



## Response of ungrafted and grafted grapevine cultivars and rootstocks (*Vitis* sp.) to water stress

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- We are all familiar with the fact that different varieties respond differently to water stress. We are also familiar with the differences among rootstocks. But we know much less about how given scion-rootstock combinations respond to water stress. The goal of this work was to study the effect of grafting using different rootstocks on a vine's response to water stress, and what the mechanism involved may be.
- The authors planted all possible combinations of two main table grapes in Tunisia –Cardinal and Superior Seedless- and two rootstocks –SO4 and 110R- as rooted cuttings in 10 liter pots containing a sandy loam soil, and grew them in a greenhouse under controlled conditions. They also planted the varieties on their own roots, and the rootstocks without scion material. Initially, the vines were irrigated to saturation. Two months later, the vines were divided into 2 treatments: 1) **control**, which continued to receive regular irrigation 3X/week, and 2) **stress**, which received 20% of field capacity first, and later no irrigation altogether. The authors then compared the biomass, leaf area, water potential and osmolyte accumulation of the different treatments. (*Osmolytes* are small organic solutes that accumulate in the interior of cells and that play a role in cell volume and water balance).
- **Impact on biomass.** Drought affected the own-rooted *Vitis* cultivars much more than those that had been grafted. Grafting to either rootstock significantly increased the scion's vigor, as expressed in increased shoot dry-matter. As the authors point out, rootstocks are more vigorous than *Vitis vinifera*, and there are reports of grafting increasing vigor –and yield and grape quality as well.
- **Impact on leaf area.** When water was not limiting –control- Superior Seedless exhibited a more expanded leaf area than Cardinal. Grafting Cardinal on 110R –versus on SO4- increased leaf expansion, whereas grafting Superior Seedless on either rootstock had the opposite effect–decreased leaf area. When the stress was imposed, Cardinal on 110R was the combination that showed the most significant reduction of leaf area. The decline of leaf area is not only due to a reduction in biomass, but other factors –like hormones- are likely involved.
- **Impact on water potential.** The water potential of Cardinal vines decreased more when vines were own-rooted than when grafted to either rootstock. Superior Seedless showed much lower water potentials than Cardinal at all times –grafted or not. By definition, water stress lowers the water potential of sensitive plants more than tolerant, or drought-resistant, plants. That is, Cardinal was more water stress resistant than Superior Seedless.
- **Impact on metabolite accumulation.** The authors checked for levels of the following in leaves (not in berries!): 1) sugars, 2) proline, and 3) Na, K, and Cl ions. 1) Under stress, Cardinal did show increased leaf sugar (150% of control), but Superior Seedless showed the opposite trend. 2) Both cultivars showed a significant increase of leaf proline (about 5-fold the control). Finally, 3) increased K<sup>+</sup> was recorded in the stressed vines, but Na<sup>+</sup> and Cl<sup>-</sup> levels were not affected. Other reports have shown K<sup>+</sup> to be one of the most important ions to increase during water stress.

In conclusion, under stress conditions, Cardinal was able to maintain a relatively steady water status, had the least leaf area reduction, and accumulated more organic metabolites in leaves, than Superior Seedless. Therefore, the authors considered Cardinal a “drought-resistant cultivar”, and Superior Seedless a “drought-sensitive cultivar”. Among the rootstocks, 110R imparted the most vigor in normal conditions, but it was also the one that had the most negative effects on biomass and leaf area under stress. According to the authors, under drought conditions, SO4 seems to confer more stability and vigor to Cardinal, whereas 110R seems to be the better choice for the vigor of Superior Seedless.

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