

PAST VINTAGES AND FUTURE WINE: SUGAR CONTENT (°BRIX) TO ESTIMATE GRAPEVINE PHENOLOGY ADVANCEMENT

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ABSTRACT

Climate Change is known to affect plant phenology, altering the timing of different physiological processes, and leading to increased stress, lower performance and, ultimately, plant death.

While there is a general ecological concern about the effects of Climate Change on plant phenology and ecosystem dynamics, there is also a particular worry referred to those species that have a great agricultural, nutritional and economical value. Despite Grapevine not being one of major crops in terms of production, it is nevertheless an important economical actor, especially when accounting for gastronomy and tourism associated to the wine industry, and in particularly in places like Mediterranean countries such as Italy, France or Spain, where their own cultural identity, landscape and heritage is tightly bound to grapevine growing and winemaking.

In order to quantify the phenological reaction of Grapevine to climate change we used maturation data (°Brix from past harvests) at Miguel Torres, a well-known cellar in Catalunya, collected between 2003 and 2021, to study the advancement of the maturation in grapevines during the last two decades.

Our results showed between 3 and 8 days per decade of advancement in the maturation of all studied varieties. This advancement was stronger in the early season and attenuated during the maturation process, translating to 1-3 days/decade of advancement at GHD (Grape Harvest Date) for white varieties, and an advancement at GHD of 2-6 days/decade for red varieties.

The present work also showed the importance and value of agricultural data collected by private businesses, and aims to encourage others to follow, and make their data available for the scientific community.

RESUMO

Sabe-se que as alterações climáticas afetam a fenologia das plantas, alterando o tempo de diferentes processos fisiológicos e levando ao aumento do stress, menor desempenho e, em última análise, à morte das plantas.

Embora exista uma preocupação ecológica geral sobre os efeitos das Alterações Climáticas na fenologia das plantas e na dinâmica dos ecossistemas, existe também uma preocupação particular relacionada com as espécies que têm um grande valor agrícola, nutricional e económico. Apesar de a videira não ser uma das principais culturas em termos de produção, não deixa de ser um importante agente económico, especialmente quando se tem em conta a gastronomia e o turismo associados à indústria do vinho, e em particular em locais como países mediterrânicos como Itália, França ou Espanha, onde a sua própria identidade cultural, paisagem e património estão intimamente ligados à viticultura e à vinificação.

Para quantificar a reação fenológica da videira às alterações climáticas foram utilizados dados de maturação (°Brix de colheitas passadas) em Miguel Torres, uma conhecida adega na Catalunha, recolhidos entre 2003 e 2021, para estudar o avanço da maturação nas videiras durante as últimas duas décadas.

Nossos resultados mostraram entre 3 e 8 dias por década de avanço na maturação de todas as variedades estudadas. Este avanço foi mais forte no início da estação e atenuado durante o processo de maturação, traduzindo-se em 1-3 dias/década de avanço no GHD (Grape Harvest Date) para variedades brancas, e um avanço no GHD de 2-6 dias/década para variedades tintas.

O presente trabalho também mostrou a importância e o valor dos dados agrícolas coletados por empresas privadas, e tem como objetivo incentivar outros a seguirem e disponibilizarem seus dados para a comunidade científica.

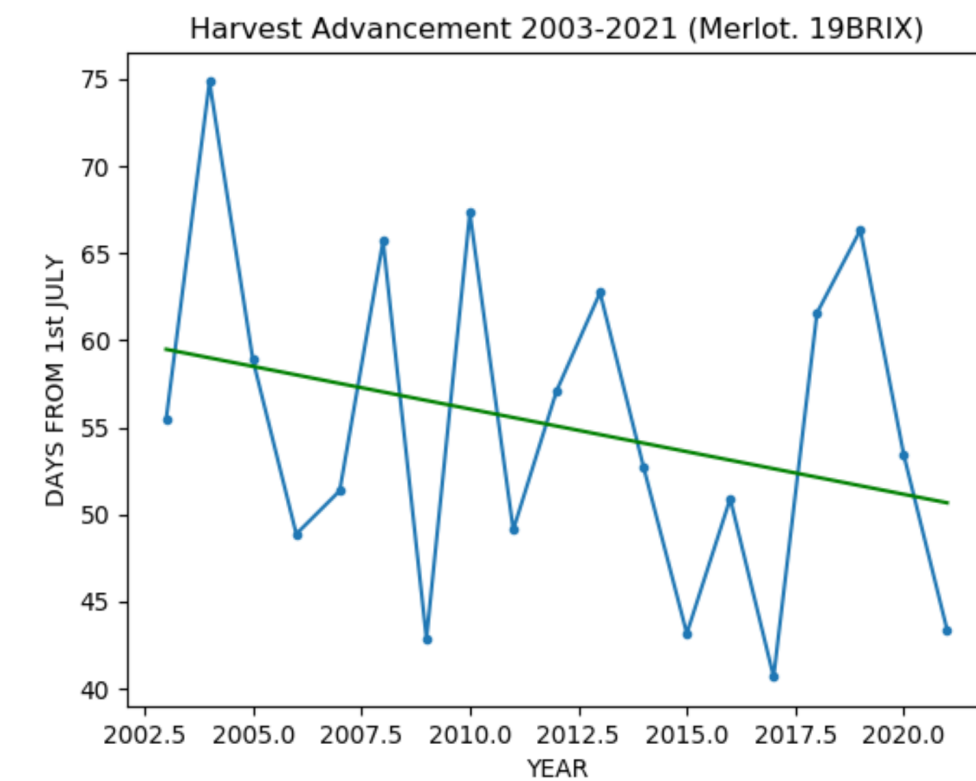
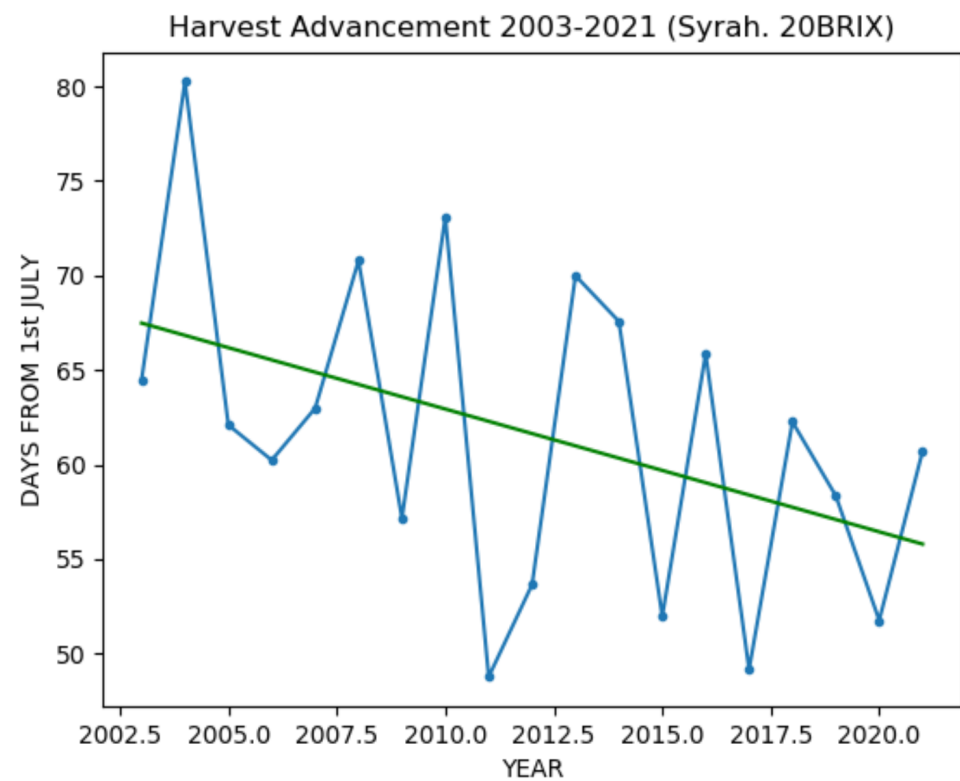
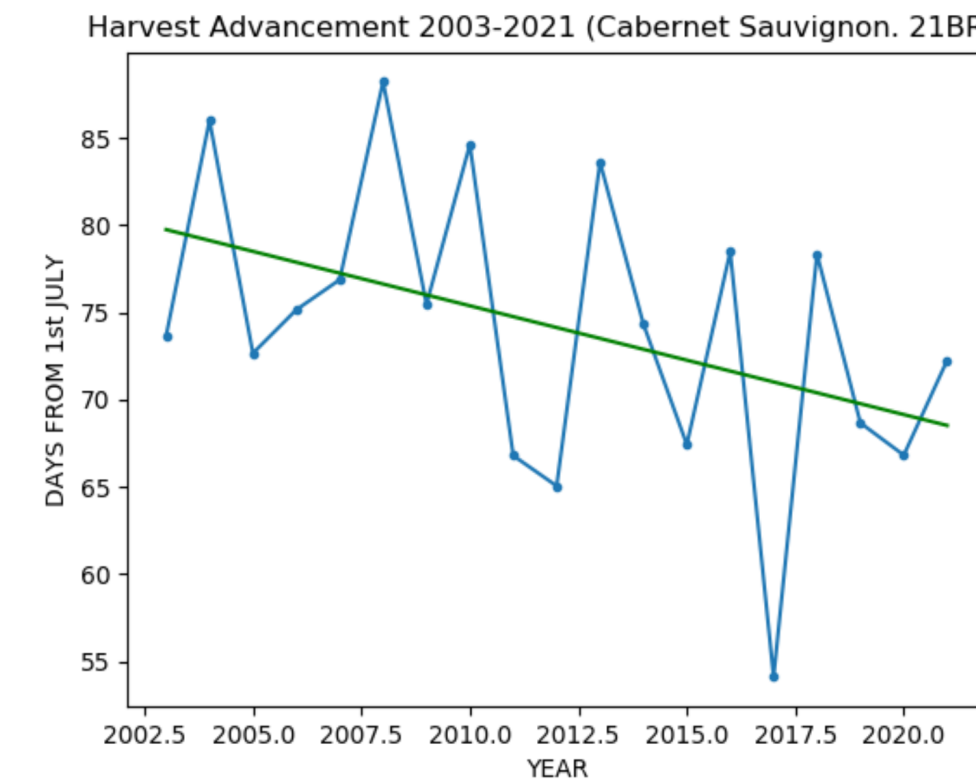
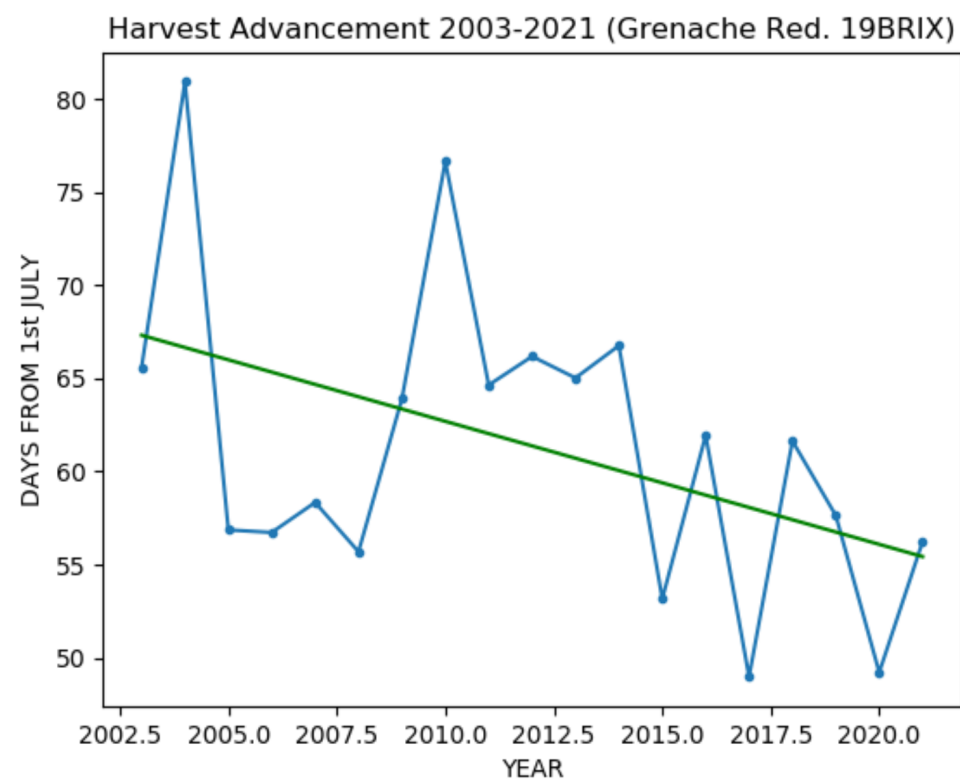
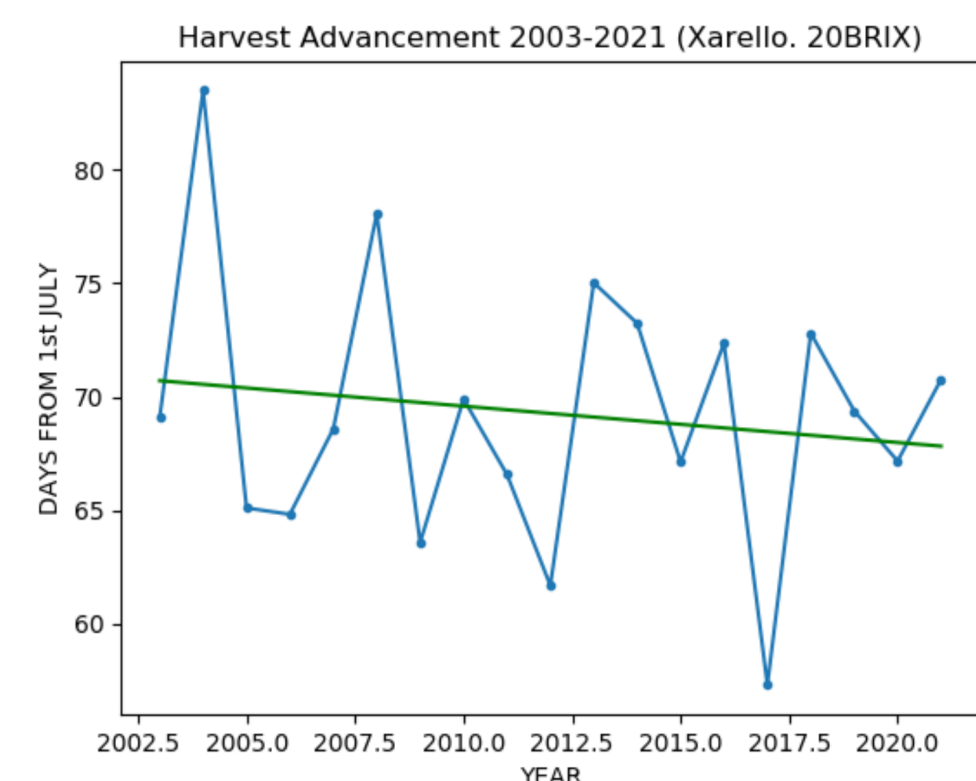
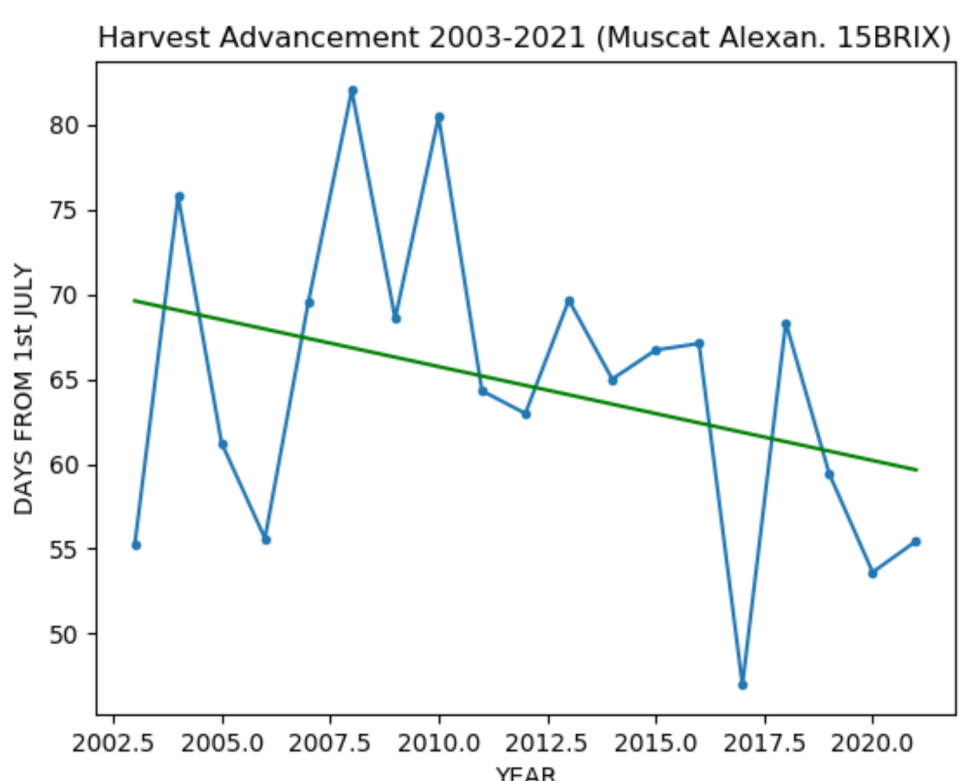
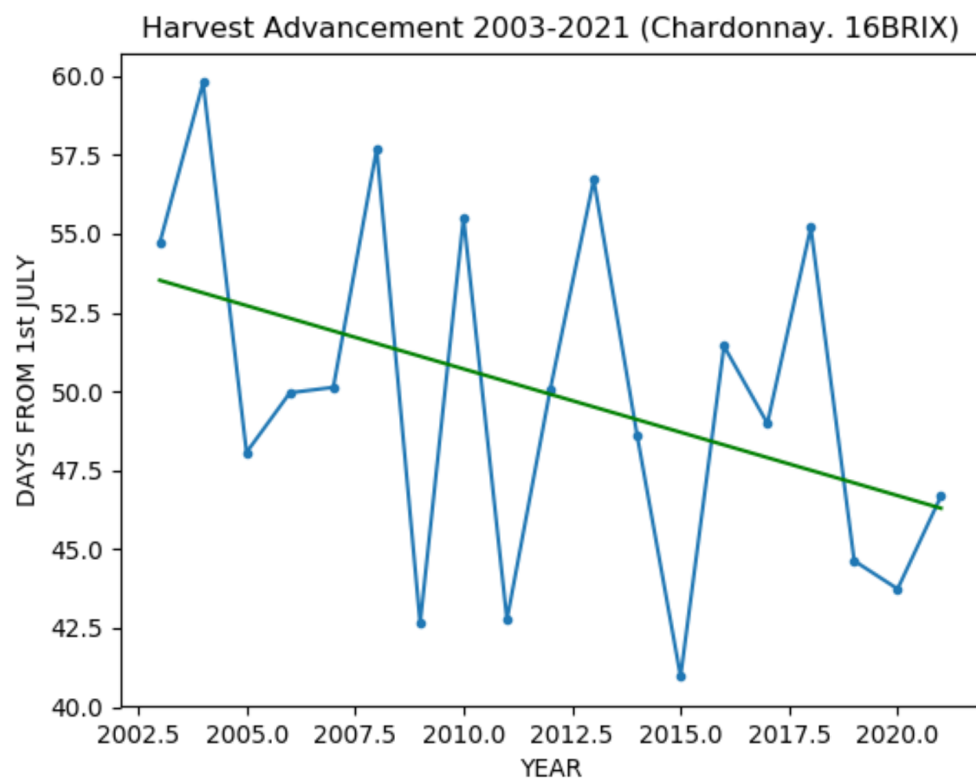
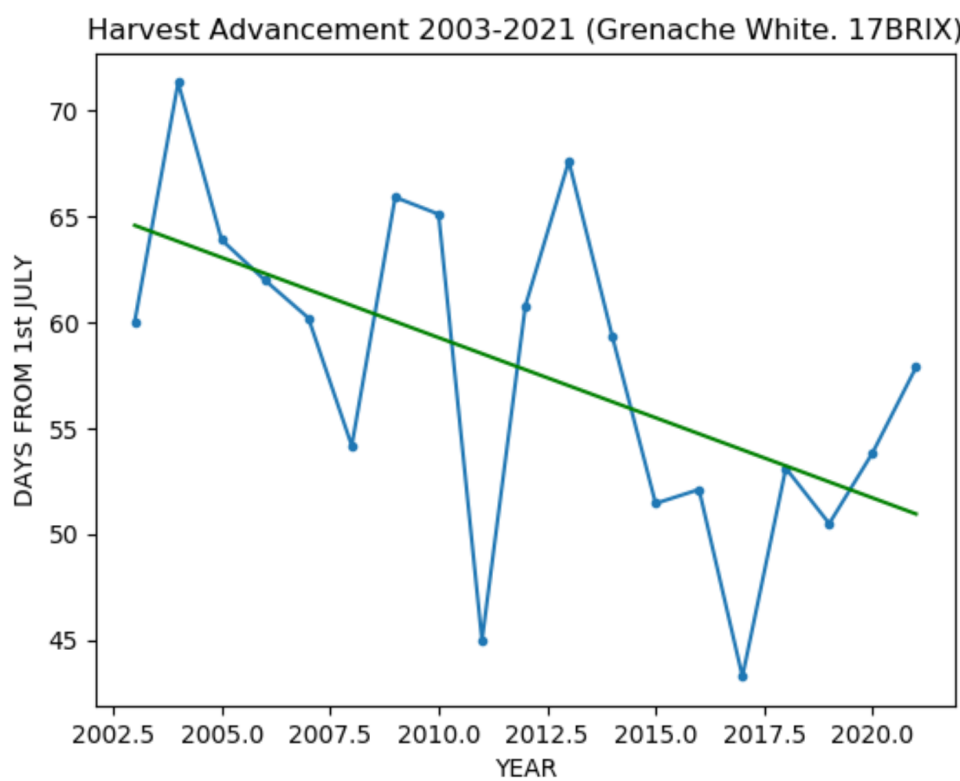
INTRODUCTION

Grapevine is not amongst the most produced cultivars in terms of biomass, nevertheless, the social role of wine, and the premium consideration of high quality wine products, not just busts its economical impact, but allows to deliver customers a storytelling very much linked to the climate reality. Thus, it is not just about offering consumers a more sustainable product (maintaining or increasing quality), but also about communicating to those consumers the effect that not being sustainable is having, and may have on grapevines and, ultimately, on wine itself.

The present work pretends to quantify the phenological reaction to all combined effects of the changing climate in the last two decades. To do so we chose to look for the most representative parameter linked to maturation: sugar content measured as °Brix (being a scale to measure sugar content, where 1°Brix is equivalent to 1 gram of sucrose in 100 grams of solution). Before harvesting, the grapes are checked at different times for sugar content as a ripening indicator, also related to the alcoholic wine strength obtained from the grapes. The more sugar content in the fruit, the more alcohol will be produced at fermentation. The sugar content is estimated on the field by refractometry, taking advantage of the changes in optical properties of grape juice when the sugar concentration changes. The values are given as degrees Brix, where 1 degree Brix is equivalent to 1 gram of sucrose in 100 grams of solution. This data is been collected for over two decades in all the vineyards owned by Miguel Torres S.A. (a well known Catalan cellar), as well as in all the vineyards of its providers. The original and coherent vast collection of data allows to draw significant conclusions.

The advancement of grapevine phenology due to climate change is been widely studied, but more data are needed to clearly understand the different effects of climate change on different grapevine varieties. This information is of great importance for adaption decisions, when next vineyards will be planted, to wisely select the best suited varieties and the best environments to achieve the desired flavours.

Variety	°BRIX	Trend (days/decade)
Chardonnay	16	-4,1
Moscat Alexandria	15	-5,5
White Grenache	17	-7,6
Xarel.lo	20	-2,8
Merlot	19	-8,2
Cabernet Sauvignon	21	-6,2
Syrah	17	-7,6
Red Grenache	19	-8



CONCLUSIONS

We confirm an advancement (in terms of °Brix) of the phenology of grapevines in Catalunya during the last 20 years, for all the studied varieties, of between 2 and 8 days per decade. The advancement is stronger at earlier maturation stages than by the end of the season, resulting in a GHD advancement of 1-3 days per decade for white varieties and 2-6 days per decade for red varieties (reduced to 2-3 days/decade at 24 °Brix).

Red varieties show a stronger advancement than white ones. The stronger advancement amongst the red varieties is observed for Red Grenache (8days/decade at 20 °Brix), whilst the strongest advancement for the white varieties is observed for White Grenache (7 days/decade at 17 °Brix).

It is important to highlight again that despite the effect of phenology advancement on GHD may not be very large, the effects of the early onset of the fruit and the subsequent mismatch between the sugar production and the aroma acquisition may lead to lower quality grapes and changes in the wine flavours. Because it is an industry based on flavour nuances, with strong identification between the terroir and the historical flavours, the effects of climate change will be felt earlier than in other crops, and have collateral effects on economy (through tourism and gastronomy) that other crops may not have.

Grapevine is thus no exception to the general observation of phenological advancements across ecosystems and crops, linked to climate change. Nevertheless, more data are needed in order to better understand what are the causes that drive the changes in phenology, and to better understand the details, so to have a wider toolbox to face adaptation.

The present work aims to encourage all producers to gather their data and make it available to the scientific community to study them. One of the lessons learnt from the collaboration between research entities and Família Torres from the present work is the necessity to improve the data collection for future studies, and to keep making it available to the scientific community.

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