

**IMPACT DU DÉFICIT HYDRIQUE MODÉRÉ
SUR LE POTENTIEL QUALITÉ DU RAISIN SUR LE PINOT NOIR
EN CHAMPAGNE (FRANCE)**

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Contexte et objectif de l'étude - Des facteurs environnementaux tels que le sol et le climat influencent la qualité du raisin potentiel. Leur impact est souvent médiatisé par le statut hydrique et azoté de la vigne. Selon la couleur de les raisins (rouges ou blancs) et le type de vin produit, le niveau d'eau et d'azote de la vigne souhaité pour une qualité optimale du vin est différent.

Peu d'enquêtes ont été menées sur ces facteurs et leur influence potentielle sur la qualité des vins effervescents sur deux millésimes. Dans cette étude l'eau de vigne et l'azote le statut ont été évalués à une densité très élevée et liés à la composition du raisin et au poids des baies. Par analyses statistiques, les principaux déterminants du potentiel qualitatif du raisin sur le Pinot noir en Champagne ont été soulignés.

Matériel et méthodes - Le potentiel de haute qualité du Champagne était lié à une composition particulière du raisin. Sur 25 hectares plantés en Pinot noir, les raisins ont été prélevés selon un maillage très dense (10 échantillons/ha). Un échantillon est composé de 200 baies prélevées sur 10 cep. Sur ces échantillons, l'eau de vigne le statut a été évalué par la mesure du $\delta^{13}C$ dans le jus de raisin et le statut azoté de la vigne par la mesure du NH_4^+ dans le moût.

Le poids des baies, le sucre du raisin, l'acidité totale, le malate et le pH ont également été mesurés. Le poids des baies a été enregistré à chaque emplacement d'échantillonnage tandis que le rendement a été mesuré à une résolution spatiale inférieure (au niveau de la parcelle). Celles-ci des mesures ont été menées sur deux millésimes (2017 et 2018) et sur 4 terroirs connus pour produire différents niveaux de qualité du Champagne.

Résultats - Le niveau de qualité du Champagne était positivement lié à la maturité technologique du Pinot noir. Ensuite, le malate et le rapport sucre/acidité totale (S/TA) ont été considérés comme un indicateur du potentiel de qualité du raisin.

Un effet millésime a été mis en évidence, le niveau de déficit hydrique plus élevé en 2018 a augmenté le niveau de maturité par rapport à 2017. Il y a aussi un effet de localisation, Tauxières Nord et Sud ont un niveau de maturité plus faible même si Tauxières Sud est plus contraint en 2018 que les autres emplacements.

Le déficit hydrique joue un rôle important sur la maturité du Pinot noir dans notre étude avec une forte relation significative avec du malate et un lien significatif plus ou moins important selon le millésime avec le pH, le rapport S/TA et la baie masse.

L'effet du statut azoté de la vigne sur la maturité est plus complexe sans corrélations nettes au cours des millésimes étudiés.

Le poids des baies est positivement corrélé au déficit hydrique ($\delta^{13}C$) d'un millésime sec (2018) et au statut azoté de la vigne (NH_4^+) dans un millésime caractérisé par un moindre déficit hydrique (2017). Un effet rendement a été identifié particulier sur le rapport S/TA.

Lorsque les vignes de Pinot noir font face à des déficits hydriques en Champagne, la maturité est améliorée. Il convient de noter qu'en raison aux mouvements capillaires de l'eau dans les sols calcaires, les déficits hydriques sont rarement sévères. Dans notre eau d'étude les déficits allaient d'inexistants à modérés. Déficit hydrique Amélioration du potentiel de qualité du raisin pour le mousseux vins produits à partir de Pinot noir dans cette étude.

D'autres investigations sont nécessaires pour confirmer ces résultats dans d'autres millésimes et sur un plus large éventail de types de sols.

IMPACT OF MODERATE WATER DEFICIT ON GRAPE QUALITY POTENTIAL ON PINOT NOIR IN CHAMPAGNE (FRANCE)

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Abstract:

Context and purpose of the study - Environmental factors like soil and climate influence grape quality potential. Their impact is often mediated through vine water and nitrogen status. Depending on the color of the grapes (red or white) and the type of wine produced, the desired level of vine water and nitrogen status for optimum wine quality is different. Little investigation has been carried out concerning these factors and their potential influence on sparkling wine quality on two vintages. In this study vine water and nitrogen status were assessed at a very high density and related to grape composition and berry weight. Through statistical analyses, the major factors driving grape quality potential on Pinot noir in Champagne were highlighted.

Material and methods - High quality Champagne potential was related to particular grape composition. On 25 hectares planted with Pinot noir, grape samples were taken following a very high density grid (10 samples / ha). One sample is composed of 200 berries taken on 10 vines. On these samples, vine water status was assessed by measuring $\delta^{13}\text{C}$ in grape juice and vine nitrogen status by measuring NH_4^+ in must. Berry weight, grape sugar, total acidity, malate and pH were also measured. Berry weight was recorded at each sampling location while yield was measured at a lower spatial resolution (the parcel level). These measures have been carried out on two vintages (2017 and 2018) and on 4 locations known to produce different quality levels of Champagne.

Results - Quality level of Champagne was positively related to technological maturity of Pinot noir. Following, malate and sugar/total acidity ratio (S/TA) were considered as a proxy for grape quality potential. A vintage effect was highlighted, the higher level of water deficit in 2018 increased the level of maturity compared to 2017. There is also a location effect, Tauxières Nord and Sud have a lower level of maturity even if Tauxières Sud is more constraint in 2018 than the other locations.

Water deficit plays an important role on maturity of Pinot noir in our study with a strong significant relation with malate and a significant link more or less important depending on vintage with pH, S/TA ratio and berry weight.

The effect of vine nitrogen status on maturity is more complex with no clear correlations during the vintages studied.

Berry weight is positively correlated to water deficit ($\delta^{13}\text{C}$) in a dry vintage (2018) and to vine nitrogen status (must NH_4^+) in a vintage characterized by lower water deficit (2017). A yield effect has been identified particular on S/TA ratio.

When Pinot noir vines face water deficits in Champagne, maturity is improved. It should be noted that due to capillary water movements in the limestone soils, water deficits are rarely severe. In our study water deficits ranged from non-existent to moderate. Water deficit improved grape quality potential for sparkling wines produced from Pinot noir in this study. More investigations are needed to confirm these results in other vintages and on a wider range of soil types.

Keywords: Grapevine, sparkling wine, Champagne, quality potential, water deficit, grape composition

1. Introduction.



Impact of moderate water deficit on grape quality potential on Pinot noir in Champagne (France)

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INTRODUCTION

Environmental factors like soil and climate influence grape quality potential. Their impact is often mediated through vine water and nitrogen status. Little investigation has been carried out concerning their potential influence on sparkling wine quality. In this study vine water and nitrogen status were assessed at a very high density and then related to yield components and grape composition. Major factors driving grape quality potential on Pinot noir in Champagne were highlighted.

MATERIAL AND METHODS

25 hectares of Pinot noir grafted on 418 (Figure 1)
 4 different locations (Tauxières Sud, Tauxières Nord, Aÿ, Verzenay)
 249 samples (10 / ha) on 72 parcels collected close to harvest
 One sample: 200 berries from 10 vines

Analyses:
 • On each sampling point (2017 and 2018):
 - Grape composition at the same date: berry weight, reducing sugars, total acidity, malate
 - Vine water status ($\delta^{13}C$) and Vine nitrogen status (must NH_4^+)
 • Per parcel:
 Average yield



Figure 1: Localization of the sampling points

RESULTS AND DISCUSSION

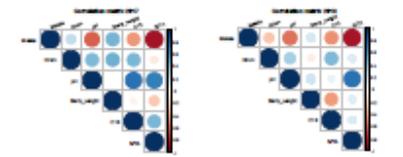


Figure 2: Correlation matrix of maturity parameters and vine water and nitrogen status (2017-2018)

Correlation matrix on 2017 and 2018 (Figure 2)

- Malate is negatively correlated to $\delta^{13}C$ and positively correlated to berry weight. Malate is also correlated to must NH_4^+ but positively in 2017 and negatively to 2018.
- Sugar/Total Acidity ratio (S/TA) is positively correlated to $\delta^{13}C$.
- Berry weight is positively correlated with must NH_4^+ in 2017 and negatively with $\delta^{13}C$ in 2018.

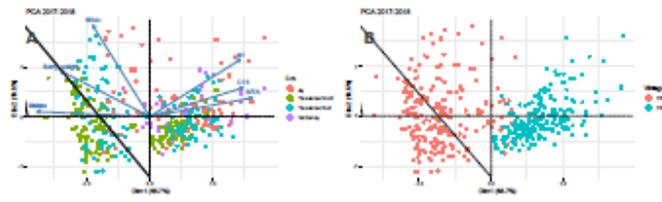


Figure 3: (A) PCA of combined results of 2017 and 2018 per location / (B) Idem per vintage

PCA 2017-18 (Figure 3)

- Dimension 1 explains the maturity. Globally for the 2 years studied, S/TA and pH are positively linked with water deficit but Malate and berry weight have a negative correlation with water deficit.
- There is a location effect: Tauxières Sud and Nord have later maturity than Aÿ and Verzenay blocks
- Vintage effect is more important than the block effect.

Location effects (Figure 4)

- Vintage effect: compared to 2017, in 2018 grapes show more water deficit and lower concentration of must NH_4^+ certainly due to climatic conditions during the spring period. The 2018 vintage is also characterized by a lower malate concentration and a higher S/TA ratio (i.e. better maturity).
- $\delta^{13}C$ results show a location effect: Tauxières Nord induced less water deficit. Tauxières Sud shows a strong vintage effect. This is maybe due to younger vines without fully established root system or the soil characteristics which are different between these blocks.
- There is no location effect in 2018 for must NH_4^+ , but in 2017 Verzenay had the lowest must NH_4^+ concentration and the range among the locations is smaller in 2018.
- Even if there are fluctuations among blocks for water and nitrogen status, Aÿ and Verzenay have always an advanced maturity.

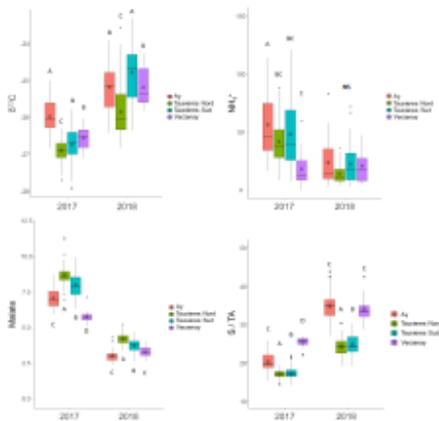


Figure 4: Boxplots of maturity parameters and vine water and nitrogen status

To take the yield into account it necessary to move to plot scale

- Statistic results of linear model (Table 1) show that yields have a significant effect on S/TA and less effect on malate concentration.
- $\delta^{13}C$ level impacts on malate whatever the vintage considered and on S/TA in 2017.
- There is a positive link between must NH_4^+ and maturity in 2017: Maturity decreases with the increase of nitrogen status. In 2018, the effect is opposite.

Table 1: multiple linear model for maturity and yield parameters per year

	S/TA 17	S/TA 18	Malate 17	Malate 18
$\delta^{13}C$	***	NS	***	***
	S/TA $\propto \delta^{13}C$ \propto		Malate $\propto \delta^{13}C$ \propto	Malate $\propto \delta^{13}C$ \propto
must NH_4^+	***	*	***	NS
	S/TA $\propto NH_4^+$ \propto	S/TA $\propto NH_4^+$ \propto	Malate $\propto NH_4^+$ \propto	
Yield	***	***	NS	**
	S/TA \propto Yield \propto	S/TA \propto Yield \propto		Malate \propto Yield \propto

CONCLUSION

- A vintage effect was highlighted: 2018 shows more water deficit compared to 2017, lower level of nitrogen and higher level of maturity.
- There is also a location effect, Tauxières Nord and Sud have a lower level of maturity even if Tauxières Sud is more constraint in 2018 than other locations.
- Berry weight is positively correlated to water deficit ($\delta^{13}C$) in a dry vintage (2018) and to vine nitrogen status (must NH_4^+) in a low water deficit vintage (2017).
- Water deficit plays an important role on maturity of Pinot noir in Champagne with a strong link for Malate and a link more or less important depending on vintage for pH, S/TA ratio and berry weight.
- The link between maturity and vine nitrogen status is more complex because the correlation can be positive or negative depending on the vintage.
- Yields have a significant impact on S/TA ratio but also on malate in 2018 vintage.
- More investigations are needed to confirm these results in other vintages with a higher range of water deficits and on a wider range of soil types.