SOIL Discuss., 1, C388–C395, 2014
www.soil-discuss.net/1/C388/2014/

SOIL Discussions Open Access

Interactive comment on "Geospatial variation of grapevine water status, soil water availability, grape composition and sensory characteristics in a spatially heterogeneous premium wine grape vineyard" *by* D. R. Smart et al.

Anonymous Referee #2

Received and published: 22 December 2014

Geospatial variation of grapevine water status, soil water availability, grape composition and sensory characteristics in a spatially heterogeneous premium wine grape vineyard

D. Smart, S. Cosby Hees, R. Plant, O. Feihn, H. Heymann and S. Ebeler

Review

General comments

This paper deals with the highly interesting topic of the impact of environmental factors

on grape quality potential. It particularly focuses on the effect of intra-block variability of Soil Water Holding Capacity (called Available Soil Water or ASW by the authors in the paper). An original approach implemented by the authors is to establish a relationship between vine water status (as measured by Leaf Water Potential or LWP and Pre Dawn Leaf Water Potential or PDLWP) and sensory characteristics of berries. The authors gathered a large data set. However, the paper is too long and weekly structured. Some major references are missing. Unfortunately, once these references are included, the work will appear much less original as presented by the authors. Some of the early references on terroir research and the major role played by water relations in terroir expression are published in French which makes them less accessible. However, the authors cite several references of papers which are not published in English, so they apparently had access to non-English literature.

The authors write that "recent relational investigations are emerging and most involve water availability (...) as being a key factor" (p. 1015, lines 2-6). In fact, these investigations are neither recent nor emerging. The feeling that terroir expression might be mediated through water relations was first expressed by Seguin back in the 1960's (Seguin, 1969). This reference is not easily accessible, but most of Seguin's work has been summarized in English (Seguin, 1986). Impact of vine water status on vine development and grape composition, including skin phenolics, was shown some 35 years ago by Duteau et al., 1981. These authors assessed water relations in vines by establishing water balance with a neutron moisture probe. The use of LWP and PDLWP in terroir studies was first implemented by van Leeuwen and Seguin (1994). These authors established correlations between PDLWP vs shoot growth cessation, berry weight and grape anthocyanins. These relations were confirmed in van Leeuwen et al., 2004. It can be understood that the authors missed the French papers, but not that they missed the latter one, which was published in the American Journal of Enology and Viticulture. Intra-block spatial structure of vine water status using stem water potential was presented in van Leeuwen et al., 2006. The authors write "at least one investigation has focussed on naturally occurring water deficits (...) and found early

water stress (. . .) increased the concentration of anthocyanins and total phenolics in berry skins (Koundouras et al., 2006)". In fact, many others do exist, among which Duteau et al., 1981 (probably the first), van Leeuwen and Seguin (1984), Trégoat et al., (2002), van Leeuwen et al., (2004), van Leeuwen et al. (2009). For relations between grape composition and water availability see also the work of Costantini and co-workers (e.g. Costantini et al., 2012)

An original aspect of the study is the investigation of the relationship between vines water status and sensory attributes of berries. Several sensory parameters turn out to be significantly related to vine water status. However, the separation of the data points in two groups (with or without severe water stress) is not clear (figure 15). The metabolomic investigation is also one of the more interesting parts of the paper, although this aspect was already investigated by Perreira an co-workers (Perreira et al., 2005a and b, Perreira et al., 2007). Interesting correlations are found between vine water status and organic acids (not so surprising) and some amino acids (original result). However, once again the PCA does not allow a clear separation of the data set in two groups of stressed vs less stressed vines (figure 16).

A major weakness of the paper is that the question of irrigation is not well addressed. In the materials and methods section the vineyard is presented in three irrigation zones, but it is not explicitly said if the vineyard was irrigated in the two years of investigation. If the purpose of the study is to show the effect of SWHC on vine growth and grape composition, it would have made sense to withdraw irrigation during the years of investigation. When I started reading the paper I presumed this was the case, but at page 1042 lines 22-27 (after 29 pages!) the authors write that "the vines were irrigated with quantities of water (. . .) that did not meet ETc demand". No indication is given neither on the amount of water applied, nor at the threshold of WP levels at which the irrigation was triggered, nor if the whole block received the same amount of irrigation water. If irrigation was not uniform across the block, you are not measuring the effect of SWHC but the effect of spatially variable irrigation treatments. This information is absolutely

critical to make the paper acceptable for publication. It is also important to know if the same amounts of irrigation were applied in both vintages.

Several times the authors say that terroir is "quasi-mystical" (p. 1015 line 2, p. 1016 line 14). In fact, terroir has nothing mystical, but it is just multi-factorial, which males it not easy to study on a scientific basis.

The authors write that "LWP at midday (. . .) is a well-known method of assessing grapevine water status. Midday LWP can be influenced by solar radiation, wind, vapour pressure deficit and temperature. Thus it is not generally a consistent measure of vine water status relative to the soil water status since the environmental parameters can quickly change (p. 1020 line 25 – p. 1021 l. 2)". I suggest the authors to use in future work midday Stem Water Potential rather than midday Leaf Water Potential. SWP is much less influenced by the specific microclimatic environment of the leaf on which the measurement is carried out compared to LWP. SWP represents whole vine water status and is thus a more precise indicator of whole vine water status (Choné et al., 2001). It is surprising that the authors do not seem to have measured water potential post veraison (table 1).

It is surprising that no results from veraison assessment are included. Was there any spatial variability in veraison dates and if so, was this related to vine water status? This is not a trivial question. If differences in veraison dates do exist (and if veraison is more early on water stressed vines), that can explain different maturity levels of grapes at harvest. That would plead for a very early impact of water deficits on grape composition. If veraison dates are similar between water stressed and not water stressed vines, then differences in grape composition at ripeness would be the results of greater ripening speed in water stressed vines.

Soil depth and rooting depth are major drivers for vine water status (p. 1034, lines 16-17). I agree, see also Coipel et al., 2006. In this study soil depth seems to be the major driver of the variation in terroir expression which are observed. More emphasis could

be put on this point in the discussion: variation in soil depth → variation in SWHC → variation in vine water status → variation in grape composition and sensory attributes of berries.

Many references cited in the text are missing in the list of references. Among them Bonfante et al., 2011 (p. 1017, line11 and line 22); Busby, 1825 (p. 1018 line 15); Tisseyre et al., 2008 (p.1037 line 29). Reynolds and co-workers, please, specify year of publication (p. 1017, lines 11 and 22). The fact that soil minerals do not have a major impact on terroir expression (except nitrogen) was already published by Seguin in 1986 and van Leeuwen et al., in 2004. Please, insert these references.

Specific comments

p. 1015, l.8 Climatic, not cimatic p. 1019, l.2 SWHC ranges in fact from 50 to 350 mm in viticultural soils. p. 1019, l.25 Vitis vinifera in italics p. 1021 l.15 For the specific effect of water deficit on grape skin phenolics see also Ojeda et al., 2002 p. 2021 l.29 For the effect of water deficit on shoot growth cessation, see also van Leeuwen and Seguin 1994. p. 1022 l.11 For the effct of sunlight on skin phenolics, see also Spayd et al., 2002. p. 1023 l.18 Vitis vinifera and Vitis rupestris in italics p. 1024 l.18 One cannot say the timing of phenological stages is depending on geographic location as such. Climate (temperature) and cultivar are obviously major drivers of phenology, but soil type can also have a small effect (van Leeuwen et al., 2004). p. 1034 l.26 Rephrase sentence “Grapes from the less water stressed. . ..” p. 1049 l.20 van Leeuwen et al., 2003: range under “v” p. 1052 L.28 van Leeuwen C., ...

Concluding remarks

This research addresses an important topic and the authors gathered a valuable data set. However, major changes should be made before the paper can be accepted for publication. The first point is that irrigation management in the experimental vineyard must be clarified. If irrigation in minimal and uniform over the block, that would not impair the conclusions of the paper. However, if irrigation varied over the block, that

would completely change the conclusions. In that case variations in vine water status would not only be the result of variations in SWHC, but also in irrigation management. In that case, the paper should be completely re-written and could no longer deal with the “terroir” effect. However, relations between vine water status, vigor and grape composition would remain valid. The paper must be shortened. The introduction should be more focussed on the impact of vine water status and not so much on geology and a so-called “mystical” effect of terroir (it is just mystical for people who didn’t study it with an appropriate methodology). Relevant references to the impact of vine water status mest be included. Also, more references from precision viticulture work (Rob Bramley and co-workers, Bruno Tisseyre and co-workers) should be included. If the authors address all the issues raised by the reviewers, the paper can be resubmitted for a second round of reviewing.

References

CHONE X., VAN LEEUWEN C., DUBOURDIEU D. and GAUDILLERE J.P., 2001. Stem water potential is a sensitive indicator for grapevine water status. Annals of Botany 87, n°4, 477-483.

COIPEL J., RODRIGUEZ-LOVELLE B., SIPP C. and VAN LEEUWEN C., 2006. Âń Terroir Âż effect, as a result of environmental stress, depends more on soil depth than on soil type (Vitis vinifera L. cv. Grenache noir, Côtes du Rhône, France, 2000). J. Int. Sci. Vigne Vin. 40, n°4, 177-185.

COSTANTINI E., BUCELLI P. and PRIORE S., 2012. Quaternary landscape history determines the soils functional characters of terroir. Quaternary International 265, 63-73.

DUTEAU J., GUILLOUX M. et SEGUIN G., 1981. Influence des facteurs naturels sur la maturation du raisin, en 1979, à Pomerol et Saint-Emilion. Conn. Vigne Vin, 15, n°3, 1-27.

OJEDA H., ANDARY C., KRAEVA E., CARBONNEAU A. and DELOIRE A., 2002. Influence of pre- and postveraison water deficit on synthesis and concentration of skin phenolic compounds during berry growth of Vitis vinifera cv. Syrah. Am. J. Enol. Vitic., 53, 261-267.

PERREIRA G., GAUDILLERE J.-P., VAN LEEUWEN C., HILBERT G., LAVIALE O., MAUCOURT M., DEBORDE C., MOING A. and ROLIN D., 2005. 1H NMR and Chemometrics to characterize mature grape berries in four winegrowing areas in Bordeaux-France. J. Agric. Food Chem. 53, n°16, 6382-6389.

PEREIRA G., GAUDILLÈRE J.-P., VAN LEEUWEN C., HILBERT G., MAUCOURT M., DEBORDE C., MOING A. and ROLIN D., 2005. 1H NMR metabolite fingerprints of grape berry: comparison of vintage and soil effects in Bordeaux grapevine growing area. Analytica Chimica Acta, 353, 1-2, 346-352.

PERREIRA G., GAUDILLÈRE J.-P., VAN LEEUWEN C., HILBERT G., MAUCOURT M., DEBORDE C., MOING A. and ROLIN D., 2007. 1H-NMR metabolic profiling of wines from three cultivars, three soil types and two contrasting vintages. J. Int. Sci. Vigne Vin. 41, n°2, 103-109.

SEGUIN G., 1969. Alimentation en eau de la vigne dans des sols du Haut-Médoc. Conn. Vigne Vin, 2. 93-141.

SEGUIN G., 1986. “Terroirs” and pedology of vinegrowing. Experientia, 42, 861-873.

SPAYD S., TARARA J., MEE D. and FERGUSON J., 2002. Separation of sunlight and temperature effects on the composition of Vitis vinifera cv. Merlot berries. Am. J. Enol. Vitic., 53, 171-182.

VAN LEEUWEN C. et SEGUIN G., 1994. Incidences de l’alimentation en eau de la vigne, appréciée par l’état hydrique du feuillage, sur le développement de l’appareil végétatif et la maturation du raisin (Vitis vinifera variété Cabernet franc, Saint-Emilion, 1990). J. Int. Sci. Vigne Vin, 28, n°2, 81-110.

VAN LEEUWEN C., FRIANT Ph., CHONE X., TREGOAT O., KOUNDOURAS S. and DUBOURDIEU D., 2004. The influence of climate, soil and cultivar on terroir. Am. J. Enol. Vitic., 55, n°3, 207-217.

VAN LEEUWEN C., GOUTOULY J.-P., AZAIS C., COSTA-FERREIRA A.-M., MARGUERIT E., ROBY J.-Ph., CHONE X. and GAUDILLERE J.-P., 2006. Intra-block variations of vine water status in time and space. VIth international terroir Congress, 2-7 July 2006, ENITA de Bordeaux – Syndicat Viticole des Coteaux du Languedoc, France, 64-69.

VAN LEEUWEN C., TRÉGOAT O., CHONÉ X., BOIS B., PERNET D. and GAUDILLÈRE J.-P., 2009. Vine water status is a key factor in grape ripening and vintage quality for red Bordeaux wine. How can it be assessed for vineyard management purposes? J. Int. Sci. Vigne Vin, 43, n°3, 121-134.

Please also note the supplement to this comment:
http://www.soil-discuss.net/1/C388/2014/soild-1-C388-2014-supplement.pdf

Interactive comment on SOIL Discuss., 1, 1013, 2014.