Study of Spray Swath in Relation to Canopy Deposition during Vineyard UAV Spray Applications

Alessandro Biglia \*, Marco Grella, Lorenzo Comba,

Alessandro Sopegno, Leandro Eloi Alcatrão,

Davide Ricauda Aimonino, Paolo Gay

Department of Agricultural, Forest and Food Sciences (DiSAFA) – Università degli Studi di Torino, Largo Paolo Braccini 2, 10095 Grugliasco (TO), Italy

\*Corresponding author: alessandro.biglia@unito.it, +39 011 670 9572

Co-authors: alessandro.biglia@unito.it; marco.grella@unito.it; lorenzo.comba@unito.it; alessandro.sopegno@unito.it; leandro.eloialcatrao@unito.it; davide.ricauda@unito.it; paolo.gay@unito.it

**Keywords.** Spray application, Aerial drones, Swath, Precision agriculture, Ground losses

**Abstract.** In the last ten years, unmanned aerial vehicles (UAVs) have been gained a raising interest for spray applications in 3D crops such as vineyards. For traditional UAV broadcast spray applications, that foresee flying perpendicular to the row orientation, the preliminary study of spray swath is a key factor. Indeed, an optimised fly path planned considering proper spray swath overlaps allows maximising the canopy spray deposition along the rows avoiding under- or over-spray situations. Achieving this goal is extremely challenging; furthermore, off-target spray losses, as well as inadequate spray canopy deposition, should be avoided as much as possible to safeguard the environment, food safety and human health.

Our research work was focused on the study of the relationships between the spray swath, the overlapping of different passes, and the canopy deposition during vineyard UAV spray applications. Six configurations were tested in an experimental vineyard (cv. Barbera), based on the combination of different UAV flight modes (1way and 2way broadcast), nozzle type (conventional, 110° 03 and 110° 015), and UAV cruise speeds (1 and 3 m⋅s-1). Three arrays of thirteen Petri dishes having a 140 mm diameter were arranged 20 m outside the vineyard to evaluate the spray swath. The three arrays of Petri dishes were located 5 m apart and placed perpendicular to the UAV flight path, while within each array, the 13 Petri dishes were placed 0.5 m distant from each other. Measurements of spray deposition in the canopy were performed at three locations along the UAV flight path, and at three heights and three depths per vine canopy, using filter paper discs of 120 mm diameter (90 g⋅m-2). Petri dishes were also placed in the middle of each inter-row to measure ground losses. To evaluate the spray swath effect on canopy deposition and ground losses, two additional sampling points were located at ± 1.6 m apart to UAV flight path (centre line) for each replicate using the same type of collectors (filter papers and Petri dishes).

The obtained spray swath allowed to optimise the UAV flight path planning, obtaining a distance of 2 m between two successive UAV flight paths. However, deposition measured within the spray swath outside the vineyard was higher than that measured in the canopy. Noteworthy, the ground losses were much larger than the canopy deposition values.