

Assessment of spray deposits and biological efficacy in apple orchard using a Crop Identification System (CIS)

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Introduction

An environmentally friendly orchard sprayer has been developed within the European Project ISAFRUIT (Increasing fruit consumption through a trans-disciplinary approach leading to high quality produce from environmentally safe sustainable methods). The sprayer is able to automatically adapt the application according to the characteristics of the canopy target (size and density), to the level of disease present in the canopy and to the environmental conditions (wind speed and direction). For the identification and the characterisation of the target, a Crop Identification System (CIS) based on ultrasonic sensors was developed by DEIAFA and 3B6 company (Balsari *et al.*, 2008). During 2008 season the CIS system mounted on the ISAFRUIT air-assisted sprayer prototype was tested in an apple orchard in order to assess spray deposits on leaves and fruits, ground losses and biological efficacy of treatments. Results were compared with those obtained using a conventional air-assisted sprayer. Tests were made in an apple orchard (cv. Gala) featured by a layout of 3.8 m (row distance) x 1.0 m (plant spacing) and with average tree height of 4.0 m.

Methodology of work

Spray deposition tests were made at two different growth stages: early development of fruits (BBCH 71) and shoot growth completed (BBCH 91). Tests were carried out applying an experimental mixture of water and yellow tracer (Tartrazine E102) 5% v/v. In the first round of experiments (BBCH 71 growth stage) two treatments were compared: 1) ISAFRUIT sprayer without the CIS activated and therefore applying the full rate volume (850 l/ha); 2) ISAFRUIT sprayer equipped with active CIS, applying a reduced volume rate of 435 l/ha.

In the second round (BBCH 91 growth stage) five thesis were compared: 1) ISAFRUIT sprayer without CIS activated (applied volume 850 l/ha), equipped with conventional flat fan nozzles; 2) ISAFRUIT sprayer with CIS activated (applied volume 540 l/ha), equipped with conventional flat fan nozzles; 3) ISAFRUIT sprayer without CIS activated (applied volume 850 l/ha), equipped with air induction flat fan nozzles; 4) ISAFRUIT sprayer with CIS activated (applied volume 540 l/ha), equipped with air induction flat fan nozzles; 5) conventional axial fan air-assisted sprayer equipped with hollow cone nozzles (applied volume 850 l/ha).

Leaf sampling was made following the indications of ISO 22522, for each thesis picking up 10 leaves from 7 positions in the canopy and replicating the sampling procedure on 3 trees. Ground losses were measured through rows of artificial collectors (250 x 100 mm) displaced flat on the ground in the inter row and under the trees. In the second round of tests, spray deposits on fruits were also assessed, for each thesis picking 30 apples from the higher part (h > 2.5 m) of the canopy and 30 apples from the lower part (h < 2.5 m) of the canopy.

Biological tests were conducted in the same apple orchard, starting from mid May and comparing the incidence of apple scab, powdery mildew and green apple aphids in experimental plots treated: with the ISAFRUIT sprayer equipped with the active Crop Identification System (volume applied ranging from 450 to 550 l/ha), with the ISAFRUIT sprayer without the CIS activated (volume applied 850 l/ha) and with a conventional axial fan air-assisted sprayer (volume applied 850 l/ha).

Results

Spray deposition tests pointed out that at the development of fruits growth stage (BBCH 71) the ISAFRUIT sprayer equipped with the active CIS enabled to obtain an average spray deposit on the leaves very close to that achieved switching off the sensors, even if the volume applied using CIS (435 l/ha) was nearly halved with respect to the reference thesis (850 l/ha). The use of sensors enabled to improve the spray deposition especially on the top part of the canopy and to reduce the average ground losses. With full vegetation (BBCH 91) it was confirmed that, employing the ISAFRUIT sprayer and using the conventional nozzles, CIS prototype allowed to keep an analogue average spray deposit on the leaves with respect to the full volume application rate. Use of air induction nozzles, on the other hand, resulted less efficient when CIS was activated. But all average spray deposits on leaves obtained using the ISAFRUIT sprayer (either with or without CIS activated) resulted higher than those obtained employing the conventional axial fan air-assisted sprayer. For what concerns deposition on fruits, slight differences were observed among the average spray deposits obtained in the five treatments examined.

Results of biological tests pointed out that the incidence of apple scab and of powdery mildew on leaves, observed at the end of June, were very low and resulted no statistical difference between the three spraying conditions examined. Similar results were observed for the green apple aphid. At harvest time damage on fruits due to apple scab and to powdery mildew was very low and no significant differences were observed between the treatments examined.

References

Balsari, P., Doruchowski, G., Marucco, P., Tamagnone, M., Zande, J.C. van de, Wenneker, M. (2008) A System for Adjusting the Spray Application to the Target Characteristics – CIGR E-Journal, Manuscript Alnarp 08 002, Vol. X, May 2008.