



Title: “Effects of drought stress on mycorrhizal and non-mycorrhizal Cabernet Sauvignon grapevines, grafted onto various rootstocks”

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A Greek study as good and uncomplicated as dolmas. The authors study the effects of inoculating roots with mycorrhizal fungi (*Glomus mosseae*) on the water relations and photosynthetic rates of Cabernet sauvignon vines grafted to different rootstocks.

- The authors compared 8 rootstocks: 110 Richter, 41B Mgt, 1103 Paulsen, 5BB Kober, 44-53 Malegue, 140 Ruggeri, 101-14 Mgt, 775 Paulsen. These were grafted to Cabernet sauvignon cuttings, and once callused, they were planted in pots with a sandy soil low in phosphate (P) and organic matter. The pots were either inoculated with mycorrhizae (originating from roots of infected corn plants), or not inoculated. Both types of pots (inoculated and non-inoculated) were then either allowed to dry, or well-irrigated (1 liter of water 3times per week to 5 liter-pots). The design was a completely randomized 8 x 2 x 2 factorial, with six blocks of eight rootstocks, two levels of water (well-watered or water-stressed), and two levels of mycorrhizal infection (presence or absence).

- **Root infection.** The authors verified that roots had been infected by isolating mycorrhizal spores, and also by taking samples of fine roots and assessing percentage of infection. All rootstocks had been widely colonized (whereas non-inoculated rootstocks showed marginal levels of colonization). The rootstock with the highest level of root colonization was 110R (90%), followed by 41BMgt, 1103P and 44-53 M. There was a very good correlation between the percent of root colonization and the number of spores.

- **Shoot growth/P uptake.** Mycorrhizal plants were more vigorous and had greater shoot dry weights (71-105 g/plant) than non-mycorrhizal plants (51-65 g/plant). Leaf P concentrations in infected plants (0.15-0.22 %) were also higher than in uninfected ones (0.09-0.18%). There was a significant effect of rootstock variety on both shoot dry weight and leaf P concentration. In fact, mycorrhizal infection modified the classification of rootstocks based on shoot dry weight. The inoculated rootstocks with the highest shoot dry weights were 110R > 41B Mgt > 1103 P > 5BB.

- **Water potential.** Irrigated plants showed no differences in pre-dawn leaf water potential due to rootstock or the presence of mycorrhizae. However, the presence of mycorrhizae in drought-stressed vines had very positive effects on leaf water potential, which was greater in mycorrhizal vines (-0.32 to -0.61 MPa) than in non-mycorrhizal vines (-0.5 to -1.07 MPa). Uninfected plants of rootstocks 101-14 Mgt, 5BB, and 775P were those with the lowest water potentials. Water potentials were extremely low after 8 days of drought for all rootstocks, included drought

resistant ones, that had been inoculated (140 Ru, 110R and 44-53M). The authors attributed the improved water status of mycorrhizal plants to either an increase of the absorbing surface due to the mycorrhizal hyphae, or to the fungus acting as a low-resistance pathway through the root cortex.

- **Stomatal conductance.** Stomatal closure is one of the mechanisms that plants use to protect themselves from excessive water loss. After 5 days of drought, mycorrhizal vines maintained higher stomatal conductances (more open stomates) than non-mycorrhizal vines. Stomatal conductances were particularly low after 8 days of drought in non-inoculated rootstocks 775P, 5BB, 41B Mgt, and 101-14 Mgt.
- **Photosynthesis rate.** Net photosynthetic activity was generally higher in irrigated vines than in non-irrigated ones. Additionally, photosynthetic rates were higher in mycorrhizal vines than in non-mycorrhizal ones. Thus, mycorrhizal infection had a beneficial effect on CO₂ assimilation in drought-stressed plants.

What are the take-home messages for the grapegrower?

_ the benefits of mycorrhizal infection were most obvious when P availability was low. Most soils will improve with mycorrhizae, but in low-P soils, mycorrhizal inoculation is probably a must.

_ rootstocks 140 Ru and 775P were the ones showing the most dramatic differences between mycorrhizal and non-mycorrhizal vines. Every rootstock tested showed improved shoot growth and improved P uptake when inoculated with mycorrhizae, but once again, if we happen to have 140 Ru or 775P, it would probably be wise to inoculate with mycorrhizal fungi.

_ cultural practices affect mycorrhizal colonization, and to stimulate vineyard mycorrhizal colonization, the authors recommend moderation with phosphate fertilization, and conservation of high levels of soil organic matter (for example through a cover crop that gets tilled under).

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