

Sprayers' classification according to their performance in terms of spray deposition quality

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Introduction

The French national action plan EcoPhyto aims to reduce the amount of plant protection products used in agriculture. Several studies carried out in the vineyard have shown that the ability of the sprayer to target precisely the sprayed vegetation and to mitigate the losses in the environment, is an important lever to achieve dose reduction without any loss in terms of crop protection reliability. Nevertheless, the lack of objective assessment of spray quality do not allow advisers and vine growers to take properly into account this criteria when choosing a new sprayer. To answer an order of the French institutions, the objectives of work was to classify the sprayers according to their performance in terms of spray deposition quality.

In order to assess the diversity of spray application techniques in standard conditions, IFV and IRSTEA developed an artificial vine called EvaSprayViti. This test bed can mimics three different growth stages of the vine. During 2013 and 2014, 11 sprayers were tested with different settings at the three standard growth stages. The total amount of tests realized during these two seasons is about 200.

A summary of these tests is analyzed in order to propose a method of multi-criteria classification of sprayers' performances in terms of spray application quality.

Materials and methods

The artificial vine EvaSprayViti consists of four 10 meters long rows that aim at reproducing the characteristics of canopy and at limiting edge effects (Codiset *al.* 2013). The row spacing implemented was 2.5 meters.

Collection rows were composed of artificial leaves dedicated to capture and assess spray deposit on the canopy. Tartrazine (E102) was used as tracer. After spraying, all the leaves were collected in box before analysis. The analyses of the boxes provided the quantity of deposit per unit of leaf area for one gram of tracer sprayed per hectare (unit: ng/dm² for 1g/ha). The distribution of tracer within the canopy was evaluated by segmenting the vegetation structure into compartments: 4 for early stage (4 depths), 6 for medium stage (left and right at 3 heights: low, middle, high), 9 for full growth stage (left, center and right at 3 heights: low, middle, high).

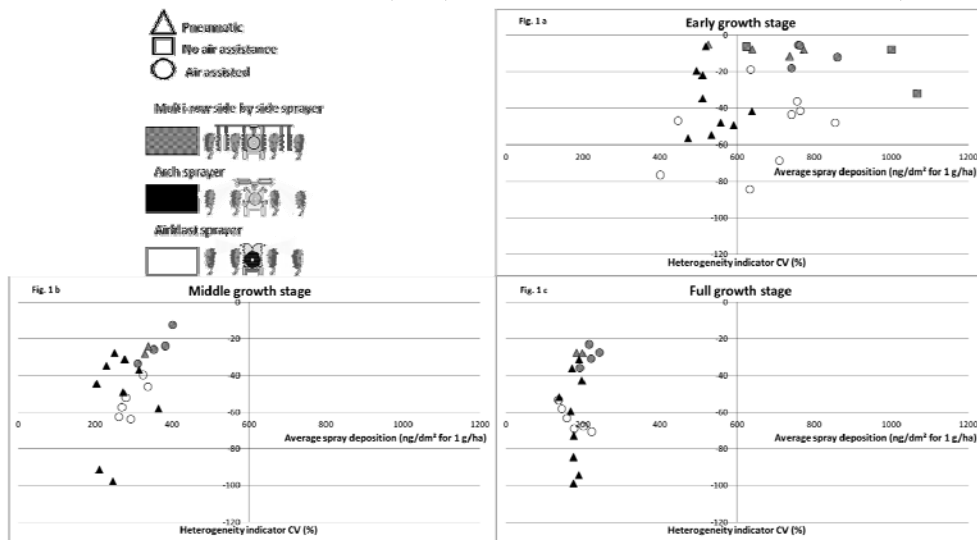
Two indicators of spray application quality were defined:

- the average quantity of deposit per unit of leaf area for one gram of tracer sprayed per hectare (unit: ng/dm² for 1g/ha) calculated for the whole vegetation;
- the coefficient of variation of deposits measured in each compartment of vegetation expressed in % of the average deposit.

In order to build a method of classification of sprayers according to spray deposition quality, the performance of 11 sprayers was assessed at three different growths stages for several settings of the machines. Considering the fact that spray quality offered by a given sprayer highly depends on the settings implemented, reference settings had to be defined for each kind of sprayer. For any parameter likely to be set, the definition of reference settings has been carried out taking into account two factors: the range of variation currently run into the field and the manufacturer recommendations. Then, for each assessed sprayer, a performance evaluation was carried out for every defined reference setting.

Results

For each reference application technique, defined as a couple (sprayer model; reference setting), the related performance was represented by a point which coordinates are the two indicators of spray quality (average deposition; coefficient of variation). The figure 1a, 1b, 1c below represents the measures carried out at respectively early, middle and full growth stage using EvaSprayViti.



This synthetic representation enables to get a global view of vineyard sprayers' performance. The same scale has been voluntary used in the three graphics in order to view the effect of vegetation growth stage on deposits amount. At full growth stage, the gaps of performance between the different applications techniques are mainly linked to the homogeneity indicator whereas both indicators are showing differences of performance at early growth stage.

Whatever the growth stage and the technology (pneumatic, air assisted or not), multi-row side by side sprayers appear to be the typology offering the best spray quality according to both criteria, average amount of deposits and homogeneity of deposits (representative points located on the top right of the figures). It appears that pneumatic arch sprayers and airblast sprayers are offering very variables quality of spray depending on the commercial model and the applied settings and practices.

In order to answer the order of the French ministry of agriculture to classify the different sprayers according to their performance, an aggregation of the multiple indications obtained has to be considered. To achieve a relevant choice of an aggregated indicator, epidemiologic knowledge will be mobilized.

Acknowledgments

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References

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