A Metabolomics based Approach to Characterize Differences in Wine Volatiles Caused due to Rootstocks and Irrigation

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Show me Grape and Wine Symposium

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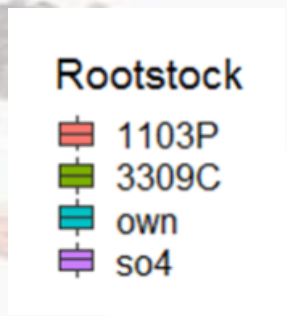
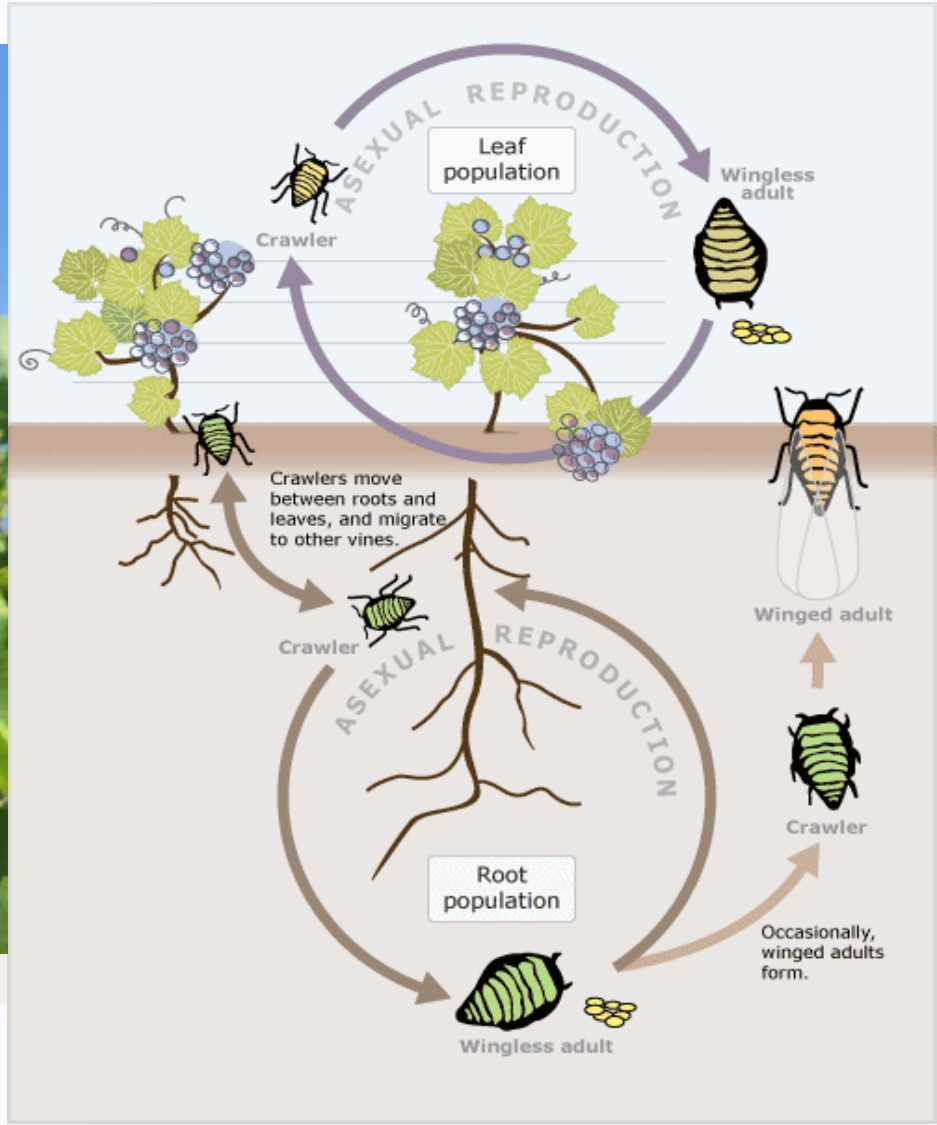


Grafting in grapevines:

- The invasion of European grape industry by the soil-borne aphid- like insect phylloxera (*Daktuloasphaira vitifoliae* Fitch)
- Rootstocks from North American species were grafted
- *V. riparia, V.rupestris and V. berlandierii*
- 80% of all vineyards grow grafted grapevines



https://teara.govt.nz/en/diagram/18318/phylloxera-aphid-life-cycle

Rootstocks can impact scion phenotypes

- Water and nutrients uptal
- Vine vigor and canopy configuration
- Fruit ripening
- Yield
- Berry composition

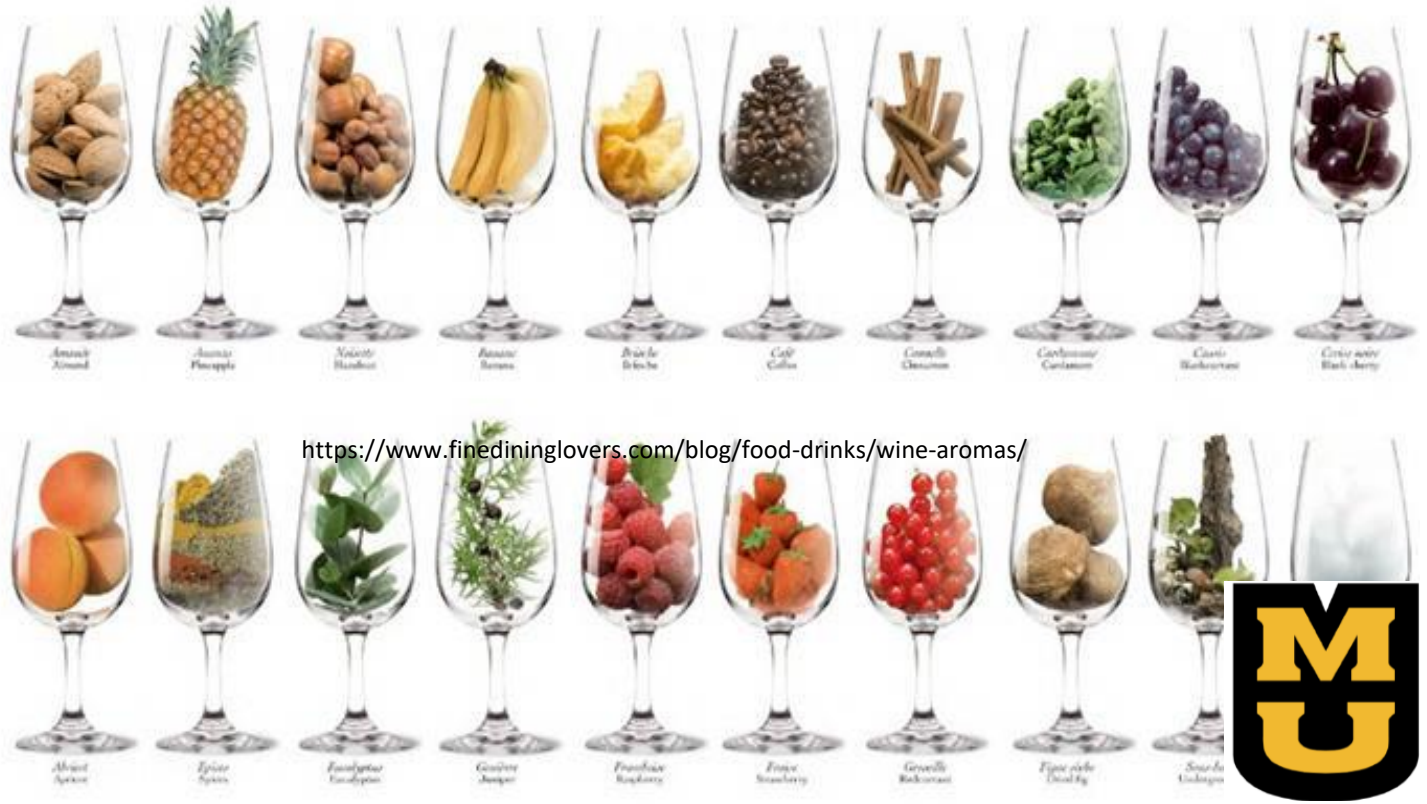
Rationale for this study:

- Hybrid grapes are mostly grown own-rooted (ungrafted)
- Besides tolerance to phylloxera, rootstocks confer many advantages including biotic and abiotic advantages
- The impact on hybrid wine volatiles due to rootstocks is not well explored
- How irrigation and rootstocks impact wine volatiles?

vitisroots

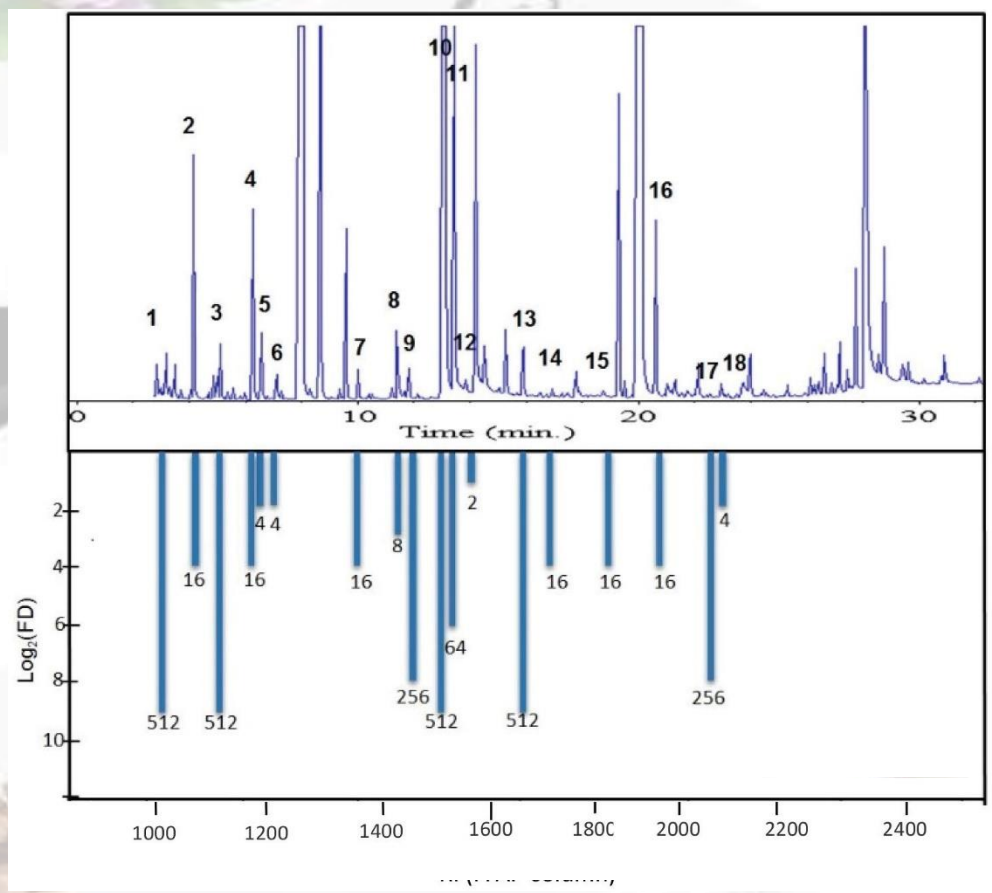
What are Aroma compounds:

- Low molecular weight compounds
- Contribute to the complexity of the wine flavor
- Floral, fruity, nutty, spicy or herbaceous aromas
- Aldehydes, alcohols, esters, hydrocarbons, ketones, furans and unidentified compounds
  - Grape-derived volatiles
  - Oak-derived compounds
  - Fermentation- derived compounds



https://www.finedininglovers.com/blog/food-drinks/wine-aromas/

How do we measure aromas?



Gas Chromatography Mass Spectrometry (GC-MS)

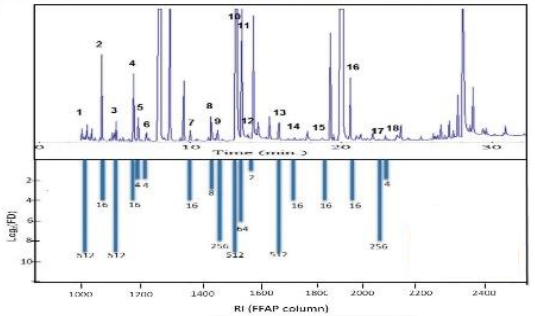
Untargeted metabolomics:

- Global profiling of the metabolome
- Extraction and detection of as many metabolites as possible
- Qualitative and relative quantification

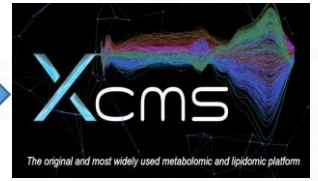
Targeted metabolomics:

- Accurate quantifications of a select group of intended metabolites
- Time consuming

Metabolomics workflow:



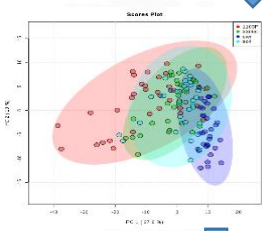
.D files from GCMS

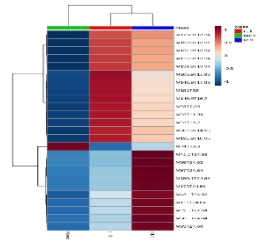


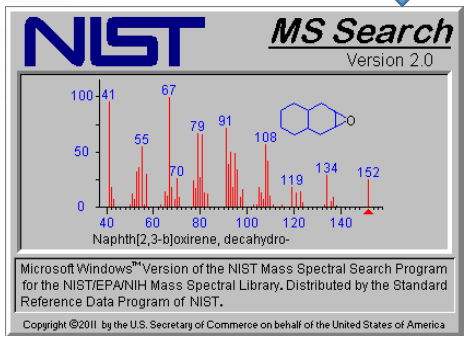
Feature detection, baseline correction, retention time correction

Features were processed using

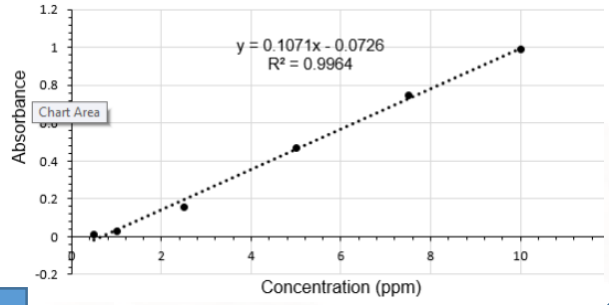
- Normalization by sum
- Log-transformation
- Autoscaling





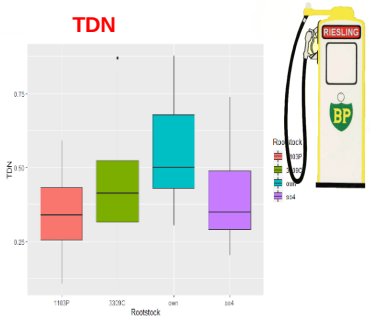


Identification of compounds from the features with Retention index and NIST library



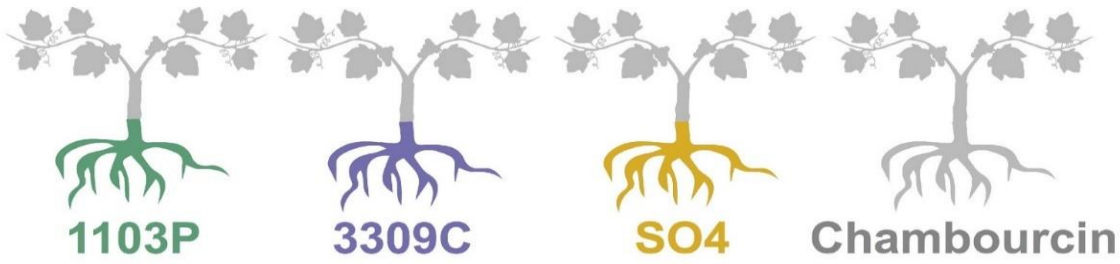
Confirmation and quantitation of compounds with authentic standards and calibration curve

Statistical analysis using R studio



Analysis and Interpretation

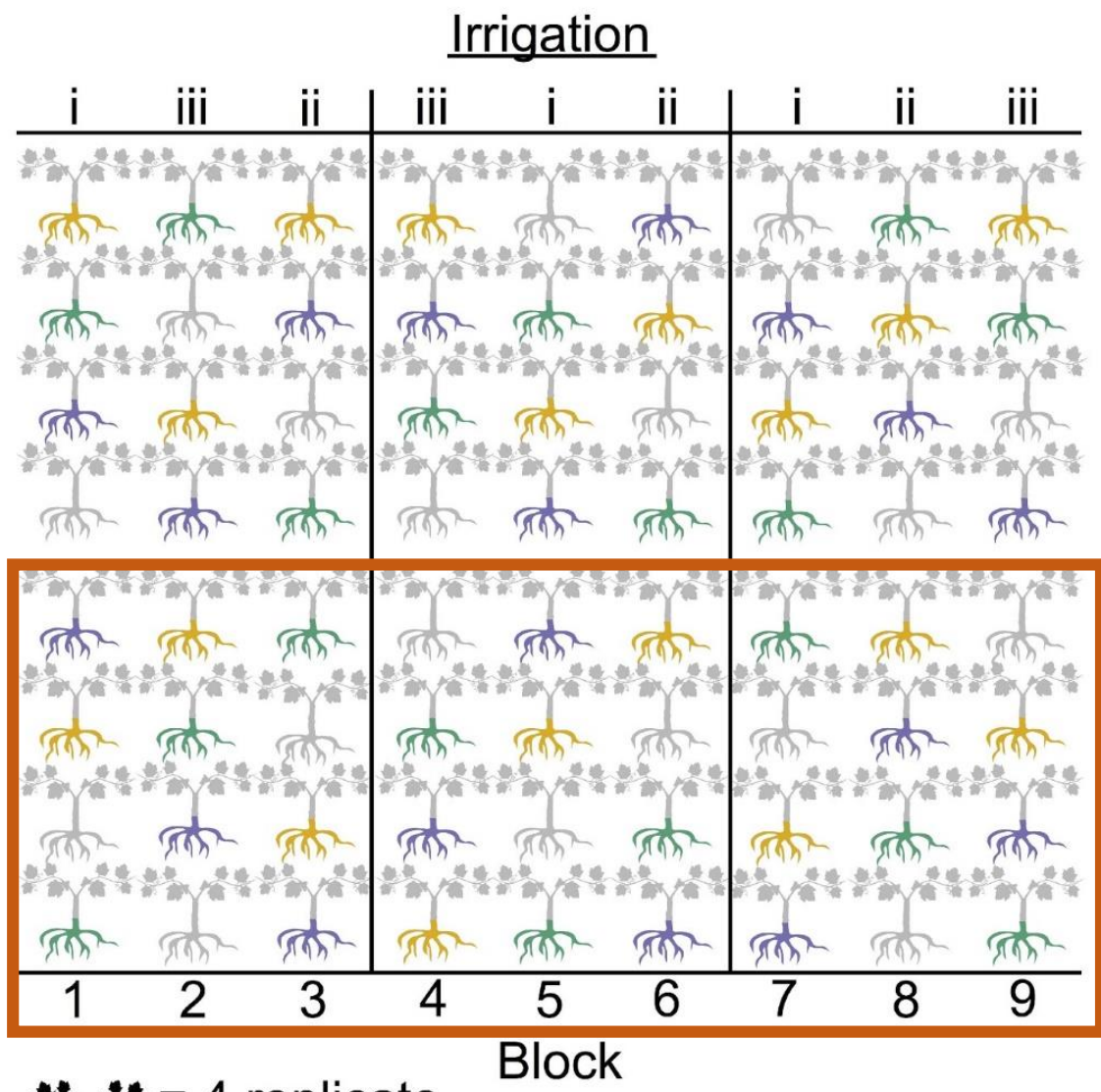
Scion: Chambourcin (a French American grape)



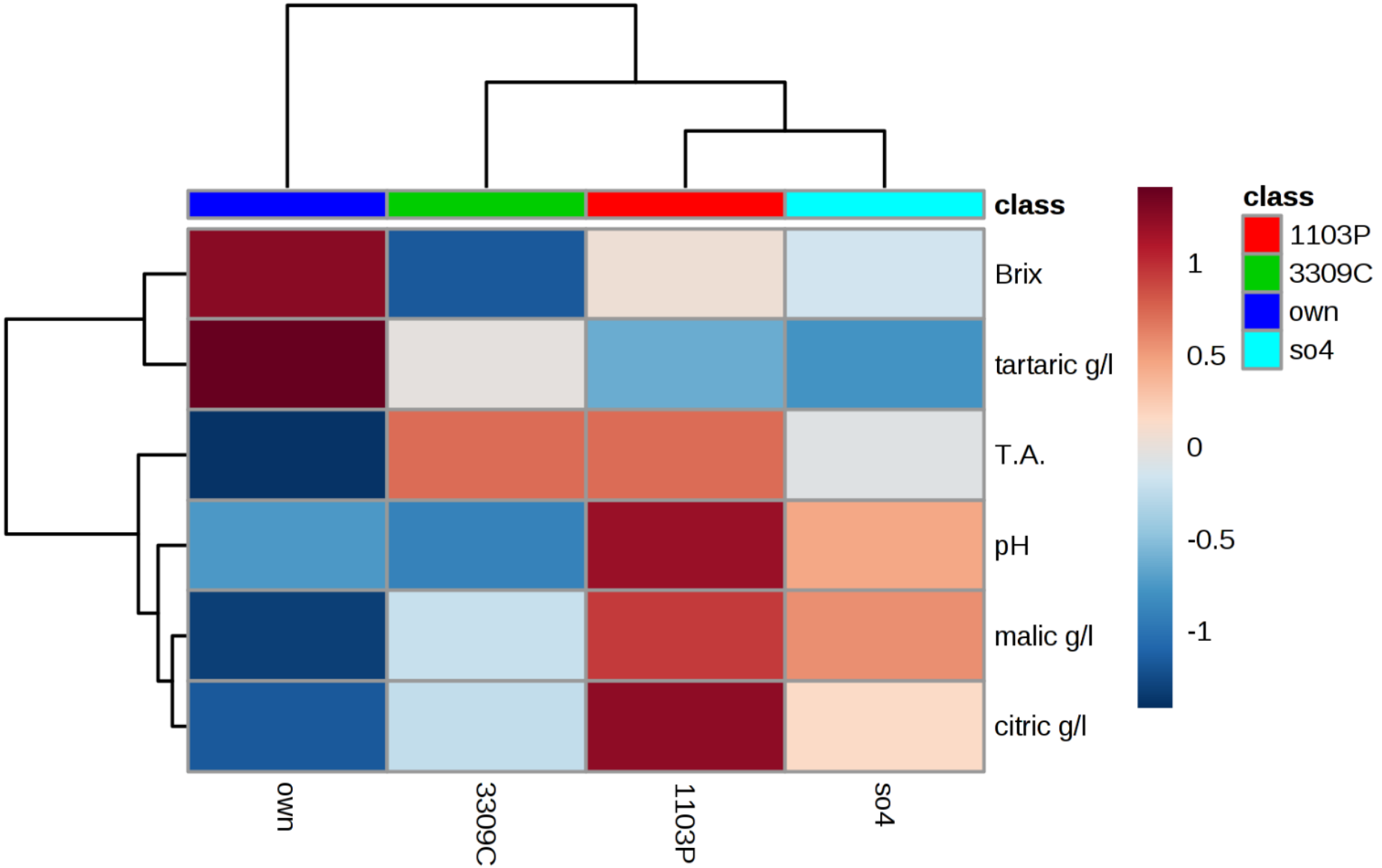
Rootstock	Parentage	Characteristics
Own rooted Chambourcin	*Vitis vinifera, V. cinerea*	
3309C	*V. riparia X V. rupestris*	suitable for wetter environments
1103P	*V. rupestris X V. berlandieri*	suitable for drier environments, especially for the hot, Mediterranean climate
SO4	*V. riparia X V. berlandieri*	Tolerant to wet soil

3 irrigation treatments:

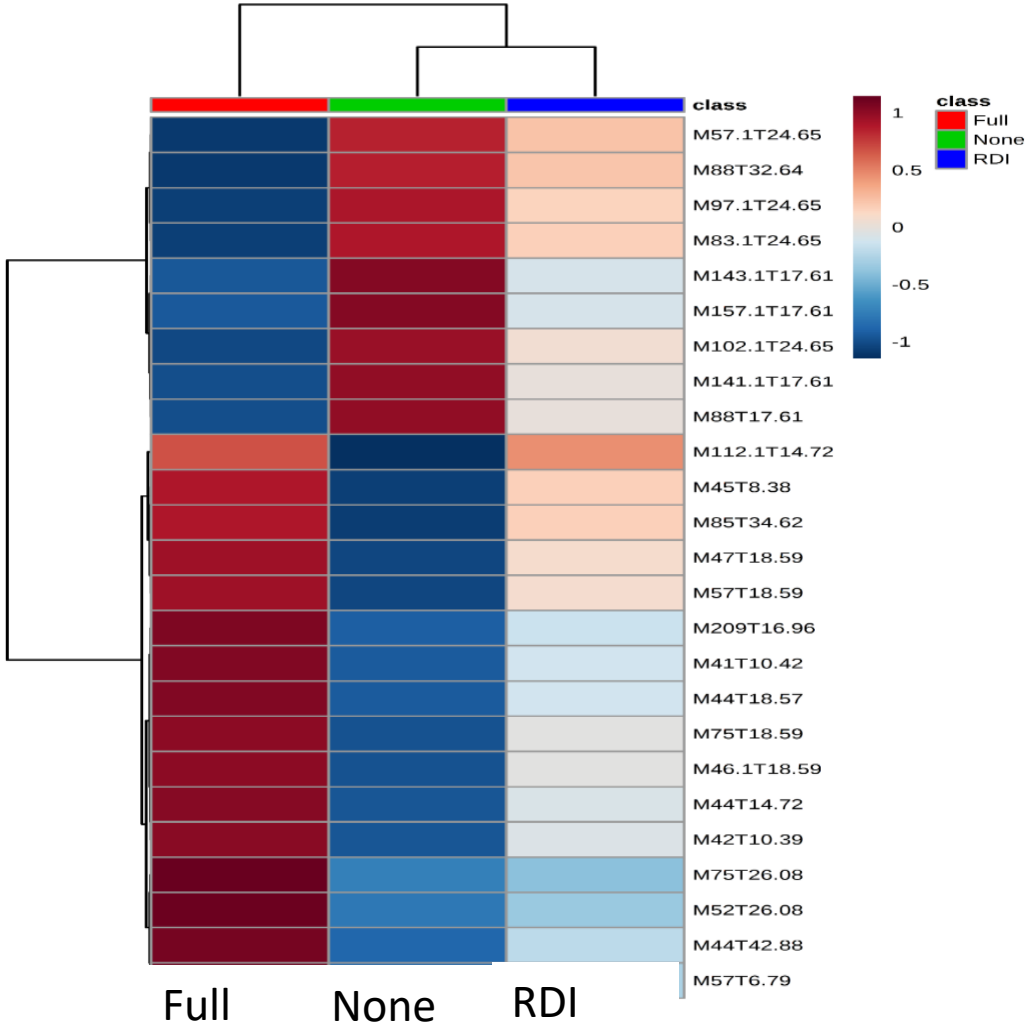
Full irrigation (Full)-100% ET
Regulated Deficit irrigation (RDI)-50% ET
No irrigation (None)-Rainfed

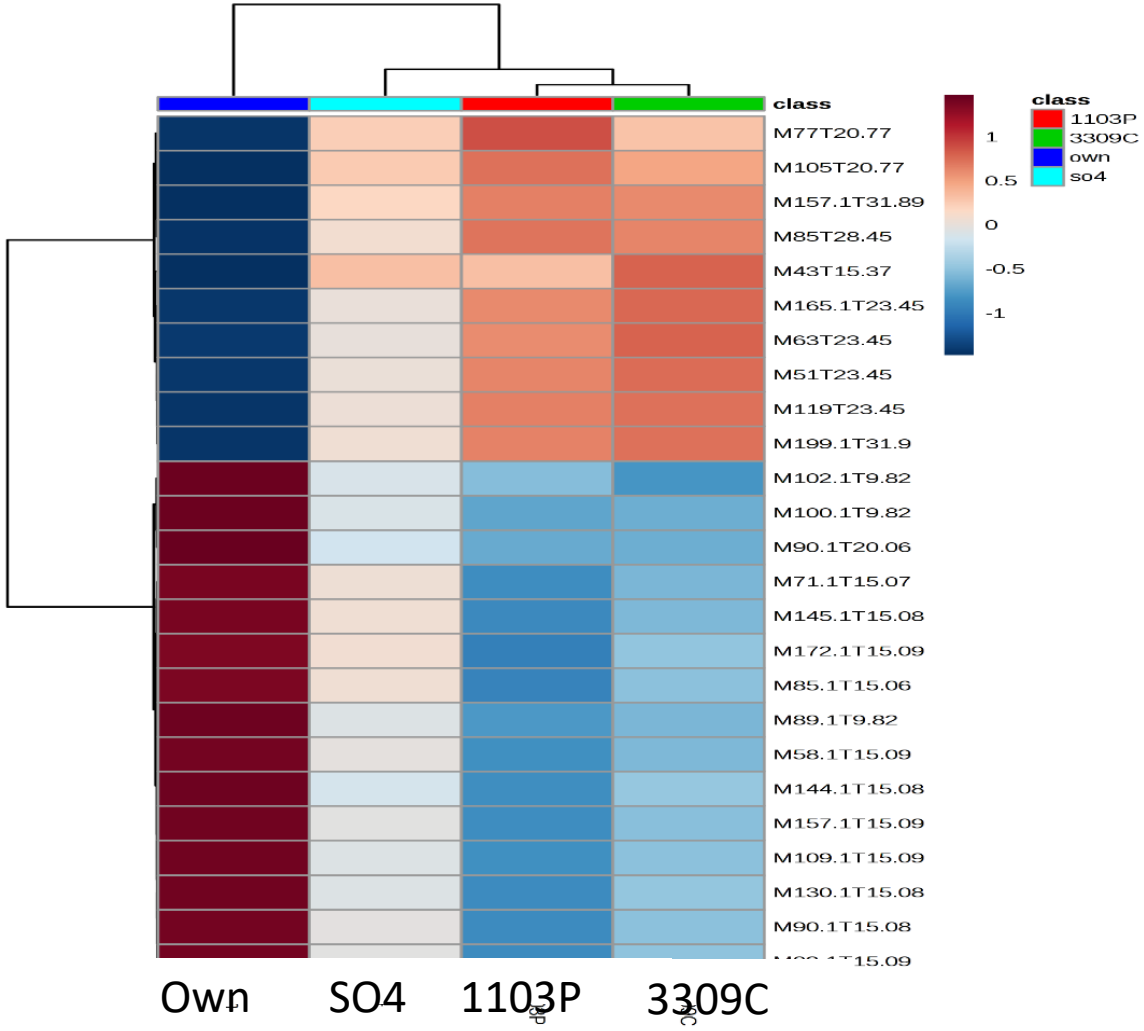


Berry chemistry changes in different rootstocks:

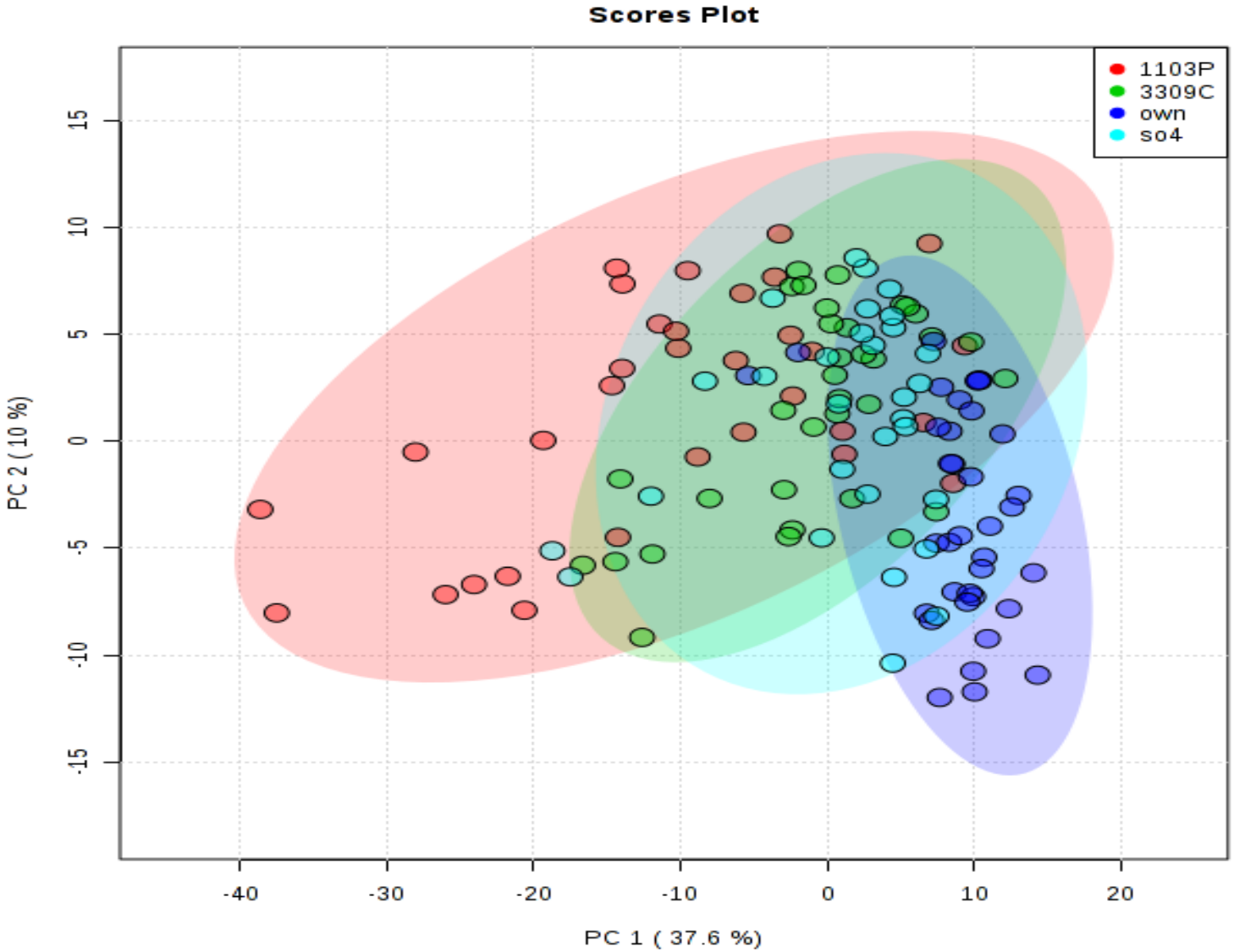


Feature differences between rootstocks and irrigation treatments in wine 2017 using untargeted metabolomics approach:





PCA shows differences in metabolic features due to rootstock :

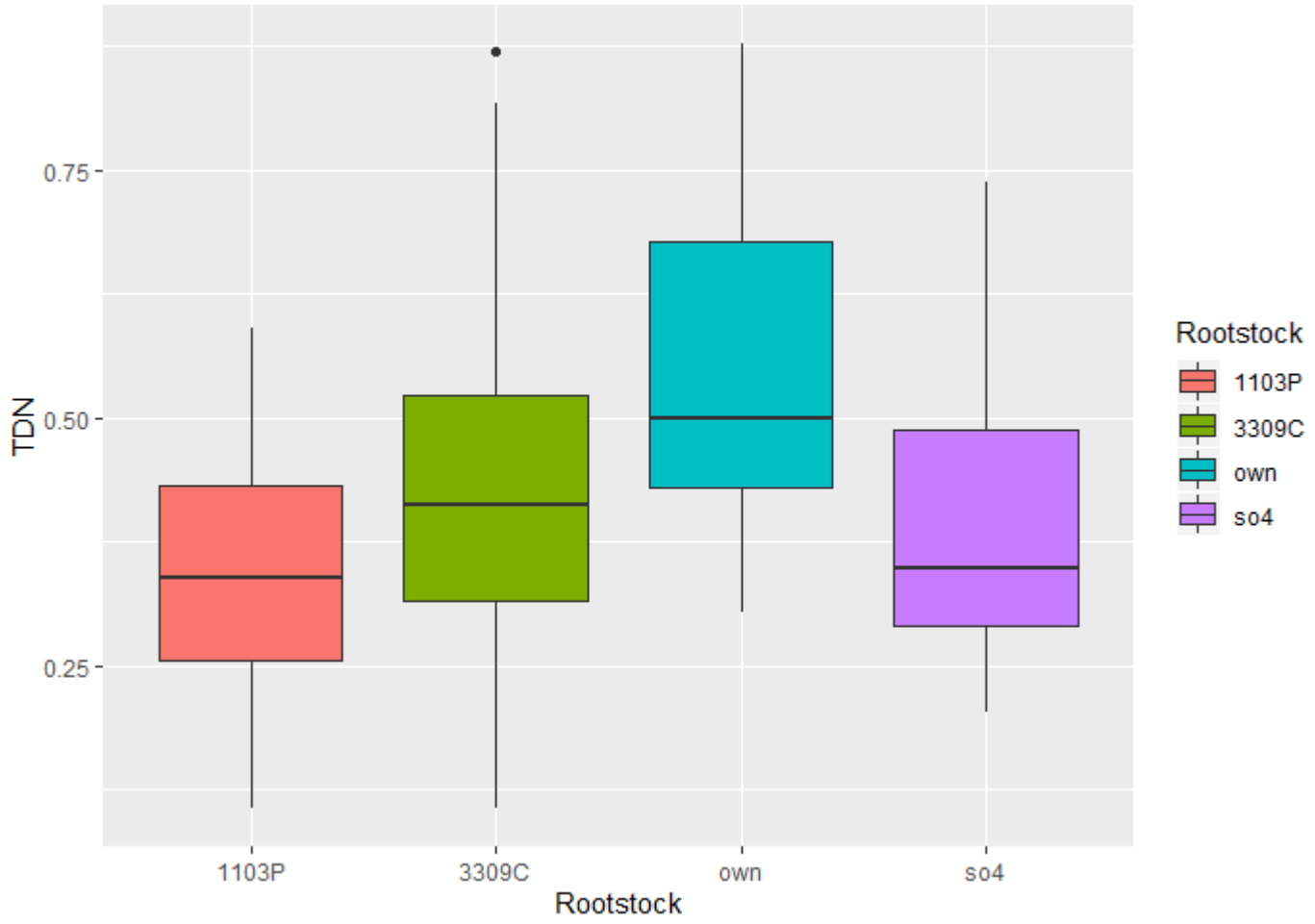


Rootstocks decreased some compounds in wine in 2017 and 2018:

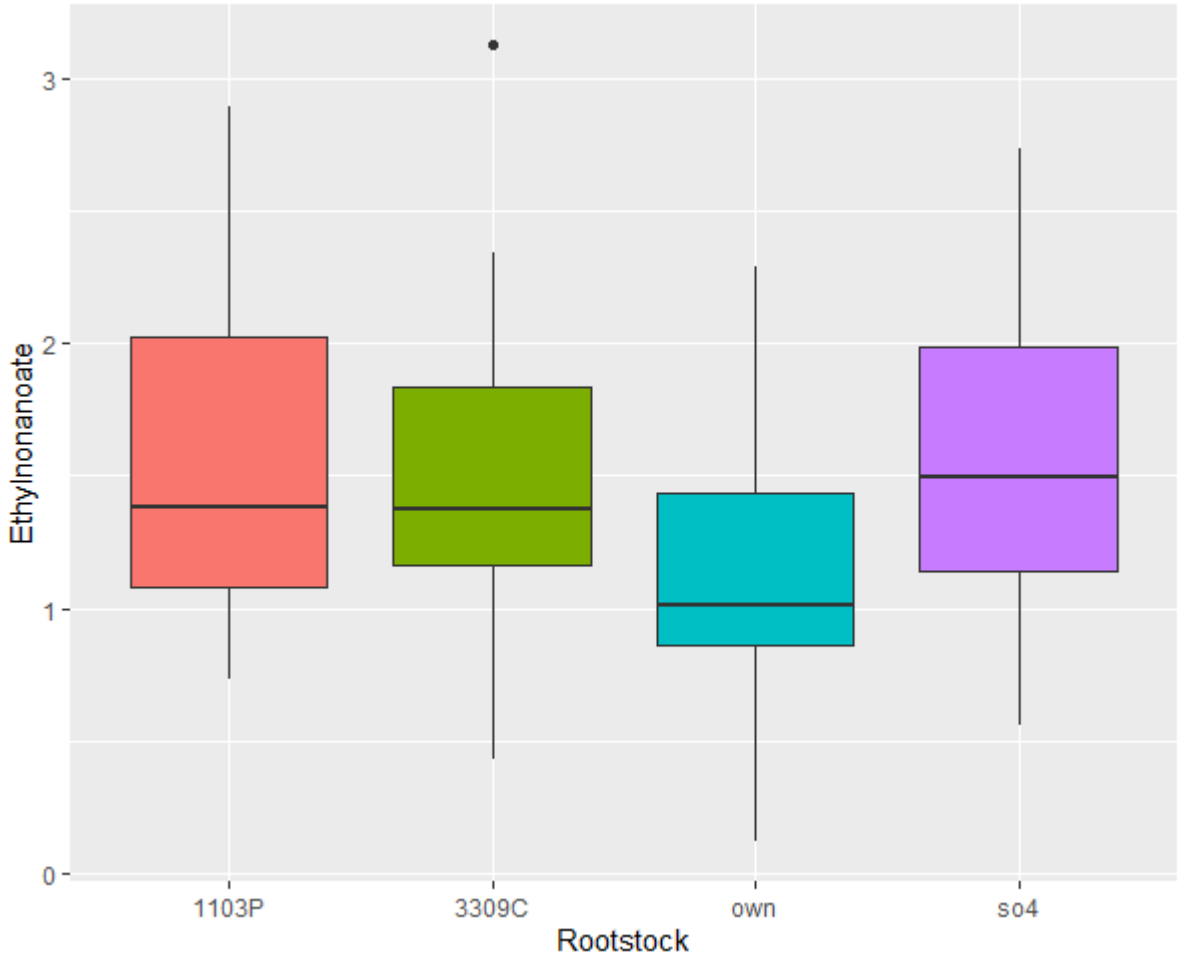
Beta Damascenone

Rootstocks decreased some compounds in wine in 2017 and 2018:

TDN (1,1,6-trimethyl-1,2-dihydronaphthalene)



Rootstocks increased the levels of some compounds in wine in 2018:



Take home messages:

- Metabolomics based approach allowed for comprehensive and unbiased identification of compounds
- Grapes and wine aroma are significantly modulated by rootstocks
- We identified more than 90 different compounds in wine and quantified 22 compounds
- Some important aroma compounds are increased by rootstocks whereas some are lowered by rootstocks
- Understanding how rootstocks impact important aroma compounds will provide important information for breeders and winemakers to produce consumer preferred high quality hybrid wines

Acknowledgements

- Dr. Misha Kwasniewski
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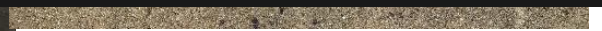
- Joe

- Missouri Wine and Grape Board

Grape and Wine Institute
College of Agriculture, Food and Natural Resources

https://twitter.com/vitisroots?lang=e

Thank You!



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Subtle Differentiation Metabolomics Workflow