Comparison of spray drift between an axial fan and a cross flow sprayer

***Wenneker, M.*[1]*, Zande, J.C. van de*[2]*, Stallinga, H.*[2]*, Michielsen, J.M.G.P.*[2]*, Joosten, N.*[1]**

[1] *Applied Plant Research (PPO-fruit), Wageningen UR – P.O. Box 200 – 6670 AE Zetten (The Netherlands); e-mail: marcel.wenneker@wur.nl*

[2] *Plant Research International (PRI), Wageningen UR – P.O. Box 616 – 6700 AP Wageningen (The Netherlands)*

Introduction

The reduction of the emission of plant protection products (PPP) to the environment is an important issue in the Netherlands. Spray free and crop free buffer zones were introduced, to minimize the risk of mainly spray drift (Water Pollution Act, Plant Protection Act). In the Netherlands drift measurements are carried out according to the ISO standard (ISO 22866) adapted for the situation in the Netherlands (ground deposits, ditch, and surface water next to the sprayed field) following the Dutch protocol (CIW, 2003). Recently, new legislation is set into force, in which it is specified that fruit growers have to achieve 90% drift reduction compared to standard spray applications with a cross flow sprayer. At this moment, 7 drift mitigation measures for fruit growing are accepted by water control authorities; e.g. crop free buffer zone of 9 meters, windbreaks (hedgerows), tunnel spraying and specific coarse droplet applications. In the Netherlands the most commonly used sprayers are cross flow fan sprayers. Therefore, the reference spraying machine for spray drift measurements in orchard spraying (Huijsmans *et al*., 1997) is a cross flow fan sprayer, equipped with Albuz ATR lilac hollow cone nozzles (spray pressure 7 bar generating fine droplets), and a spray volume of approximately 200 $l.ha^{-1}$. However, a substantial portion of around 25% of the growers uses axial fan sprayers. The question is whether spray drift from axial fan sprayers is equivalent to that of cross-flow fan sprayers. Also, within Europe many spray drift trials are performed, however spray drift trials with a direct comparison between the cross flow and the axial fan sprayer types are scarce. This makes it difficult to interpret results from different countries and therefore field experiments were setup.

Experiments

In this paper we present and discuss the results of experiments on spray drift with an axial fan and a cross flow fan sprayer. In a series of experiments spray drift was evaluated in the dormant and early growth stages (in the Netherlands before May 1st) and the full leaf stage (after May 1st) of an apple orchard. The spray drift into the air, and soil deposition outside an apple orchard were measured. Spray drift measurements were carried out adding the fluorescent dye Brilliant Sulfo Flavine (3 g/l BSF) and a non-ionic surfactant (Agral; 0.075%) to the spray agent. Spray deposits were calculated and presented as percentage deposit of the applied rate per unit surface area on the different distances of the collectors. The spray applications with the cross flow sprayer were performed with Albuz ATR Lilac hollow cone nozzles at 7 bar spray pressure (200 l/ha), and low-drift air induction flat fan nozzles; i.e. Lechler ID 90-01C at 5 bar spray pressure (200 l/ha). In practice, fruit growers use a spray volume of 200-250 l/ha. The axial fan sprayer was equipped with the same nozzle types and also Albuz ATR yellow nozzles (7 bar spray pressure). The latter nozzle to compensate the lower number of nozzles compared at the axial fan sprayer to the cross flow sprayer to apply 200 l/ha. During the experiments (10 repetitions in both growth stages) average wind direction was 1 – 13 degrees from cross to the tree rows and average wind speed at 3 m height was 2.1 – 3.8 m/s for the early growth stage, and 6 – 14 degrees and 2.2 – 3.7 m/s for the fully developed growth stage of the apple orchard.

Results

Spray drift deposition at an early growth stage (developing foliage)

In the early growth stages the spray drift curves of the axial fan and cross flow orchard sprayers – equipped with Albuz hollow cone nozzles showed a gradual decrease in drift deposition with increasing distance from the last tree row (figure 1). When both sprayers were equipped with low-drift air induction venturi flat fan nozzles (Lechler ID 90-01C) spraying resulted in high spray drift deposit on soil surface at short distance from the outer tree row, as coarse droplets fell down at short range from the last tree row outside the orchard. Very low spray drift deposits were measured at greater distances from the last tree row. The spray drift curves for the axial fan sprayer and cross flow sprayer showed equal patterns. Drift reductions achieved with the coarse droplet applications were comparable for the axial fan and the cross flow sprayer, being 0%, 60% and 80% at respectively 5m, 8m and 11m distance from the last tree row.

Drift into the air at a height of 1 meter was considerable higher for the cross flow sprayer with standard Albuz lilac nozzles compared to the axial fan sprayer with Albuz lilac or yellow nozzles. Mounted with drift reducing nozzles drift into the air was significantly reduced for both sprayer types.

Spray drift deposition at a fully developed foliage stage

In the full leaf situation, the drift deposition was comparable for all nozzle and sprayer combinations. At greater distance from the last tree row outside the orchard the spray drift curves for the Albuz ATR hollow cone nozzles and both sprayer types were the same; i.e. gradual decrease in drift deposition with increasing distance from the last tree row. The spray drift deposition curve for the cross flow sprayer equipped with venturi flat fan nozzles was lower than for the axial fan sprayer.

The amount of spray drift into the air was depending on the nozzle type and sprayer combination. High spray drift values were measured for the cross flow sprayer with Albuz lilac hollow cone nozzles and very low values for the axial fan sprayer with air induction flat fan nozzles.

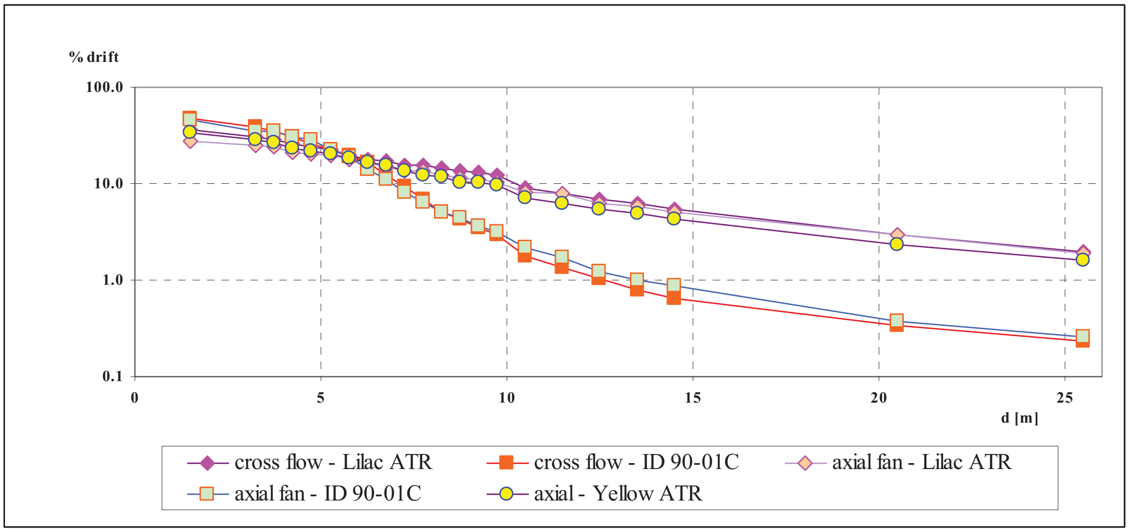

Figure 1. *Spray drift deposition on soil surface next to a dormant apple orchard, spraying with an axial fan and a cross flow sprayer equipped with hollow cone and air induction flat fan nozzle types.*

Conclusion and discussion

Based on the experiments it can be concluded that, both in the dormant or full leaf situation, the axial fan sprayer equipped with Albuz lilac or yellow hollow cone nozzles does not give higher spray drift values than the reference cross flow fan sprayer (equipped with Albuz ATR lilac nozzles). With drift reducing air induction flat fan nozzles the spray drift values for the axial fan sprayer and cross flow sprayer are equally minimized in the dormant situation. However, in the full leaf stage for the axial fan sprayer the spray drift deposition at short distance from the last tree row was lower and higher at larger distances, compared to the cross flow sprayer. These results indicate that the outcome from the nozzle classification system for fruit growing that is currently developed can be used for axial fan sprayers and cross flow sprayers (Van de Zande *et al*., 2008).

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