LIFE 14 CCA/GR/00389 - AgroClimaWater

UNIVERSITÀ DEGLI STUDI DELLA BASILICATA

Stomatal and hydraulic water transport factors in mycorrhizated olive trees

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BACKGROUND AND AIM

Several models predict that climate change will cause growing seasons in various cropped areas to become hotter and drier. This will negatively impact crop profitability and in turn trigger socio-economic uncertainties.

The European Project AgroClimaWater (Life14 CCA/GR/00389) is committed among others tasks to rise the awareness of growers regarding climate change impacts and to build adaptive capacity of farmers and their organisations to climate change. AgroClimaWater is also pursuing the determination and application of agricultural practices that increase water use efficiency in perennial crops.

Water uptake and transport are complex processes affected by root hydraulic conductance and water utilization, as mediated by leaf. Arbuscular mycorrhizal (AM) fungi may colonize roots and regulate water flux across the tree contributing to the overall water economy of the tree. This study test whether AM colonisation has a beneficial effect on total root hydraulic conductance and leaf gas exchange parameters in olive trees both well irrigated and under drought.

MATERIALS AND METHODS

Approx. 20 2-year old potted olive trees were inoculated with *Glomus intraradices. A* group of 10 inoculated trees were kept well irrigated (WI) (-0.5 MPa predawn leaf water potential, Ψ) while the remaining were progressively droughted (D) till a value of -2 MPa Ψ. Additional 20 trees were not inoculated and served as control.

Root hydraulic conductance (*K*, kg s^{-1} MPa^{-1}) was calculated using an HCFM (Dynamax, Inc. Houston, TX - USA) measuring the water flow forcing distilled water into the excised root system. Values of *K* were calculated after cutting plants a few centimetres above ground and carefully mounting the compression coupling head on the cut surface (see inset of HCFM below). The slope of the linear regression (over the range of 0.1-0.5 MPa pressures applied) between water flux (F) and pressure (P): $K=\Delta F/\Delta P$ represented the hydraulic conductance.

Leaf transpiration (E), assimilation (A) and stomatal conductance (g_s) were appraised through an open-flow portable photosynthesis system (LI-6400; Li-Cor Inc., NE, USA) on 3-5 leaves per tree. Measurements were carried during 7-17 h interval time.

A view of the HCFM. In the inset: the coupling hedge fitted to a cut trunk

The Li-6400 for the gas exchanges measurements.

RESULTS

The root systems of olive trees showed ~45% increased *K* when colonised with *Glomus intraradices.* That positive effect was detected under both drought and well irrigation conditions (Fig. 1).

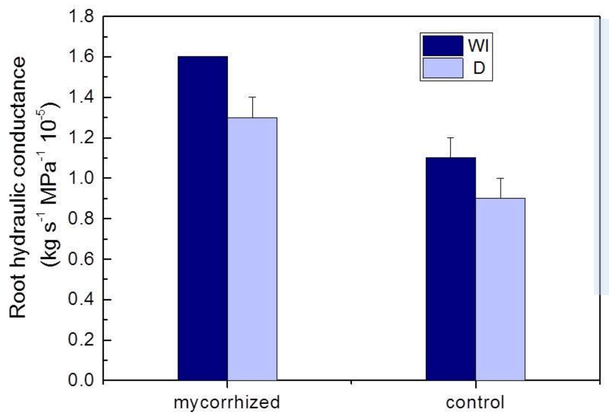

Figure 1 Mean root hydraulic conductance (±SE) measured in mycorrhized and control olive trees under well irrigation (WI) and drought (D) conditions.

In WI and D trees, values of *A* remained similar in control and mycorrhizated trees although a transient increase of *A* was detected early morning in WI ones (Fig. 2). Concomitantly, on a mean daily basis a 30% (WI) and 40% (D) lower *E* were registered in mycorrhizated trees compare to non mycorrhizated. Mycorrhizas induced a 55% reduction of g_s in WI trees while no clear effect was detected on g_s of D ones (Fig. 2).

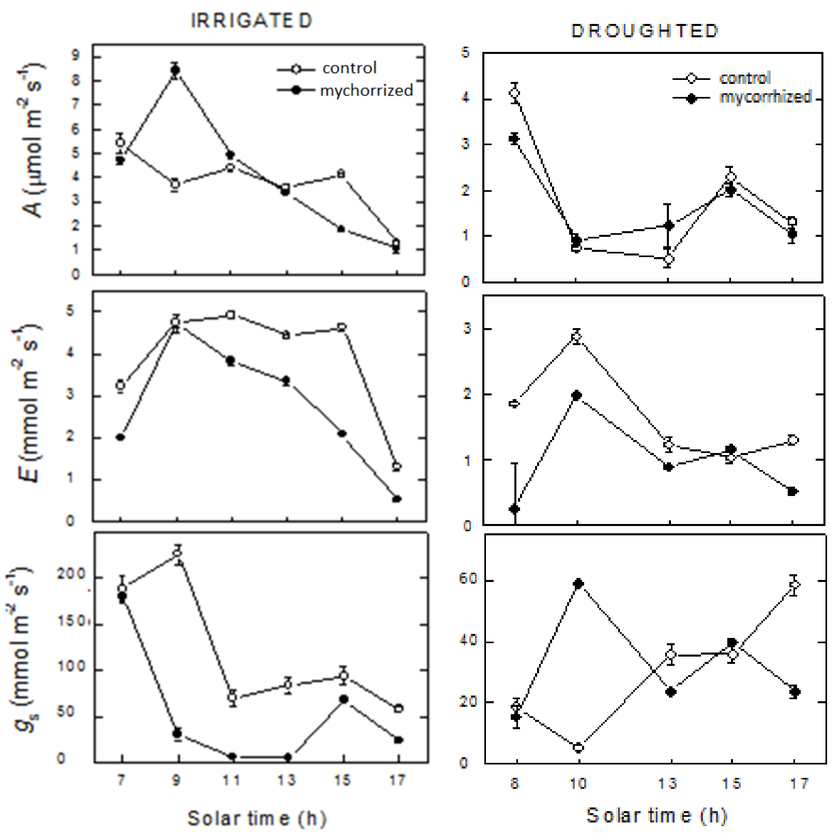

Figure 2 Daily pattern of leaf gas exchanges measured in irrigated (left) and droughted (right) mycorrhizated and control olive trees.

CONCLUSIONS

This study revealed that in WI trees AM may regulate both the hydraulic (i.e. increased *K*) and the stomatal (decreased g_s) factors affecting the transpiration and in turn increasing WUE. AM clearly improve *K* also under D conditions but more efforts are required to elucidate their role in stomatal regulations in D trees.

It could be concluded that knowledge and improvement of soil biodiversity level (including AM) through sustainable agricultural practices may be in favour of an optimal water use in agriculture to face some aspects of climate changes challenge.

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