The new concept of dose adjustment in tree crops

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Introduction

The lack of a harmonized method to establish the suitable dose in accordance to the real orchard conditions is one of the most important constraints affecting the sustainability of the use of pesticides in tree crops. Several attempts to introduce new dosing methods, such as canopy height or LWA (Wolhlauser, 2009) have appeared in high density fruit orchards and vineyards. Nevertheless 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 located 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 ($l \cdot ha^{-1}$) has to be sprayed for an efficient and effective control of pests? The objective of the present paper is to present DOSAFRUT, 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 improvements are being implemented based on additional field tests and latest sensor advances conducted in 2014 and 2015.

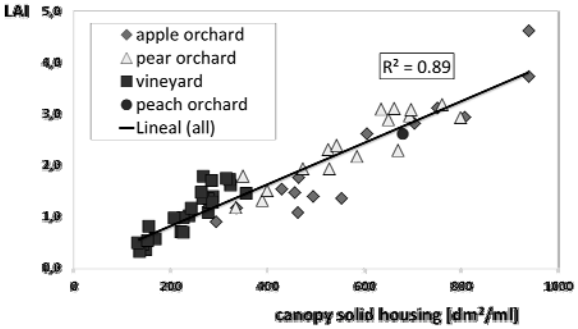

Figure 1. Correlation between the orchard structure (obtained with the LIDAR sensor) and the LAI for four tree crops.

From the estimated *LAI* and the predicted overall efficiency *(E)*, the volume application rate (*V)*in $l \cdot ha^{-1}$can be calculated by means of the following expression:

$$V = \frac{120 \cdot LAI}{E} \quad (2)$$

Where *LAI* is the leaf area index and *E* the application efficiency, considering the spraying parameters. To be reliable, the system assumes that, for effective control of pests, an impact density of 100 pesticide droplet·cm^{-2}is required having a representative diameter of 225 μm. Easy and user-friendly tool to estimate *E* and calculate *V* is provided in DOSAFRUT website (Figure 2).

Field tests

Field tests have been conducted to validate DOSAFRUT volume rates. Twenty field tests have been carried out over three successive seasons, 2009–2011, with the objective of assessing the efficacy of chemical treatments to control *Psyllapiri* (psylla), *Tetranychusurticae* (spider mite), and *Frankiniellaoccidentalis* (thrips) in pear, apple, and peach orchards, respectively. In 2012, one multiple chemical treatment for the control of *Psyllapiri* was applied in order to evaluate the chemical residues on fruits at harvest. DOSAFRUT provided adjusted doses, enabling pesticide savings of between 14% and 53% (volume reduction) as compared to the volumes usually adopted by farmers (standard dose) (Planas et al., 2013)

The difference in efficacy between dosing methods was not significant. In the last season (2012), no pesticide residues were detected on fruit from trees treated with pesticide doses determined using either DOSAFRUT or standard dosing. Additional tests have been carried out in 2013 in a Flat Queen peach orchard.

Figure 2: Pictogram of DOSAFRUT website available at www.dosafrut.es.

Conclusions

The DOSAFRUT decision dosing system sets significant savings of pesticide in effective treatments. In consequence, it can be very helpful to harmonize dose recommendations and for implementing the national action plans according to the Directive 2009/128 on the Sustainable Use of Pesticides who advocates a significant reduction in the quantity of pesticides used.

References

Planas, S., Camp F., Escolà, A., Solanelles, F., Sanz R., Rosell, JR. (2013) Advances in pesticide dose adjustment in tree crops. Proc. 9th Eur. Conf. Precision Agriculture. Lleida, 533-539.

Sanz, R., Rosell, J.R., Llorens, J., Gil, E., Planas, S. (2013). Relationship between tree row LIDAR-volume and leaf area density for fruit orchards and vineyards obtained with a LIDAR 3D Dynamic Measurement System. Agricultural and Forest Meteorology.

Wolhlauser.R. (2009).Dose Rate Expression in Tree Fruits.The Need for a Harmonized Approach from an Industry perspective.An Industry Proposal.Tree Fruits Dose Adjustment. Discussion Group Meeting – Wageningen (unpublished).

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