TEXTURE-RELATED SOIL WATER-HOLDING CAPACITY MODULATES ABSCISIC ACID (ABA) EFFECTS ON GRAPEVINE ADAPTATION TO INCREASING DROUGHT LEVELS AND BERRY QUALITY (5.64)

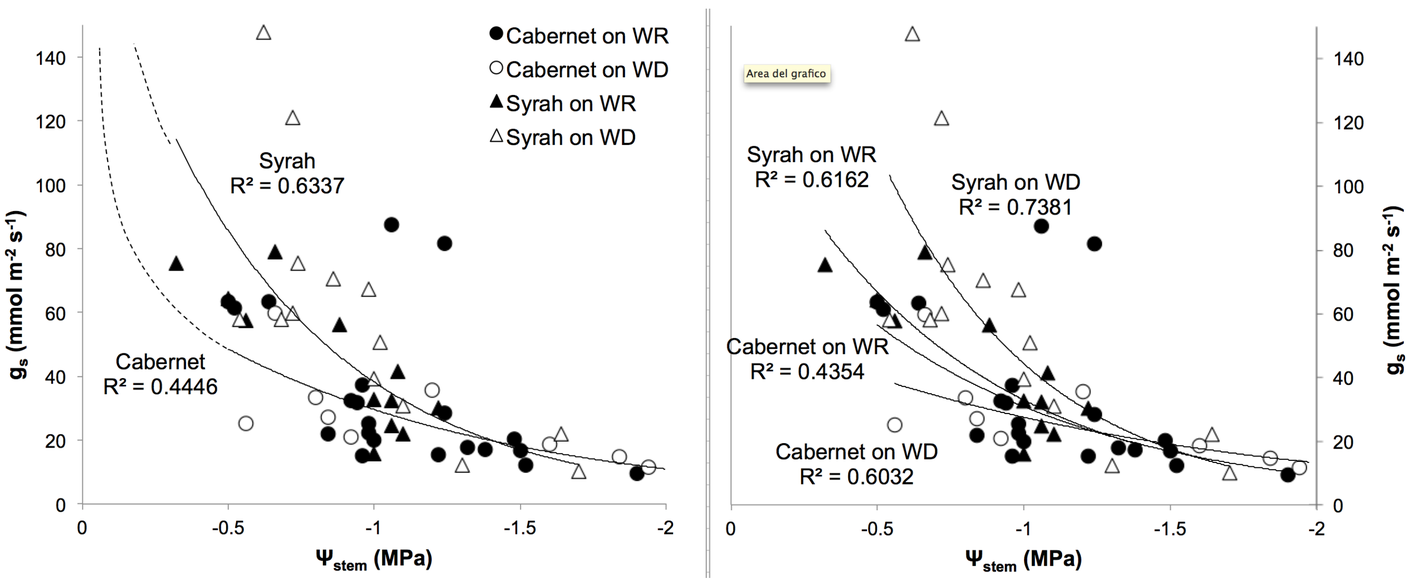
FERRANDINO A., VITALI M., CARLOMAGNO A., IVALDI G., KEDRINA O., SCHUBERT A., NOVELLO V., LOVISOLO C.
University of Turin, DISAFA, Largo P. Braccini 2, 10095 Grugliasco, TO (Italy)

Objectives:

In rain-fed vineyards, soil controls the productive potential additively to and even more than rootstock and scion. Soils with different texture, imposing specific conditions of water availability, could override the genotype effect, either of rootstock or scion, in the long term adaptability processes.

The aim of this work was to understand whether in rain-fed vineyard conditions an ABA related drought signal, putatively influenced by the texture related to water-holding capacity of the soil, drives ecophysiological plant adaptation to seasonal water availability, reflecting on grape ripening traits.

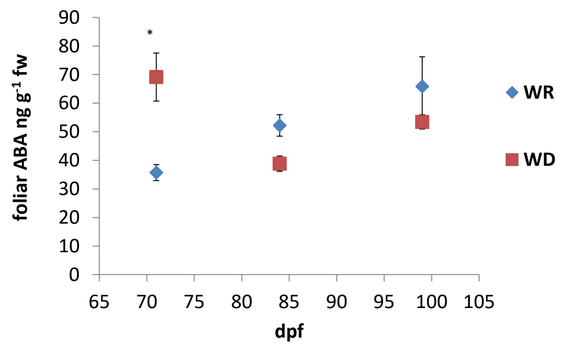
To this aim, field trials were followed on Nebbiolo vineyards established either on more clayey, water retaining (WR) or on more sandy, water draining (WD) soils. A parallel pot trial with two different substrates, showing different sand/clay ratios, at the extremes of the field textures, was carried on.



In potted grapevines (Tramontini et al. 2013 *Funct Plant Biol*), Syrah, anisohydric variety as well as Nebbiolo, was compared with Cabernet sauvignon, isohydric variety.

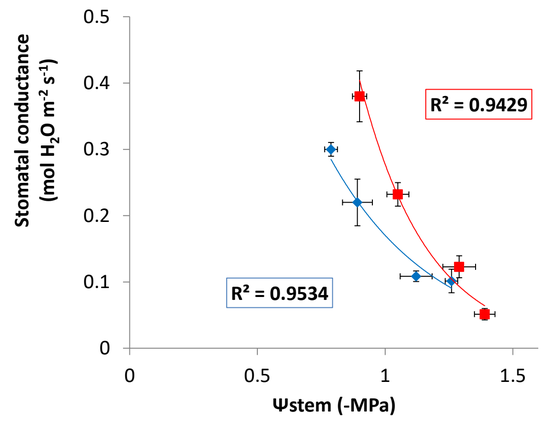
Compared with Syrah, Cabernet Sauvignon showed lower stomatal conductance (g_s) under mild water stress conditions without strong changes under severe water stress conditions characterising its isohydric behaviour.

The two cultivars on WD soil maximise their differences, whereas on WR soil they become minimised, either upon severe or mild drought stress.

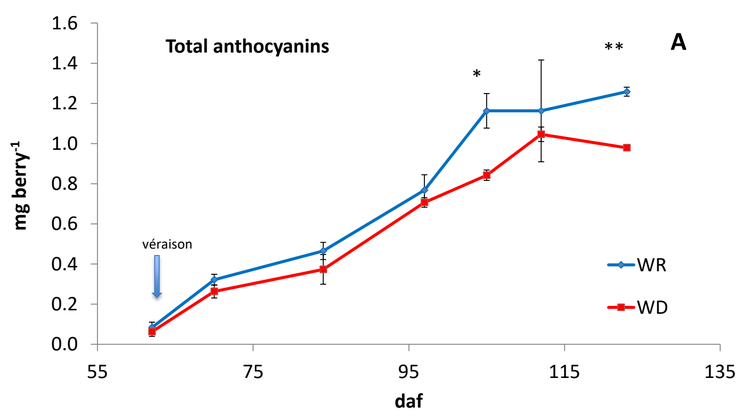


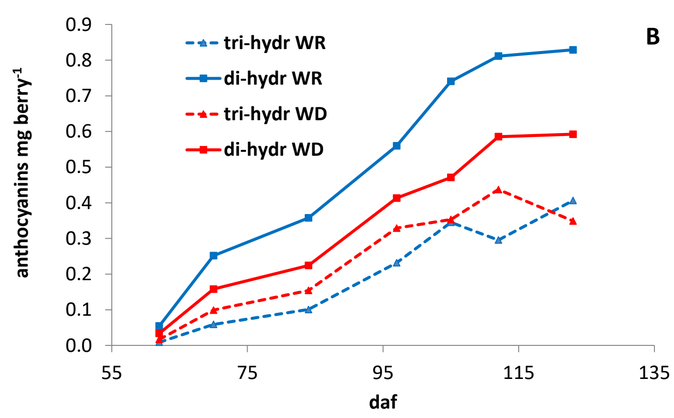
In a Nebbiolo vineyard (Cannubi, Barolo, Damilano cellar) in 2013, after a period of severe stress condition, rainfall events (the first during the second half of July correspondent to 45-60 days post-floraison, dpf, of about 50 mm of water and the second between August the 8th and the 14th, 68-72 dpf of 30 mm), restored soil water content. Following rainfall, leaf ABA content, that was initially higher in WD soil-grown vines which had previously experienced more severe water stress-conditions, dropped down.

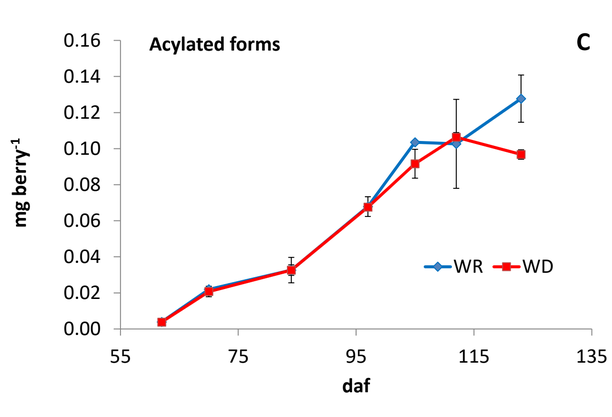
On the contrary, in WR soil-grown vines, leaf ABA concentration was lower during early summer months and progressively increased in the mild water stress conditions of the late season.



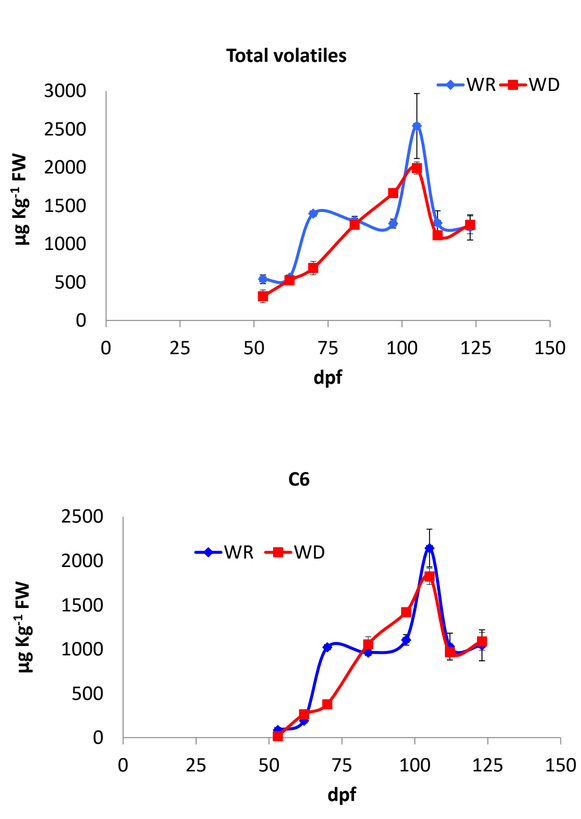
In Nebbiolo, the anisohydric behaviour experienced in WD soils (in red, right figure) was limited in WR soils (in blue), where an ABA-related stomatal closure was effective upon mild drought stress.

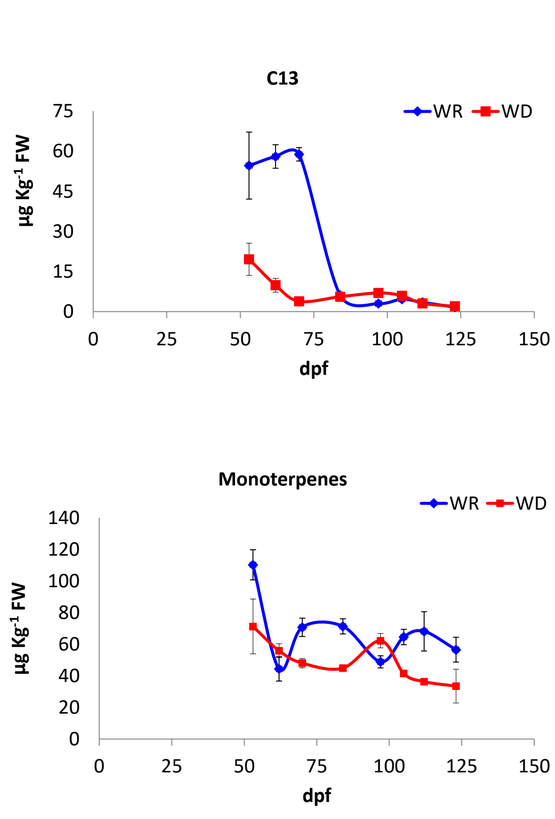






Total anthocyanins were similar in berries from the two water conditions until 10 days after véraison. Afterwards, in berries of plants experiencing mild water stress conditions (WR) in the late season, total anthocyanins increased more, resulting in a significant higher anthocyanin content at harvest (A). The prevalent Nebbiolo grape anthocyanin forms (di-hydroxylated anthocyanins) increased more than tri-hydroxylated forms (B) and soils inducing water retaining conditions favoured acylation (C), with possible positive consequences at the level of must stability and wine colour.





Total volatiles, C6 and C13 compounds, monoterpenes of Nebbiolo grapes cultivated in either clayey water retaining (WR) soils or sandy water draining (WD) soils.

C6 compounds = hexanal, (Z)-e-hexenal, (E)-2-hexenal and 1-hexanol.

C13 = ß-ionone + ß-damascenone.

Monoterpenes = D-limonene + eucalyptol + E-geranylacetone + geraniol

In WR soil-grown vines, experiencing mild water stress conditions during the late season, an increase in total volatiles, particularly C6 compounds, an accumulation of C13 compounds and a restart of monoterpene accumulation, that resulted in a significantly higher accumulation of monoterpene at harvest, were noticed. Accordingly to the profile (data not shown), in berries from WR vines there was a more rapid transformation of E-geranylacetone into geraniol (the odour-active compound, characterized by sweet floral notes).

Outline:

In water retaining (WR) soils, in the presence of higher percentage of clay, Nebbiolo response to water deprivation switched from aniso- toward iso-hydric control, maintaining water potential during drought periods through an ABA-related stomatal regulation. In parallel, in berries, anthocyanin accumulation was faster and their total content was higher at harvest; the berry anthocyanin profile differed in terms of hydroxylation and acylation. Also the accumulation of free volatiles, especially terpenes, was affected by texture related soil water-holding capacity.

Conclusions:

Mild water stress conditions experienced by grapevines in vineyards are prolonged in clayey WR soils, driving ABA-related plant responses both at the leaf (stomatal regulation) and at the berry (secondary metabolism induction) levels. Consequences on metabolite accumulation in berries increase must quality coming from WR soil-grown vines.