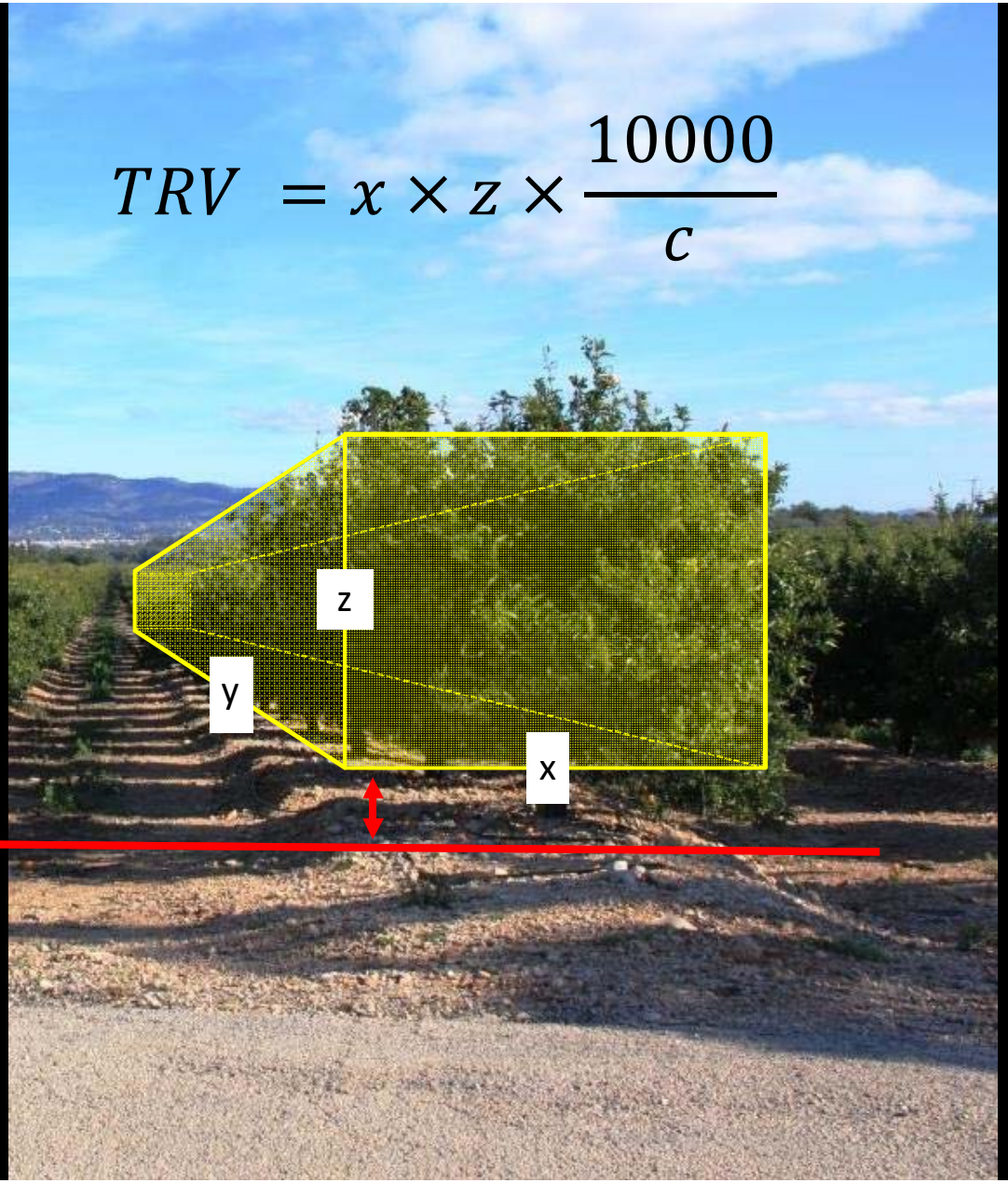

spraying continuous
uniform liquid flow rate

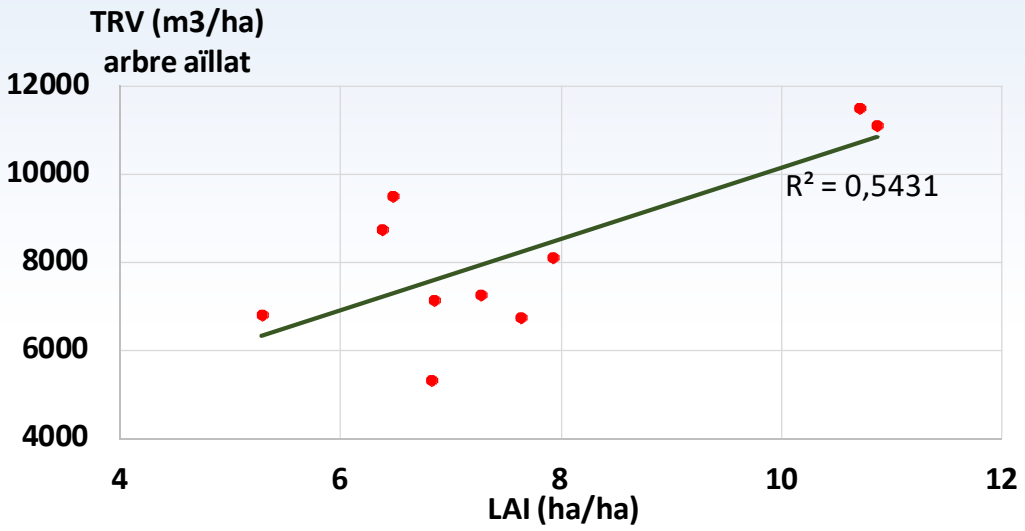
$$TRV = x \times z \times \frac{10000}{c}$$



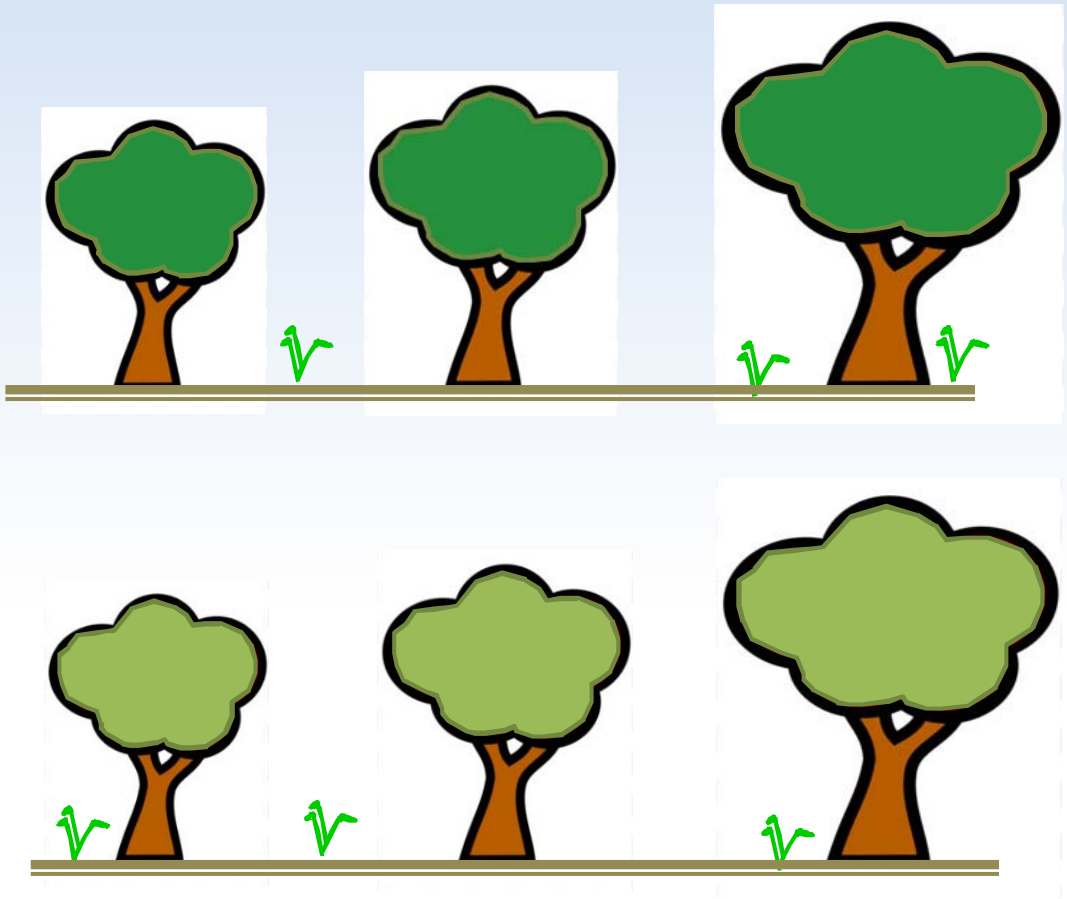


Measured leafiness

7 - 12 m^2/m^3



27 June 2018


Dimension
-
+
Canopy density
-
+


constant
concentration

Pest or disease to be controlled

constant concentration

California red scale
(Aonidiella aurantii)

Mites

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$$V(L/ha) = I_c(\mathrm{L}/m^3) \times \mathrm{TRV}(m^3/ha)$$

Summary for reference trials (2017-18)

					Volume rate (L/ha)		
	Canopy density (m^2/m^3)	**LAI**	**TRV** (m^3/ha)	**Spraying occasions**	**Farmer**	**DOSA3D**	**Reduction (%)**
CITRICS TERRES DE L'EBRE	**9,55**	10,8		4	1600-3800	1500-3000	0-21
MONTSIA	**11,24**	6,8	12800	2	3100	2500	18
IRTA	**9,90**	7,6	9573		1300-3800	1000-3300	0-29
Soldebre	**9,56**	6,5	10000	4	1500-1750	1000-2500	9-32
VIVEROS ALCANAR	**7,05**	6,4	8742	2		3000	6

Equivalent efficacy

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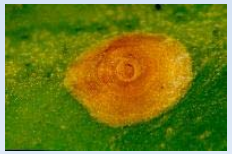
IRTA · CITRICS TERRES DE L'EBRE · MONTSIA · Soldebre · VIVEROS ALCANAR

Summary for reference trials (2017-18)



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IRTA

CITRICS TERRES DE L'EBRE

MONTSIA

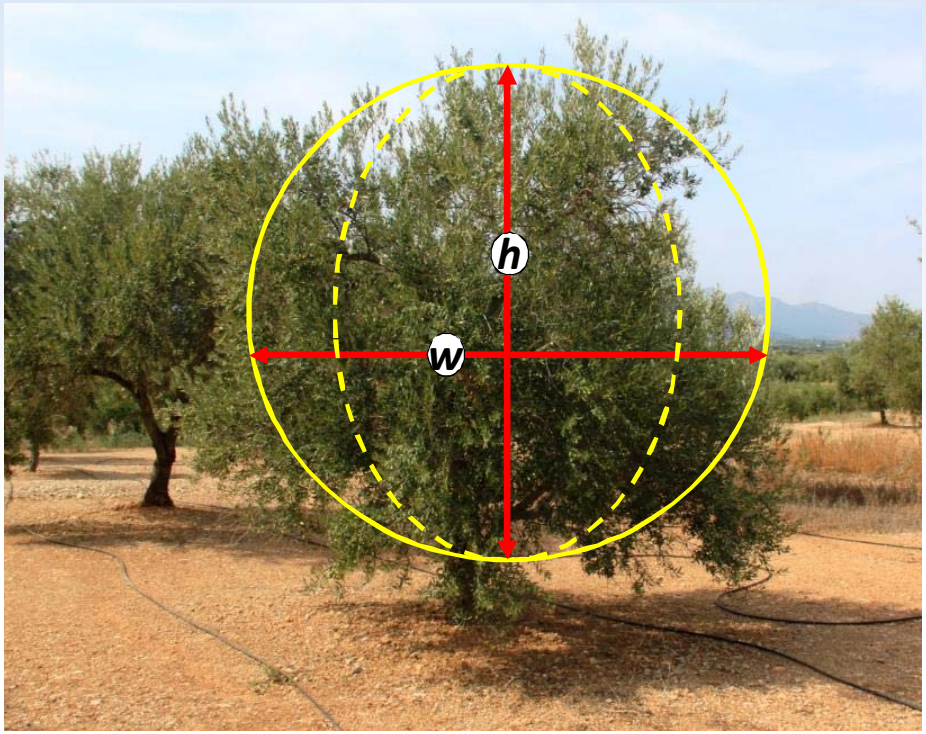
Soldebre

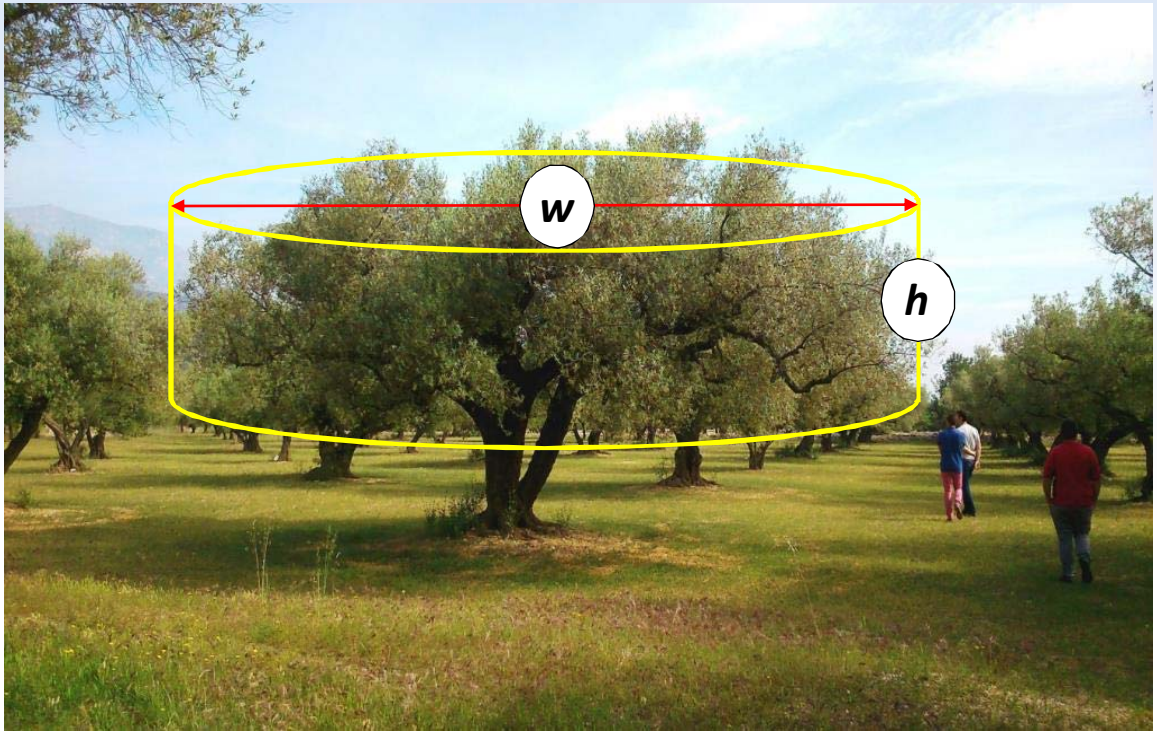
VIVEROS ALCANAR

Olive – isolated trees – on / off spraying

$$TV = 4/3 \times \pi \times \frac{w^3}{8}$$

$$TV = \pi \times w \times h$$





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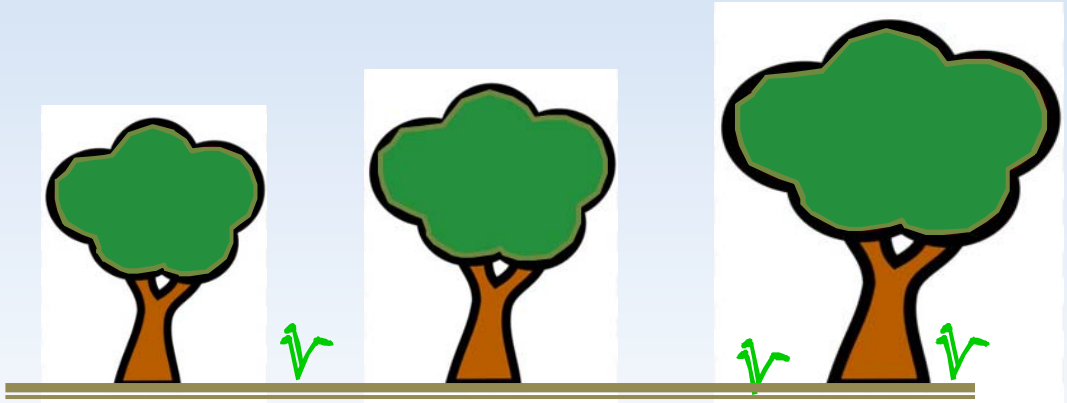
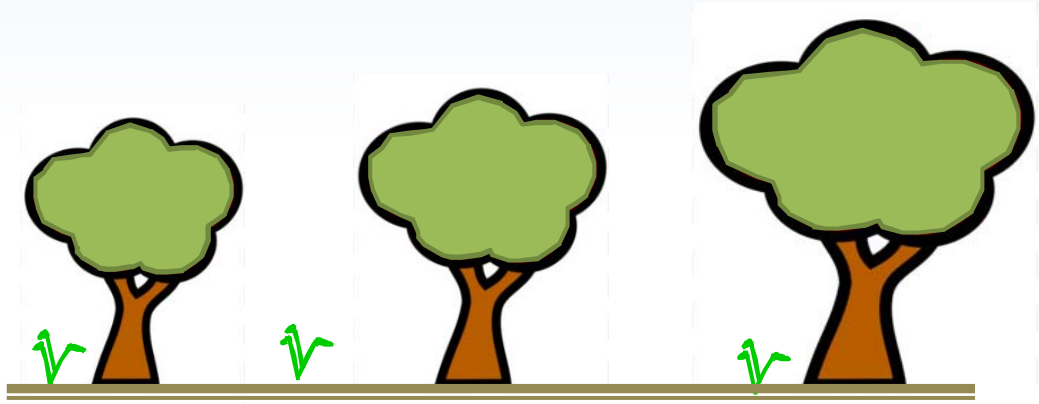
Dimension

Canopy density





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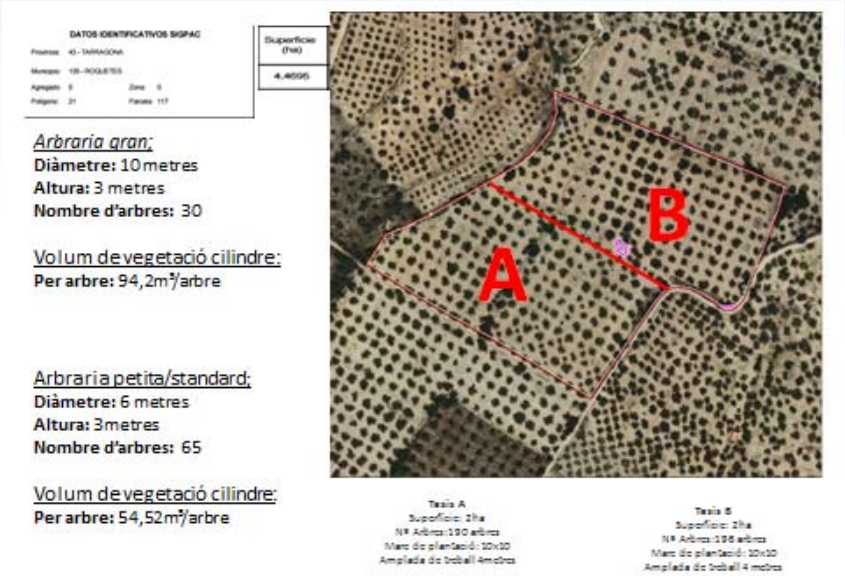
Pest or disease to be controlled

+10 %

Peacock spot
(Cycloconium oleaginum)

Farmer volume	Adjusted volume
0.07 L/m³	0.05 L/m³
1000 L/ha	700 L/ha (-30%)



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Summary for reference trials (2017-18)

	Canopy Volume (m^3)	Proportion (%)	Total tree volume (m^3/ha)	Spraying occasions	Product	Farmer (L/ha)	DOSA3D (L/ha)	Reduction (%)
Small trees	**85**	65%	5500	June 2017	**Cupper oxicloride (0.30%)**	**1000**	**700**	**30%**
Big trees	**250**	35%	8800	June 2018				
			13300	October 2018				

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Big trees	**250**	35%	8800					
			13300					

	Efficacy	Leaves infected (%)				
			initial	**23.4**	**26.2**	**Similar efficacy**
			final	**6.0**	**11.5**	

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Conclusions

- DOSA3D provided adjusted doses which permitted pesticide savings of up to 30% in citrus orchards and olive groves with respect to the standard doses normally applied by farmers.

- DOSA3D could prove very helpful for harmonizing the doses applied in citrus and olive orchards and for taking action to reduce the use of pesticides, as advocated by the Sustainable Use of Pesticides Directive.

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ADV per al control de la "mosca de l'oliva" al Baix Ebre i Montsià
ADV de l'Olivera del Baix Ebre i Montsià

Focus Group – Cítrics (2017-19)

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Angel Roda (Soldebre)
Joan Gisbert (Soldebre)
Dídac Royo (Coop Exp. Citrics d'Alcanar)
Josep Miquel Fibla (IRTA)
M Teresa Martínez (IRTA)
José Miguel Campos (IRTA)
Joan Porta (DARP-SSV)
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Santiago Planas (SSV-DARP / GRAP-UdL).

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Santiago Planas (SSV-DARP / GRAP-UdL).

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IRTA

DOSA3D