Selection of yeasts and fermentation conditions for the production of Sauvignon Blanc

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INTRODUCTION

Sauvignon Blanc is one of the most popular aromatic varietals through the world and is characterized by particularly strong but also very sensitive varietal flavors such as **polyfunctional thiols** with very low perception thresholds **balanced with fermentative fruity and floral flavors and aromas** (Figures 1 and 2).

This study aims to confirm and illustrate the **importance of** the **yeast strain** selection, fermentation **temperature** and **nutrition regime** on the fermentation kinetics, the analytical and sensorial profiles of Sauvignon Blanc. The objective is to recommend the best strain and fermentation conditions according to the winemakers' target.

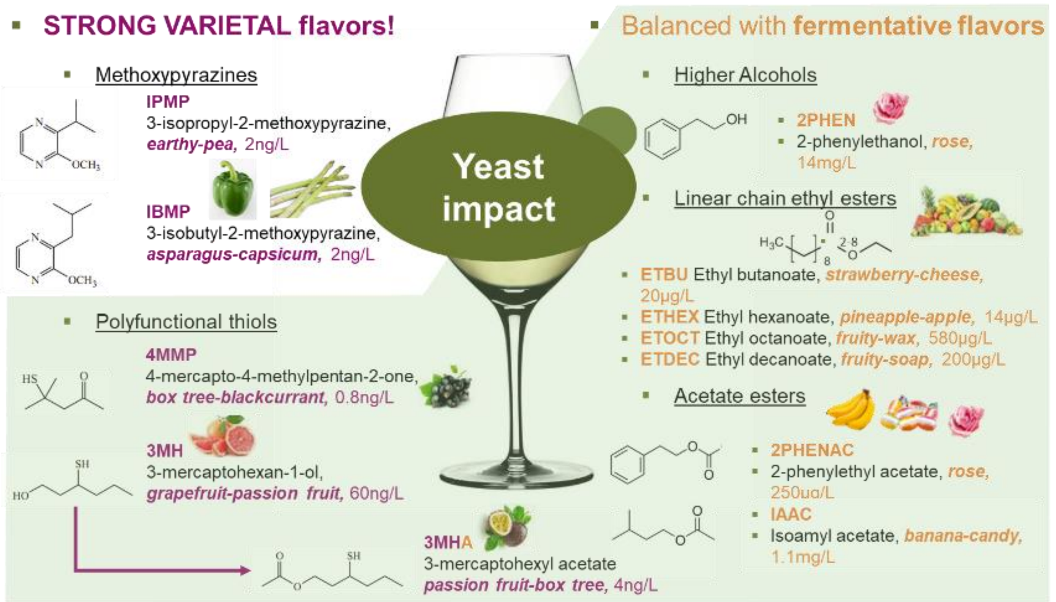

Figure 1: Sauvignon Blanc's Aromatic profile

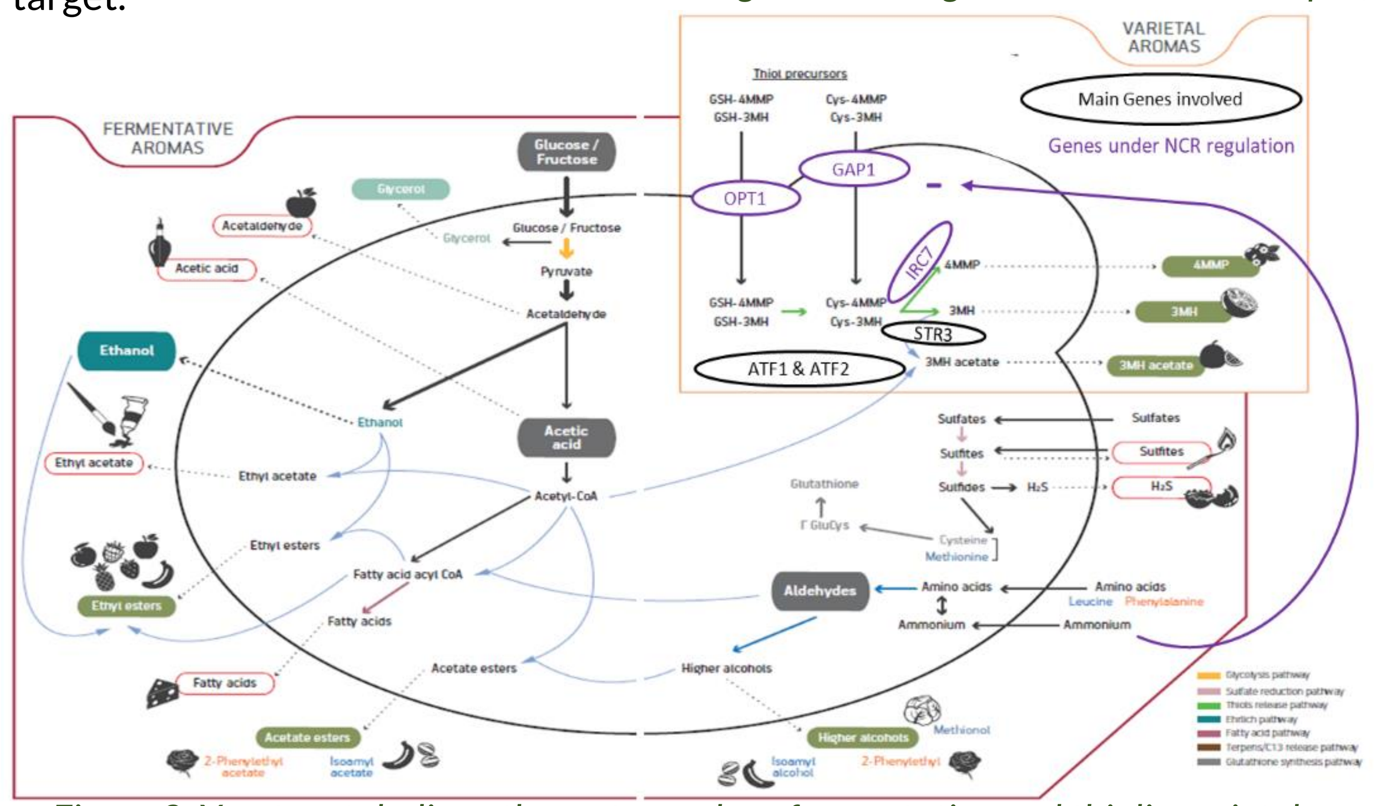

Figure 2: Yeast metabolic pathway to produce fermentative and thiolic varietal aromas

The release of free thiols by yeast (Figure 2) from the must precursors is highly regulated by genes such as IRC7 and by conditions, mainly temperature and nutrition (NCR regulated genes) (Figure 2).

MATERIAL AND METHODS

- **18 Fermentations** differing on yeast strain, fermentation temperature and nutrition regime (Table 3) were carried on a 2019 Sauvignon Blanc from the Loire valley (France) in 50L tanks (Table 1).

Table 1: Sauvignon Blanc's must analysis used for case study

Sugars	Total Acidity	pH	Malic Acid	Alpha-amino nitrogen	Ammoniacal nitrogen	YAN	Turbidity
[g/l]	[g/l H_2SO_4]		[g/l]	[mg/l]	[mg/l]	[mg/l]	[NTU]
210	3.47	3.42	3.3	100	57	157	45

- Fermentation were pitched with 20g/hl **of 2 yeast strains** selected from previous screening and selection work (Table 2).
- The ratio YAN (ppm)/Sugar(g/L) were adjusted to 1.00 with different nutrients added 50% at yeast inoculation and 50% at 1/3^rd^ AF. Springferm™ Xtrem is a total yeast autolysate rich in nitrogen (mainly amino acids), lipids (survival factors), vitamins and minerals. Its content is Amino Nitrogen is 3.7% of by weight but its fermentative power is greater due to other fractions of interest. For this study we will consider its YAN equivalent to be 10% (vs 21% for DAP).

Table 2: Yeast Strains' characteristics for the case study

Strain ref	Origin of the strain	IRC7 genotype	Main fermentative aromatic profile	Main Thiols released
Strain A	Market reference for aromatic varietals fermentations	$IRC7^S/IRC7^S$	Amylic - Acetate Esters and Higher Alcohols	3MHA and 3MH
Strain 17912	Selected in partnership with IFV from a pool of 299 strains on criteria: $IRC7^L$ (abilities to release 4MMP), Killer status, Fermentation abilities, Acidity maintenance, low VA, low H2S,aromatic and sensorial profile for thiolic varieties	$IRC7^L$/IRC7L	Complex Fruity - Ethyl Esters	4MMP

Table 3: Scenarios tested in the case study

Yeast Strains: N°	Yeast strain		Alcoholic Fermentation Temperature: N°	Regime		Nutrition regime: N°	Nutrient added at yeast inoculation	Nutrient added between 1/3 and 1/2 AF
A	Strain A	X	1	12°C constant	X	1	DAP	SpringFerm ™ Xtrem
B	Strain 17912		2	3 days at 18°C then in 12°C		2	SpringFerm ™ Xtrem	DAP
			3	18°C constant		3	SpringFerm ™ Xtrem	SpringFerm ™ Xtrem

RESULTS

The results showed large differences between strains and among different fermentation parameters.

- **The kinetics:** were very similar in between strains (Figure 3). The main differences in kinetics were through temperature regimes with 18°C been the fastest. Time of fermentation was approximately the same for 18→12°C and 12°C constant. When focusing on the effect of nutrition on kinetics (Figure 4) the experiment highlighted more differences in between scenarios at 12° constant than other regimes, because of added stress on the yeasts, and with a slightly shorter fermentation when SpringFerm™ Xtrem was the only nutrient which demonstrates the Fermentative Power of yeast autolysate vs DAP.
- **The analytical parameters:** There is a real differences between strains (data available on request), with Strain A producing more Volatile Acidity and TSO_2 than Strain 17912 overall. More VA is produced and less Acidity is maintained at low temperature when the yeast are under stress. This study does not show significant differences through nutrition regime for VA. Lower production of TSO_2 for both strains is at the 18->12°C temperature regime. Furthermore, with Strain A produces less TSO_2 with only SpringFerm™ Xtrem which is a less stressful environment for the yeast.
- **The acetate esters and higher alcohols** (Figure 5): we can again see real differences between the strains with strain A producing more acetate esters and higher alcohols. Isoamyl acetate is strongly impacted by evaporation at 18°C but there is no obvious impact of the nutrition. The 2-phenylethanol acetate and 2-phenylethanol are following the same trend with a higher production at higher temperature but also sensitive to evaporation. For strain A we observe an increase of these 2 molecules when SpringFerm™ Xtrem is used at start or sole.
- **The Ethyl esters** (Figure 6): we can also see real differences between strains with strain 17912 producing more of these complex esters overall. We also observe different impacts between strain of the temperature and nutrition regimes. The main trend for both strains is equal or lower concentration of C4-C6 esters and higher concentration of C8-C10 esters with higher temperature. This could be due to an increase of the membrane fluidity that facilitates the diffusion of this long chain molecules.
- **The thiols** (Figure 7): we can see major differences between the strains especially for the 4MMP. We confirm that only the strain 17912 can produce some in some scenarios. Globally we can see a higher release of thiols 3MH and 4MMP at higher temperature, with none being release at 12°C for 17912. However, there is a lower evaporation of 3MHA and 4MMP at lower temperature so starting at high temperature then lower to 12°C is a good compromise. There is an important impact of the type of nutrition on 4MMP especially with scenario adding DAP at the beginning of the fermentation blocking the release of 4MMP and illustrating the importance of the NCR impact on thiols intake and *IRC7* expression.
- **Preliminary tasting** of the wines (Table 4) confirmed most of the conclusions reached by the analytical data, highlighting the following choices for winemakers to match specific wine aromatic profiles.

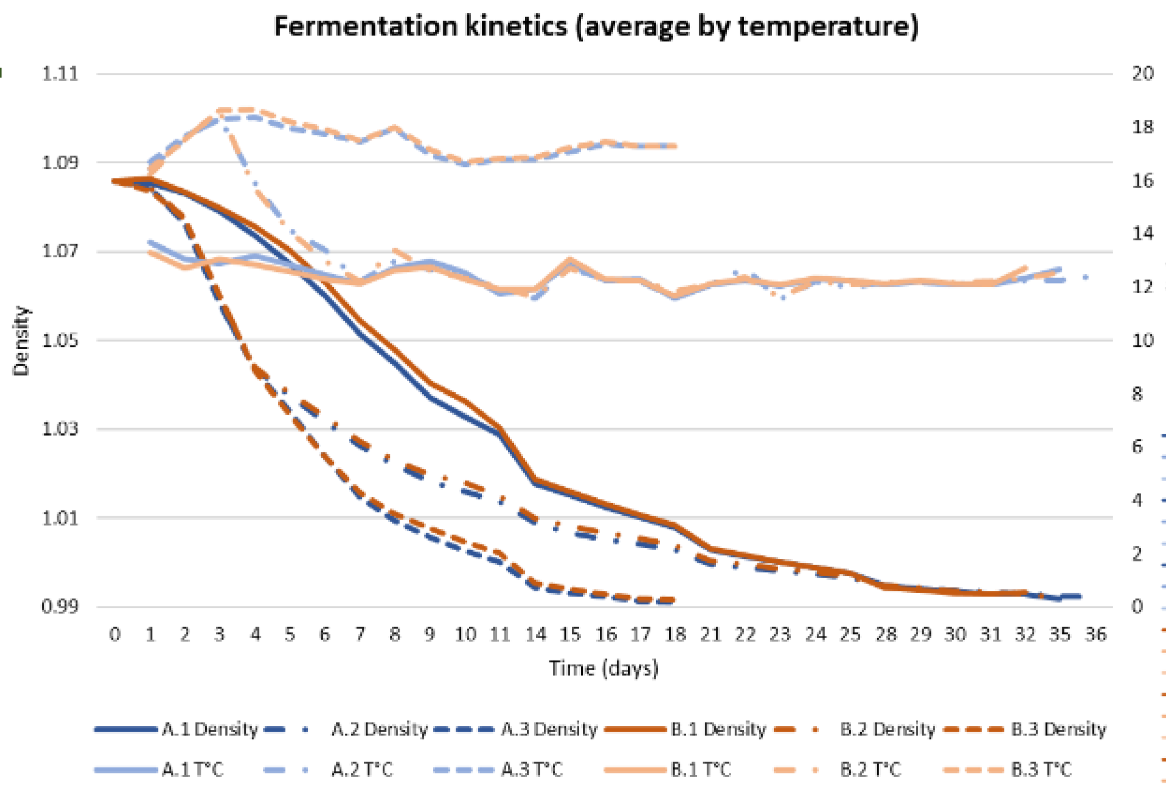

Figure 3: Fermentation kinetics by average temperatures

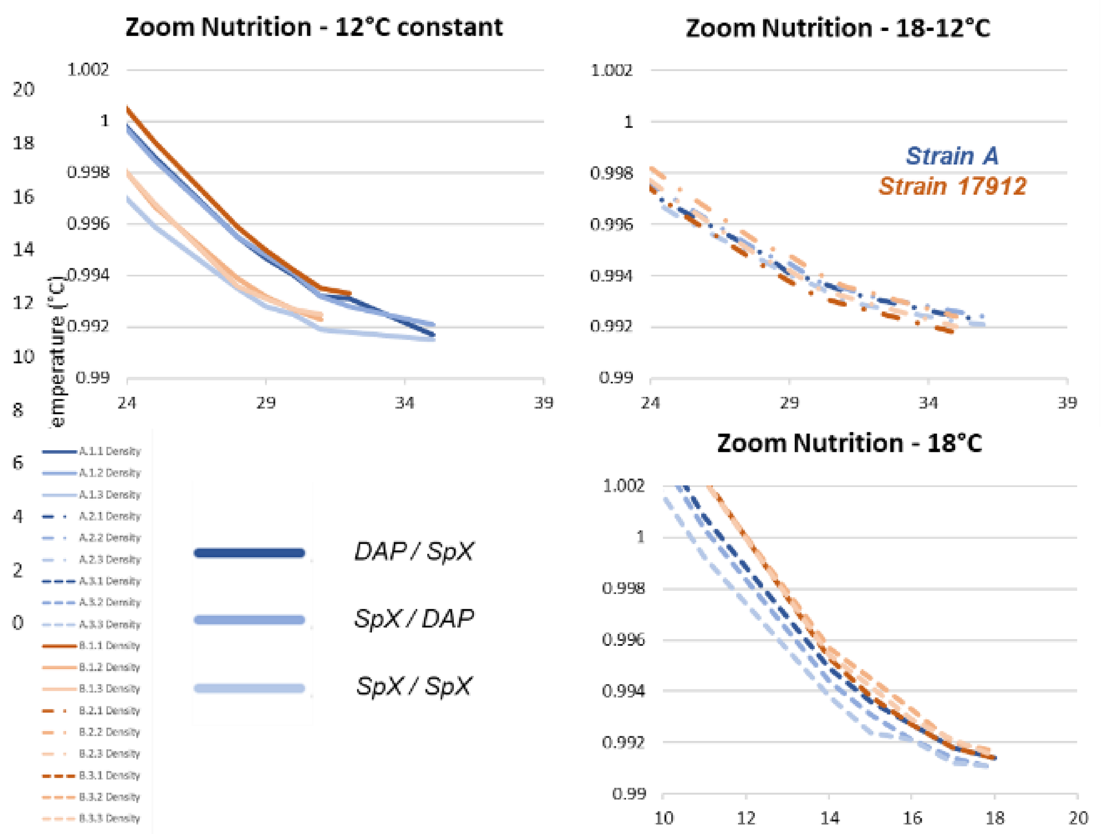

Figure 4: Fermentation kinetics by temperature & nutrition

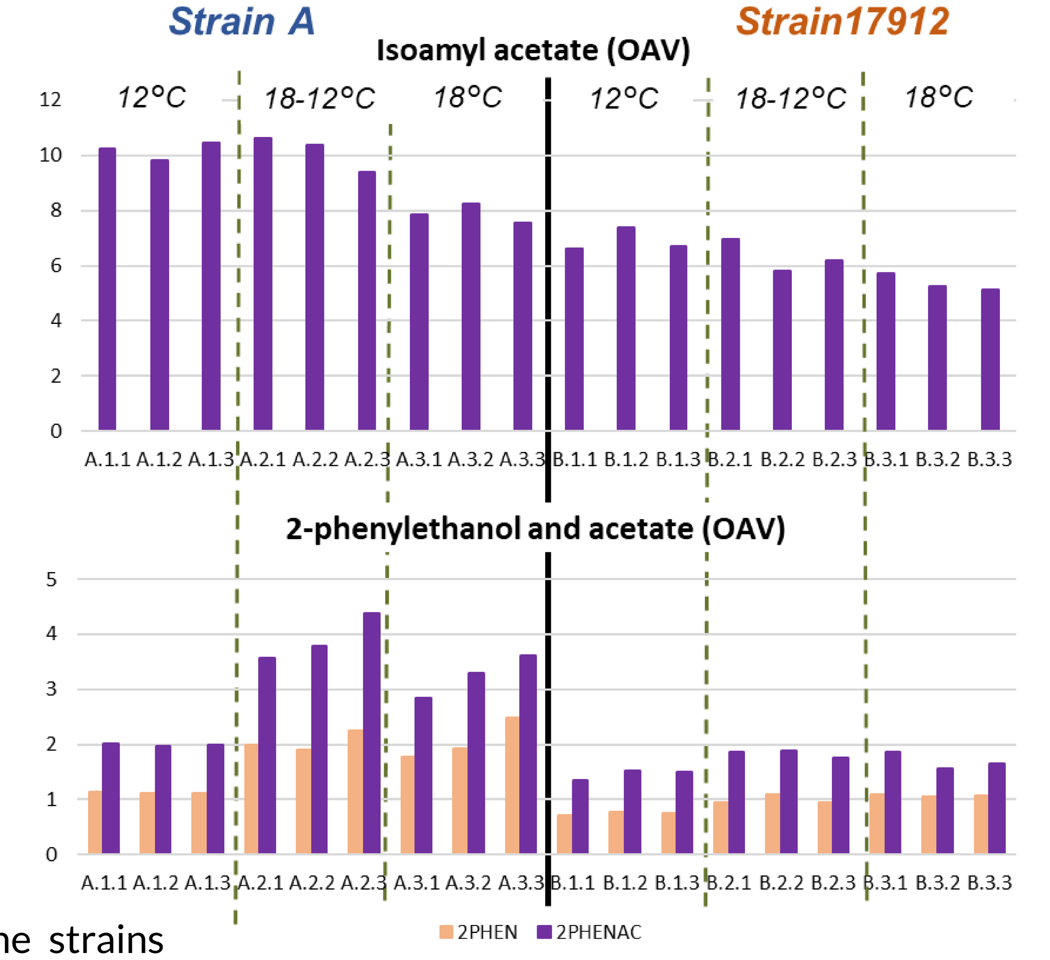

Figure 5: Acetate esters and Higher alcohols

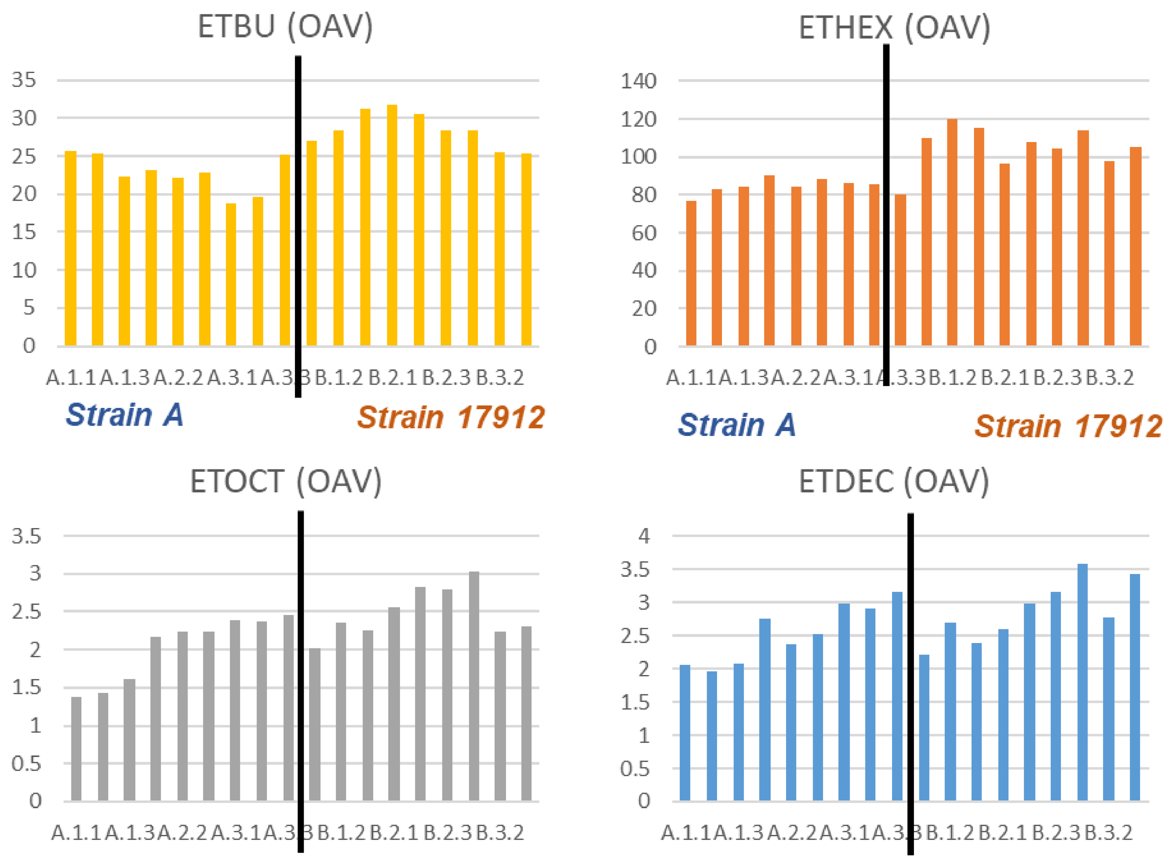

Figure 6: Ethyl Esters

Table 4: Main conclusions from preliminary tasting

Wine Profile	Yeast choice	Temperature	Nutrition
Fruity Amylic	Strain A	12°C	DAP/SpX
GreenThiols	Strain 17912	18°C	SpX/DAP
Complex thiols/esters	Strain 17912	18->12°C	DAP/SpX or SpX/DAP

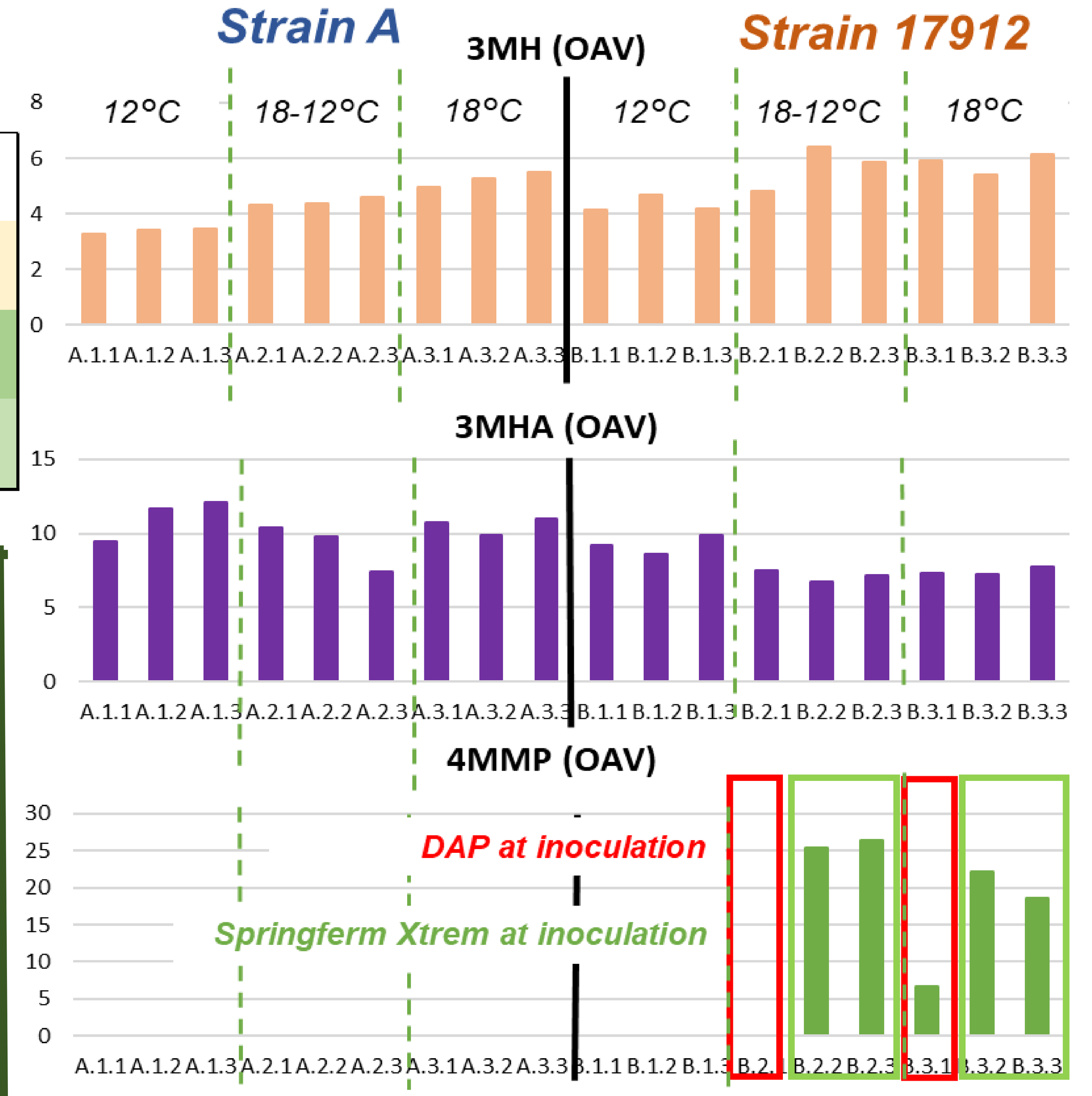

Figure7: Thiols

CONCLUSION

- **Yeast selection is crucial** in the style of Sauvignon blanc that a winemaker wishes to produce because of the yeasts ability to produce different types of esters and release thiols from their precursors, notably through *IRC7* gene expression.
- **After the strain, the fermentation temperature is the biggest factor influencing flavors.** Fermenting at high temperature increases the release of thiols and the production of higher alcohols and long chain ethyl esters. Fermenting at low temperature put the emphasis on the acetate esters and the production of short chain ethyl esters. Starting at high then lower the temperature seems to be the best compromise to release, produce and conserve the aromas for complex thiolic wine while decreasing defects (SO_2, VA).
- **The effect of nutrition is lower but ammonium supplementation at the start of AF can lower or block thiol release, especially 4MMP.** Organic nutrient supplementation lowers the stress of the yeast and so the defects. The best compromise for Sauvignon Blanc and yeasts with the ability to release 4MMP is to start with the addition of the organic nutrient at inoculation then Ammonium at 1/3 of fermentation.