Spray deposition of a cross-flow fan orchard sprayer with low air and low spray pressure settings

Jean-Marie Michielsen, Hein Stallinga, Dirk de Hoog, Pieter van Dalfsen, Marcel Wenneker, Jan van de Zande

Wageningen University and Research - Wageningen Plant Research, P.O. Box 16, 6700 AA Wageningen, The Netherlands
Email address: jean-marie.michielsen@wur.nl

INTRODUCTION

To improve the current practice of spray application in fruit crops a research programme was setup assessing spray and liquid distribution of nowadays often used single- and multiple-row orchard sprayers and spray deposition and distribution in orchard trees. Potential pathways of improvement are; air amount, nozzle type and spray pressure. Improved spray deposition can lead to reduced use of agrochemical and therefor reduced emission to the environment while maintaining high levels of spray drift reduction and biological efficacy. This paper presents results of a single row cross-flow fan sprayer.

MATERIALS AND METHODS

Spray deposition measurements compared a reference cross-flow fan orchard sprayer (Munckhof, Horst, The Netherlands) and a HSS (Hol Spraying Systems, Meteren, The Netherlands) cross-flow fan sprayer following the ISO-22522 protocol. The measurements were performed in an apple orchard (Randwijk, The Netherlands) in full leaf (June-October 2017). The reference sprayer was equipped with standard hollow cone nozzles (Albuz ATR lilac), operated at 7 bar spray pressure, a forward speed of 6.5 km/h applying a spray volume of 200 l/ha (Table 1). Air setting during the experiments was in the high fan gear box setting of the sprayer. The HSS sprayer is equipped with individual air spouts just behind the nozzles at 8 height positions. Air settings of the HSS sprayer used were maximum and reduced; resp. 2100 rpm and 1800 rpm of the fan. Spray nozzles fitted to the HSS were Albuz TVI8001 hollow cone venturi nozzles operated at 7 bar spray pressure, and the Lechler IDK 9001 and IDK90015 flat-fan nozzles both operated at 3 bar spray pressure. Forward speed was varied between 6.5 km/h and 8 km/h (Table 1). Spray volume varied therefore between 138 L/ha and 263 L/ha.

To measure the spray deposition in the apple tree both sprayers sprayed the tree rows with a fluorescent tracer (BSF 0.3 g/l). A single row was sprayed from both sides over a 25 m length spraying consecutively from the left and right hand side of the sprayer (same driving direction). Four individual trees were sampled and leaf samples were taken by counting all leaves in seven tree sections: Top, Middle East side, Middle West side, Bottom Inside West, Bottom Outside West, Bottom Inside East, Bottom Outside East and putting every 10th leaf in a bag. The picked leaves were analysed in the laboratory for spray deposition of the sprayed fluorescent tracer BSF. The leaf areas were determined, and the spray deposition was calculated and expressed as µl/cm^2 and % of applied spray volume per tree compartment and for the whole tree leaf canopy.

RESULTS AND DISCUSSION

Total spray deposition in the leaf canopy of the apple trees for the reference sprayer was only 13% of total applied spray volume. This could be increased by as much as 67% depending on nozzle type, air setting and forward speed of the HSS sprayer (Table 1). Low air setting, using low spray pressures of 3 bar and flat fan nozzles (IDK9001, IDK90015) seems to be good alternatives for increasing spray deposition in tree canopy compared to high pressure (7 bar), full air setting and TVI8001 hollow cone nozzles.

Table 1. Spray deposition in full-leaf situation of apple trees presented as µL/cm² at leaves, % of sprayed volume in tree canopy and in tree canopy deposition of the different objects of the HSS sprayer (1-8) relative to that of the reference sprayer (9)

object	Nozzle	bar	Speed (km/h)	Air setting	Spray volume (L/ha)	LAI tree	Spray deposition (µL/cm²)	% of sprayed volume	relative to reference
1	TVI 01	7	6.5	Low	251	1.97	0.46	18%	145
2	TVI 01	7	6.5	Full	263	2.14	0.37	14%	111
3	TVI 01	7	8	Low	211	1.88	0.44	23%	167
4	TVI 01	7	8	Full	211	1.67	0.33	16%	123
5	IDK 01	3	6.5	Low	165	1.73	0.31	18%	150
6	IDK 01	3	6.5	Full	172	1.66	0.22	14%	104
7	IDK 015	3	8	Low	207	1.72	0.37	18%	141
8	IDK 015	3	8	Full	207	1.88	0.29	14%	113
Ref 9	atr lilac	7	6.5	Full	201	1.81	0.25	13%	100

Not only is spray deposition at total leaf canopy influenced by sprayer settings but also in-tree distribution. Differentiation in spray deposition for the top, middle and bottom section of the apple tree shows large variations (Fig. 1) between sprayer settings. Low air setting increases spray deposition mainly in the middle and top part of the tree whereas 8 km/h forward speed increased spray deposition mainly in the bottom part of the tree. For the HSS sprayer increased spray deposition in total leaf canopy (50%) seems most homogeneously distributed over tree sections with the IDK9001 at 3 bar, low air setting and 6,5 km/h forward speed (object 5).

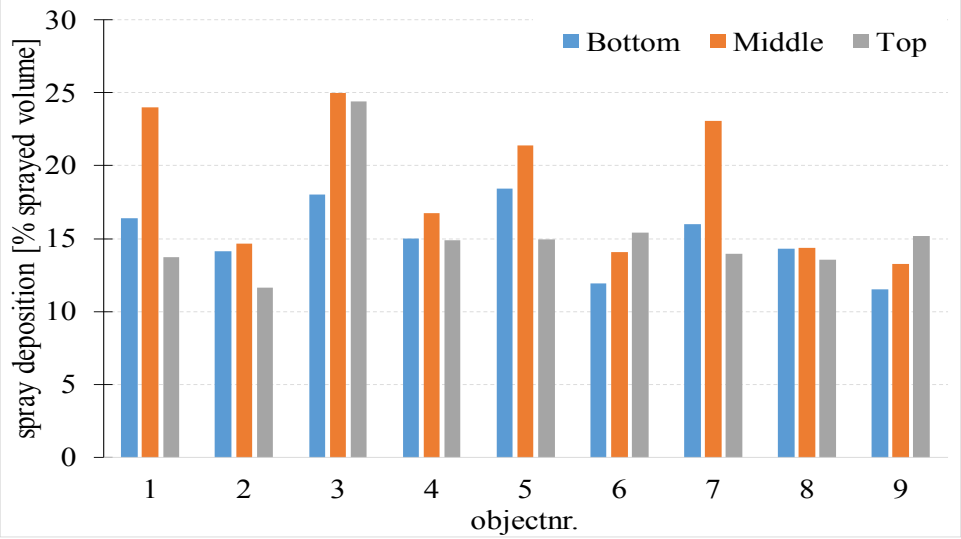

Fig. 1. Spray deposition (% of sprayed volume) of the different techniques (9=ref) in the Top, Middle and Bottom section of the apple trees.