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Assessment of drift and deposition from UAV sprayers in super-high-density olive orchards and agroforestry crops

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1 Introduction

Spraying drones are a powerful tool with potential to keep farmers' profitability and improve agriculture sustainability. However, the strict regulatory framework limits the adoption of this technology in the EU.

Objectives:

1. To quantify and model sedimenting spray drift generated by UASS under different operational conditions and compare these results with established terrestrial and aerial drift reference models.
2. Evaluate the implications of UASS adoption for environmentally sensitive areas through comparative drift analysis.
3. To propose best practices for UASS adoption, aiming to improve spraying and operational efficiency, reduce PPPs use, and support sustainable orchard management.

2 Methodology

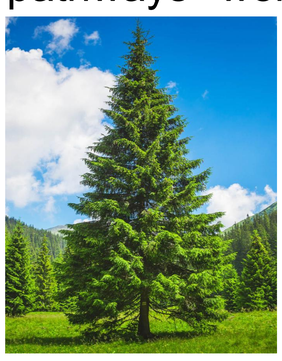
Three field studies were run in Spain in 2022 to compare Unmanned Aerial Spraying Systems (UASS) with a conventional tractor-mounted sprayers in super-high-density olive orchards, grapevines and pine plantations. In total there were 7 trials at 4 sites with 3 UASS models. The UASS flew along the row centre, 1.5 m above the canopy, spraying 10 - 50 L·ha^{-1}. Crop porosity and spraying dosage for the olive and grapevine orchards were estimated using the Dosa3D tool developed by the University of Lleida.

Trials followed ISO 22866 and 22522, only trials meeting the ISO weather requirements were considered for the analysis (three repetitions per sprayer). The tracer was tartrazine, quantified by spectrophotometry. Four pathways were measured:

- Sedimenting drift
- Airborne drift
- Soil depositions
- Crop depositions







UASS swath width was measured indoors to prevent wind disturbance and at the same spraying height and speed as in the field trials. Drift curves were fitted to the 90th percentile and compared with the European reference models (Rautmann, 2001and the aerial model developed by the European Working Group on Surface Water Scenarios, 2001).

3 Results

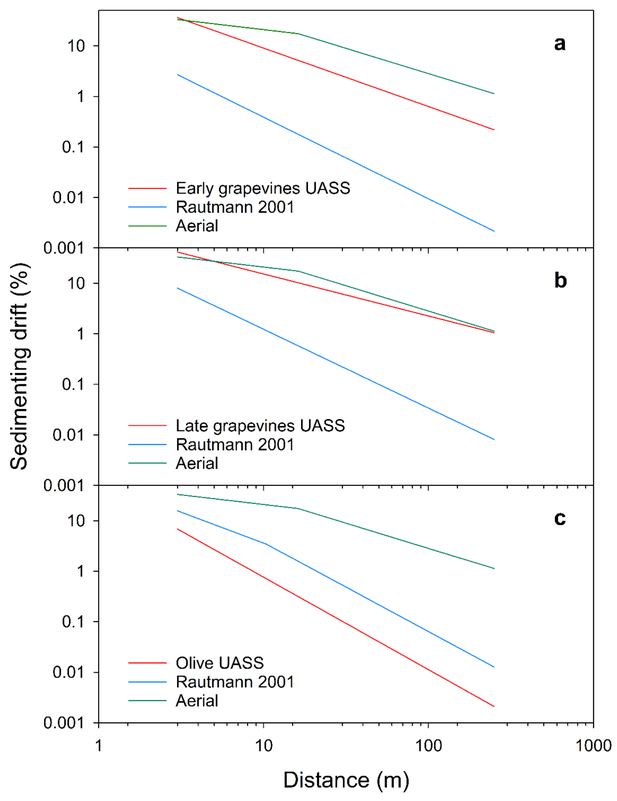
Olive orchards

- **Sedimenting drift**: Sedimenting drift fell significantly when spraying with UASS compared with conventional orchard sprayers.
- **Airborne drift**: UASS generated significantly lower airborne drift at 5 and 10 m downwind.
- **Soil deposition**: Total soil deposition did not differ significantly. The mist blower was higher at some intra row sampling points, UASS depositions were more variable.
- **Crop deposition**: Significantly lower with UASS. It peaked at the canopy top instead of at mid-canopy.

Drift curves across crops

- **Olive**: UASS drift was below both the terrestrial and aerial reference models
- **Grapevine**: drift was above the terrestrial modes and close to the aerial model
- **Pine**: No reliable curve could be fitted and drift was high.

4 Discussion



Vertical spraying and rotor downwash direct the spray into the canopy, explaining the lower sedimenting and airborne drift in hedgerow olives.

Performance depended on the crop, mainly through swath width. This is also the likely reason grapevine drift resembled conventional aerial spraying; the swath width was wider than the distance between rows.

In tall pines, high flight altitude and rotor vortices prevented a robust model.

5 Final Remarks

UASS can reduce drift in hedgerow crops such as super-high-density olive, but their performance depends on the crop and on matching swath width to canopy geometry. Wider adoption in Europe needs technical advances and a regulatory framework specific to UASS.