Design and evaluation of a manual device for air flow rate adjustment in spray application in vineyards

E. Gil, J. Llop, M. Gallart, M. Valera, J. Llorens

Department of Agri Food Engineering and Biotechnology, UniversitatPolitècnica de Catalunya, Esteve Terradas, 8 – Campus del Baix Llobregat – 08860 Castelldefels, SPAIN, www.uma.deab.upc.edu

Introduction

Air assisted sprayers (mist blowers) is the most common technology used for pesticide application in vineyards. An accurate calibration process is always requested to obtain a uniform distribution, avoiding problems such as drift and pesticide losses to the soil. During the calibration process one of the key aspects affecting the quality of the process is the air assistance characteristics (air flow and air speed). However, while different methodologies have been already established to determine the optimal amount of liquid/pesticide depending on canopy characteristics, very few data exist concerning the best relationship between air assistance and canopy. The purpose of this research was to evaluate the effect of air assistance on spray distribution/deposition in a traditional vineyard in Spain.

Material and Methods

A special device for air adjustment was designed and implemented in a multi row sprayer Ilemo Hardi Iris-2 (Ilemo-Hardi, S.A.U., Lleida, Spain). The system allowed to adjust the air characteristics (air flow rate) from 0 (no air) to its maximum level (4750 m^3/h per side) using a manual adjustable valve (Fig. 1). Four air flow rates (0%, 25%, 50%, 75% ad 100%) were selected during the spray application of a constant volume rate of 260L/ha (4.4 km/h; 12ATR lilac nozzles, 7 bar, 3 m working width).

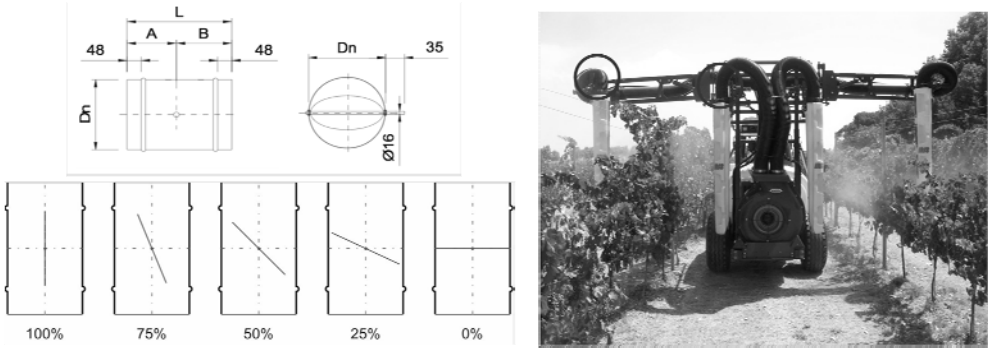

Figure 1. Technical characteristics of the adjustable valve (left) and Iris 1500 L sprayer (Ilemo Hardi S.A.U.) modified for the trials (right).

Spray deposition and coverage were evaluated using three different collectors: real wine leaves filter paper for deposition and water sensitive paper for coverage. Nine sampling zones (three heights and three depths) were selected in five replicates. For deposition, absolute values of deposition (l/cm^2) were determined using a constant amount of tracer (E-102) in the spray tank and measuring the collector's area (leaf area or filter paper surface), following the procedure previously established (Llorens *et al.,* 2010). Water sensitive paper coverage was measured by image analysis using Image J software (Rasband, 2014). Deposition and coverage data were analyzed by one-way analyses of variance considering the air flow rates as a source of variation followed by Tukey-Kramer post hoc test.

Results and discussion

Results (Fig. 2) indicated a very good correlation between collectors (leaves and filter paper) as tools for evaluation of deposition. The same tendency was observed when water sensitive papers were used. Concerning the effect of air flow rate, it was observed that no statistical differences were detected between maximum air flow rate (100%) and 75% in deposition values in grape leaves. Using filter paper as collectors, there were no significant differences between 75% and 50% of maximum air flow rate. This tendency was also observed analysing the coverage values obtained in WSP.

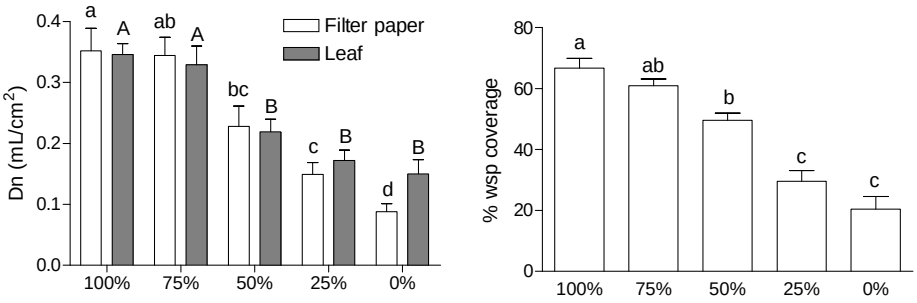

Figure 2. Deposition (mL/cm^2) on filter paper or wine leaves according to the air flow percentage (left). Water sensitive paper coverage according to the air flow rates(right). Different letters mean significant differences among air flow rates.

Conclusions

It is clear that an accurate air flow rate adjustment represents an important benefit both in economic and environmental aspects, while spray distribution quality is not affected considering the direct influence of air flow rate and direction in risk of spray drift (Gil *et al.,* 2014) and the important variation of tractor fuel consumption at different air flow rates.

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