DRIVE
Drought Resilience Improvement in Vineyard Ecosystems

LIFE19 ENV/IT/000035

# Report on the definition of PocketPlant3D thresholds for quantifying initial water stress

## Sub-action B1.1

# Contents

# Abstract

This deliverable focuses on the activities conducted during the first two years of the project to define relationships between canopy architecture and physiological variables of plant water conditions for multiple grape cultivars, with the ultimate goal of identifying thresholds of synthetic indexes of canopy architecture corresponding to well-known thresholds of leaf stomatal conductance for moderate and severe water stress.
Dedicated field activities were conducted in 2021 and 2022 involving different grape cultivars. Multiple samplings were conducted during the season, to explore a wide range of plant water status. Each time, measurements involved both synthetic indexes of canopy architecture and water stress physiological variables.
Results highlighted clear relationships between canopy architecture and stomatal conductance, which can be used to identify the values of canopy architecture parameters corresponding to well-known thresholds of stomatal conductance for moderate and severe stress in grapevine for each variety. This would enable farmers to easily detect stressful conditions by simply using the DRIVE monitoring tool (MT).
The activities conducted also allowed to define a protocol for canopy architecture measurements suitable for operational contexts.

# Introduction

This deliverable focuses on the field activities conducted during 2021 and 2022 to define relationships between canopy architecture (evaluated with the app PocketPlant3D as implemented in the project's app PocketDRIVE) and water stress physiological variables for multiple grape cultivars. The ultimate goal was to use such relationships to define threshold values of synthetic indexes describing canopy architecture corresponding to well-known thresholds of stomatal conductance for moderate and severe water stress. This would allow to use the MT to easily and promptly detect early water stress in vineyards (see deliverable B2.1 for details on the MT functions and on the app PocketDRIVE).
This document provides only a general overview of the activities conducted and results obtained.
Detailed results will be made available publicly as scientific publications.

# Activities

To derive a first evaluation of the relationships between canopy architecture and plant water stress (*milestone B1.3*), dedicated field activities were conducted by UNIMI and UCSC **during 2021** in two demo-vineyards, one with cultivar Croatina, and one with the cultivar Malvasia di Candia Aromatica. During the summer, multiple sampling events were conducted, with both measurements of plant water status and canopy architecture acquired at each event.
Physiological measurements of plant water status were conducted by UCSC using a portable gas exchange analyser and a pressure chamber. Canopy architecture was evaluated by UNIMI using the app PocketPlant3D (as implemented in PocketDRIVE. Leaf angles were used to estimate synthetic indices of canopy architecture (e.g., Campbell, 1990).

Additional field activities were carried out **in 2022** (*milestone B1.6*), involving three grape varieties (Malvasia, Pinot Noir, Sangiovese). Sampling events were conducted during the summer to explore a wide range of water stress conditions, using the same protocol of measurements adopted in 2021.

To extend the analysis to more cultivars and to collect more data for improving the robustness of results, **complementary activities outside LIFE** were carried out by UNIMI during 2021 and 2022.

# Results

Results showed that the experimental activities allowed to explore a wide range of crop water status, with conditions close to optimum during the early field visits and for well-watered treatments, and water stress increasingly higher while moving through the summer, especially for not irrigated treatments. Overall, observed values of stomatal conductance ranged indeed between values lower than 10 $mmol \cdot m^{-2}\ s^{-1}$ to values higher than 500 $mmol \cdot m^{-2}\ s^{-1}$.

Clear relationships were found between canopy architecture and stomatal conductance, regardless of the cultivar analysed ($R^2$ always higher than 0.70). Correlation of canopy architecture with leaf water potential and net assimilation was instead less clear, highlighting the role of factors other than water stress in defining these specific physiological responses.

The activities conducted in 2021 and 2022 also allowed to define a protocol for canopy architecture measurements. The analysis of of the data collected with the app showed indeed how the angles of around ten leaves collected in the middle of the canopy (Figure 1) are enough to derive reliable estimates of canopy architecture, thus confirming the suitability of this approach for water stress evaluation for operational contexts.

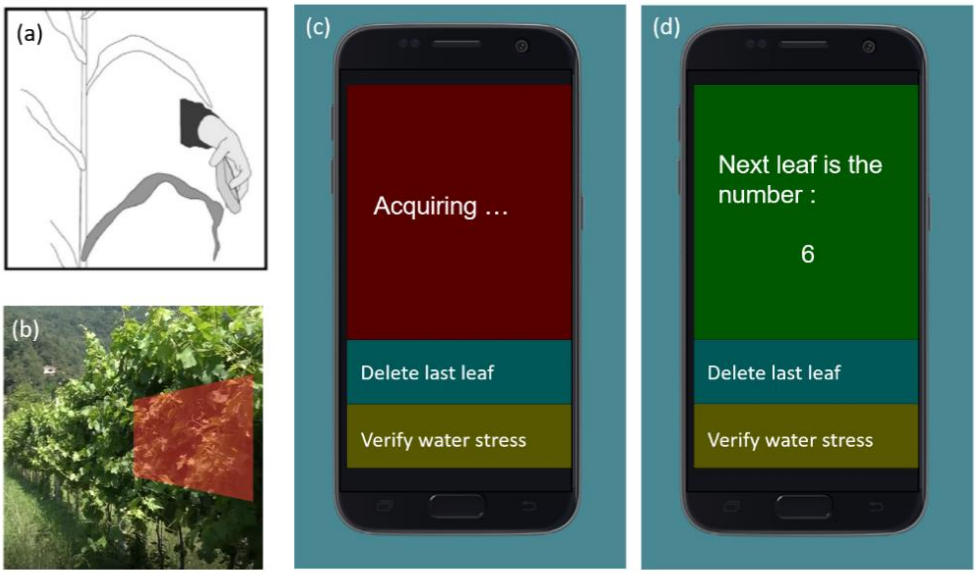


*Figure 1. Collection of leaf angles with the app PocketDRIVE to evaluate canopy architecture and verify water stress occurrence. The device has to be kept parallel to the leaf main axis (a). The angle collection should involve leaves in the middle part of the canopy (b) and can be started by clicking on the red button (c). The app keeps count of the leaves measured (d) because at least 10 leaves are needed to derive reliable estimates of canopy architecture.*

# References

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