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INTRODUCTION

Spray quality is a key point to optimise the use of plant protection products while maintaining the effectiveness of the crop protection. The French Plan Ecophyto2+ encourages the use of high-performance application techniques. This requires the ability to assess and classify sprayers on objectively measured indicators. The PerformancePulvé® sprayers labelling system, targeted to winegrowers, guarantees the performance of vine sprayers through an objective assessment of their sprayer's quality and potential in terms of plant protection products reduction through trials (Vergès et al., 2017). The trials are carried out on the EvaSprayViti test bench, which mimics 4 rows of vine at 3 different growth stages (Codis et al., 2013). The objective of the Performance Pulvé Arbo project (2021-2023) is to extend this approach to the fruit-growing sector. A new test bench that mimics three rows of orchard has been developed to assess performances of fruit trees sprayers in terms of deposits and drift. The characteristics of the test bench were determined according to a panel of LiDAR characterizations of more than 200 orchards located in France. To overcome climatic conditions and to be able to work all year-round, the tests are carried out indoor a platform located at CTIFL in Bergerac. This article presents the ongoing work on the performance of the deposits of the project PerformancePulvé Arbo led by the CTIFL, in partnership with IFV and INRAe.

MATERIALS AND METHODS

The test bench is made up of three rows of 10 meters long and includes two parts: The first part was a measurement section, consisted of 1 custom-designed metal support that enables the collection of spray deposits from on the artificial leaves. The second part of the test facility was a section without measurement, consisted of 16 insect proof nets (mesh size: 3.4x2.2mm, and fiber diameter: 0.3mm) mounted on either side of 8 custom-designed metal supports to simulate different levels of canopy porosity. Designed to reproduce a fruit hedge, the height, the width and the porosity are adjustable to mimic two growth stages. The early stage (until blossoming) was 3.30 m high and 1.45 m wide whereas the full growth stage was 3.80m high and 1.90 m wide. The tests were carried out with an inter-row spacing of 4.2 m, (Fig. 1).

Figure. 1. Performance Pulvé arbo test facility located in TITEC platform.

The measurement section contains branches each with 14 leaves consisting of a fibrous tarpaulin used to collect and assess the spray deposition on the canopy. The leaves are bounded by a branch made of the same material; 12 branches constitute a frame. 24 frames are present

in the early stage and 36 in full vegetation. The tracer used for trials was tartrazine (E102). After spraying, the branches were collected and placed separately in boxes, (one per box) then washed with demineralized water. The individual analyses of the boxes provided the amount of tracer per unit of area for one gram of tracer sprayed per hectare (unit: ng/dm² for 1g/ha). The following table describes the configurations chosen for the tests considering the stage of vegetation and the row spacing of 4.2 m.

Table 1. Characteristics of the measurement section simulating two possible stages of vegetation.

Growth stage	Early	Full
Number of leaves / branches	1680 / 120	3024 / 216
Number of layers	2	3
Leaf Area Index (m²/m²)	1.19	2.13

Net benches are structures with insect proof nets that aim to replicate the air porosity characteristics of the canopy and limit edge effects. The dimensions are adjusted according to the measurement section. The sprayers used were Nicolas ASI Magistral and Chabas Opti-ajust, with 3 replicates for each sprayer and each step. The first step consisted in validating the number and arrangement of branches for each stage of vegetation (according to a fixed leaf area index), and the repeatability of the method. The second step aimed to study the minimum sampling to be carried out to guarantee the reliability and reproducibility of the results. The third step aimed to study the sensitivity of the method using a completely different type of sprayer.

RESULTS AND DISCUSSION

The results obtained made it possible to validate the characteristics chosen for each stage of vegetation, thanks to the consistency of the deposits with respect to previous results. The coefficients of variation depending on the stage and the sprayer were between 2.5% and 4.4%, showing very good repeatability of the method. For the Opti-adjust sprayer, the coefficients of variation according to height and thickness are respectively 20% and 10% at the early stage, 30% and 20% at the full vegetation stage. Sampling will be done over the entire height and over the 3 thicknesses. The deposits according to the width of the facility provided coefficients of variation of 3% whatever the stage. This will reduce the number of branches to be sampled by 66%. Both sides of the measurement section will be sampled to retain sufficient data for evaluation. The average deposit obtained at the early stage for the Magistral sprayer and the Opti-ajust were respectively 179 and 210 ng/dm² per 1g/ha, and 142 and 187 ng/dm² per 1 g/ha in full vegetation, i.e. a difference of 15% and 24% respectively. These figures are similar to those obtained during our trials in real orchard, during the French project PulvArbo (Verpont and Douzals, 2020).

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