4.1 Airborne spray drift and ground deposition spraying an orchard with standard and drift reducing techniques

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INTRODUCTION

In the Netherlands spray drift experiments for orchard spraying are carried out on a uniform basis comparing a reference spray application technique and a yet to be classified drift reducing technique (DRT). As spray drift measurements are done both as ground deposition next to the orchard and as airborne drift at one distance from the last treated tree row of the orchard, these data can be evaluated for the level of drift deposition and similarity of drift reduction. These comparisons can be relevant in exposure assessments for bystander and resident risk and of non-target plants or arthropods.

MATERIALS AND METHODS

Spray drift measurements were carried out according to the ISO standard (ISO 22866; 2005) adapted for the situation in the Netherlands (ground deposits, ditch, surface water next to the sprayed field) following the Dutch protocol (TCT, 2003, 2017). The outside 24 m (8 rows) of an apple orchard were sprayed with a solution containing the fluorescent dye Brilliant Sulpho Flavine (Chroma 1F 561, BSF) and a non-ionic surfactant (Agral) to the spray agent. Spray drift deposition was measured using collectors (synthetic cloths of 0,05 m^2/0,1 m^2) which were placed at several distances up to 25 m from the centre of the last tree row on ground surface on the downwind edge of the orchard. At 7.5 m distance from the last tree row, collectors (Siebauer) were fit to vertical lines up to 10 m height to collect airborne spray drift. The spray drift was measured by quantifying the BSF deposition using liquid fluorescence spectroscopy of the ground and airborne collectors.

The reference technique for orchard spraying was a cross-flow fan sprayer (Munckhof), equipped with Albuz ATR lilac nozzles, which at 7 bar spray pressure produced a Very Fine spray quality (ISO25358). The experiments were carried out in the full leaf growth stages of the trees (BBCH 56-92) and carried out with 540 rpm PTO and high gear fan settings. Drift Reducing Techniques (H.S.S., KWH, Lochmann, Munckhof) and nozzles can be grouped in drift reduction classes compared to the reference (ISO22369-1). Entries in the drift reducing classes in the Netherlands for orchard spraying (based on spray drift deposition at 4.5-5.5 m from the last tree row in the full leaf situation) are determined and based on comparative field measurements. In total 22 spray drift measurements were compared for these analyses, performed in the period 2008-2020; representing 3 DRT75, 5 DRT90, 4 DRT95, 4 DRT97.5 and 6 DRT99 techniques.

RESULTS AND DISCUSSION

Of the evaluated 22 spray drift measurements, spray drift reduction ranged from 76.8% to 99.5% and was on average 93.9%. Mean spray drift deposition at 4.5-5.5 m from the last tree row was 9.4% for the standard spray technique and 0.57% for the DRTs. Mean airborne spray drift over 0-10 m height at 7.5 m distance from the last tree row was 5.5% for the standard technique and 0.45% for the DRTs (Table 1).

Table 1. Mean spray drift deposition (% sprayed volume) at ground surface and airborne spray drift at different evaluation zones for a standard spray technique and drift reducing techniques (DRTs) and mean drift reduction (%) for the DRTs spraying an orchard at full leaf stage.

	Drift deposition ground [%]			Airborne drift [%] at 7.5m		
	4.5-5.5m	7-8m	0-10m	0-1m	0-2m	0-10m
standard	9.4	5.2	5.6	7.9	8.5	5.5
DRT	0.57	0.27	0.30	0.49	0.55	0.45
Drift reduction (%)	93.9	94.3	94.2	93.8	93.5	91.9

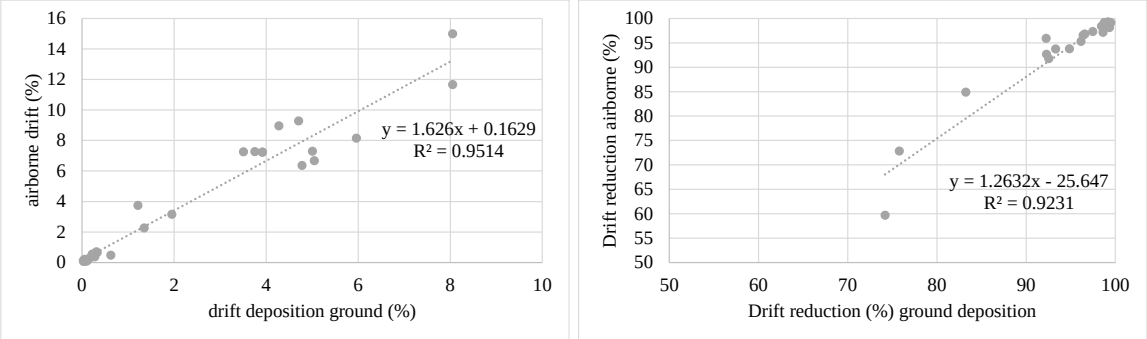

Fig. 1. Spray drift deposition (% sprayed volume; left) for the standard and drift reducing techniques and drift reduction (%; right) for the DRTs at ground surface at 7-8 m and airborne spray drift at 0-2 m height at 7.5 m spraying an orchard at full leaf stage.

Spray drift deposition at 7-8 m, coinciding with the position of the airborne drift pole (7.5 m), is for the standard technique and DRTs respectively 5.2% and 0.27%. Airborne drift at 0-2 m height is 8.5% for the standard technique and 0.55% for the DRTs. This shows that at the same distance (7.5 m from the last tree row) airborne spray drift is higher than ground deposition (Fig. 1). Mean airborne drift over 0-10 m height was for the standard technique 7% higher and for the DRTs 64% higher than ground deposition at 7.5 m distance. Two different height ranges were used which represent bystander and resident exposure of children and adults during risk analysis; for the standard technique airborne drift was 53% and 65% higher for 0-1 m and 0-2 m height respectively. For the DRTs airborne drift at 0-1 m and 0-2 m height was 81% and 102% (two times) higher than drift deposition at ground surface at the same distance.

Mean spray drift reduction of the DRTs at the ground surface for the distances 4.5-5.5 m, 7-8 m and 5-10 m were 93.9%, 94.3% and 94.2% respectively. At 7.5 m distance from the last tree row spray drift reduction at the airborne heights of 0-10 m, 0-2 m and 0-1 m were 91.9%, 93.9 % and 93.8% respectively. This shows that the spray drift reduction classes evaluated either at different ground surface zones or at airborne heights are of a similar level. For 14 of the 22 individual spray drift measurements the drift reduction classes remain similar for airborne and ground drift reduction at 7.5 m from the last tree row, for 6 DRT techniques airborne drift class is lower than ground drift class, and for two measurements the airborne drift class is higher (Fig. 1).