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Short Communication

Phenology of the Mencía Variety Cultivated in a Territory Included in the UNESCO World Network of Biosphere Reserves

J. Antonio Cortiñas[1],* M. Eva Fernandez-Conde[1]

[1]Department of Culture, Education and Universities, Government of Galicia, Spain

Abstract

The study of grapevine phenology is very useful for vineyard management and control, as it allows the application of phytosanitary treatments at the phenological stages where the crop is most susceptible to different diseases, mainly cryptogamic. This work describes the phenological behaviour of the red Mencía variety, the most common in the Ribeira Sacra Designation of Origin (Northwest Spain), as well as its thermal requirements throughout its vegetative cycle. It has been carried out in a vineyard located in the highest areas of the Sil River canyon, during the year 2021. The observations were made on 10 vines and the phenological scale used was the one standardized by the BBCH. The vegetative cycle, from the beginning of sprouting to the harvest, took 163 days, during which 5097 GDD (Growing Degrees-Days) were accumulated.

Keywords: Phenology, Vitis, Mencía variety, Thermal requirements

Introduction

In agronomic, economic, social, historical, and cultural terms, the grapevine is one of the most important crops in the northwest of the Iberian Peninsula, including areas such as Galicia, León, and the north of Portugal. According to the Spanish Wine Market Observatory (OEMV), the vineyards in this area cover an area of some 25,823 hectares. This study focuses on the Ribeira Sacra Designation of Origin, a territory that offers an excellent opportunity to study what has been called "Heroic Viticulture", in reference to the special orographic characteristics of the area, which determine the cultivation methods http://www.cervim.org/.

The aim of the work is to provide information on the direct relationship between phenology and the different meteorological parameters, during a complete vegetative cycle of the crop, in a territory that has recently been included in the UNESCO, World Network of Biosphere Reserves https://es.unesco.org/.

The knowledge of vine phenology carried out during the year 2021 provides essential information on the characteristics of wine-growing regions, making it possible to plan cultural agricultural practices and the timing of phytosanitary treatments.[1,2] Moreover, by taking into account information on geographical variations in phenology in crops located in different bioclimatic zones, we can determine the adaptive capacity of a given variety to different weather conditions.[3] The main factors that determine the onset of the vegetative activity of a vine, as well as the development of the successive phenological phases, are meteorological, among which parameters such as temperature, precipitation, and photoperiod stand out.[4] Of all the meteorological parameters, the temperature is

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***Corresponding author:** Antonio Cortiñas J, Department of Culture, Education and Universities, Government of Galicia, Spain

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one of the main ones, due to its great influence on the microclimate of the vineyard, having a great significance in the distribution and diversity of cultivars.[5] Other factors such as photoperiod, soil type, crop orientation, cultivar genetic factors, cultural practices, and inter-species competition also have an important influence.[6]

We must also consider climate change, which has become a major concern for wine production worldwide, as grapevines are very sensitive to variations in climatic conditions, mainly temperature changes.[7] Factors such as temperature and solar radiation are decisive in fruit ripening, inducing earlier harvests, which implies important modifications in the chemical composition of the fruit, as well as in the organoleptic characteristics of the wine obtained.[8] Winegrowers are forced to adapt to this new situation, carrying out practices such as reorienting planting lines or modifying the vegetative canopy to ensure greater shade.[9] According to the winegrowers themselves, harvests have been brought forward by three to four weeks over the last 50 years. Phenological studies have proved to be a very useful tool for wine production, both qualitatively and quantitatively.[10] There are previous studies on the phenology of Mencía in this same Designation of Origin, together with studies on the incidence of phytopathogens on the crop,[11,12] so the current study aims to determine the variations in the phenological behaviour of the main red variety grown in this territory over time.

Materials and Methods

Location and climatic characteristics of the study area

The present study was conducted at the O Mato plot (332m a.s.l. 4230032.3” N; 73003.02” W), Figure 1 during the year 2021. The predominant cultivar in the O Mato vineyard is Mencía, included in the preferential category according to the regulations of the Ribeira Sacra Designation of Origin (DOG N 194, 2009). The Mencía cultivar has a medium vigour with early sprouting and semi-late maturation.

For climatic characterization, we considered the meteorological data of the maximum, minimum, and mean temperature, relative humidity, and rainfall variables Table 1, provided by one station located very close to the studied vineyard, in Monforte, a station belonging to the weather service Meteogalicia

https://www.meteogalicia.gal.

Table 1: Meteorological parameters, maximum temperature, minimum temperature, average temperature, average relative humidity, and rainfall, in the study area.

		Phenological Stages					
		0	1	5	6	7	8
Annual Average Meteorological Data	MaxT (°C)	19,29	25,63	24,16	27,36	31,41	29,13
	MinT (°C)	9,81	10,00	11,05	12,36	14,05	13,03
	MeanT (°)	14,9	17,11	17,37	19,45	22,22	20,29
	Mean RH (%)	84,08	76,59	76,32	71,70	70,92	76,32
Annual Total	Rainfall (mm)	45	44,5	35,00	2,40	1,00	46,40
Maximum	Daily rainfall (mm)	20					
	Date	12-May					

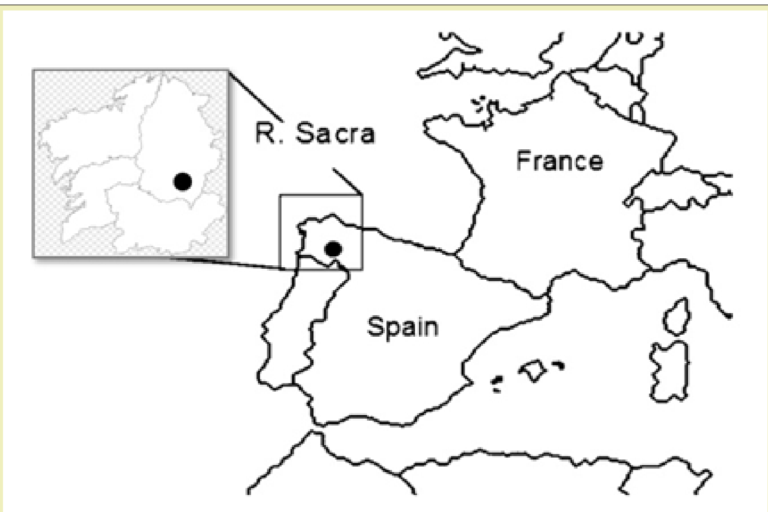

Figure 1: Location of the Ribeira Sacra Designation Origin area in the Northwestern Spain.

Fieldwork and phenological protocol

We studied the phenological stages for the cultivar Mencía following the scale adopted by the BBCH (*Biologische Bundesanstalt Bundessortenamt und Chemische Industrie*) as a standardized scale.[13] Table 2 The phenological observations were applied to 10 grapevines distributed throughout the plot. The study was carried out during the active grapevine cycle, from the 1st of April to the grapevine harvest date in September. During the sampling period, the vineyard was visited weekly, except at the flowering period, when the number of visits was increased to twice a week. For the purposes of determining the phenological calendar of the vines, the start date of each stage was deemed to be when 50 % of the plants under study reached the stage concerned. From the BBCH scale, a total of 18 phenological phases belonging to the six main stages were selected for observation.

Thermal requirements

The heat requirements were calculated following the criterion proposed by Galan,[14] which considers the daily sum of the maximum temperatures (growing degrees-days, GDD) from the end of the cold period to the start date of each phenological phase.

$GDD\ ºC = \sum Ti_{max}$

Ti_{max}= daily maximum temperatures in a number of days i.

The F-test of the statistical analysis determines whether the variability between the means of the groups is greater than the variability of the observations within the groups. If this ratio is sufficiently large, it can be concluded that not all means are equal. In this study, it gives a relatively high value, due to the fact that it is a one-year sample, where the elements sampled are not excessively large Table 3.

Table 2: Stages and Phases of the BBCH scale (*Biologische Bundesanstalt für Land und Forstwirtschaft, Bundessortenamt und CHemische Industrie*) considered in this study.

STAGES (St)	PHASES (Ph)
0: Sprouting	03 - End of bud swelling: buds swollen, but not green
	05 - “Wool stage”: brown wool clearly visible
	09 - Bud burst: green shoot tips clearly visible
1: Leaf development	11 - First leaf unfolded and spread away from shoot
	13 - 3rd leaves unfolded (continuos)
	15 - 5th leaves unfolded
5: Inflorescence emerge	53 - Inflorescences clearly visible
	55 - Inflorescences swelling, flowers closely pressed together
	57 - Inflorescences fully developed; flowers separating
6: Flowering	61 - Beginning of flowering: 10% of flowerhoods fallen
	65 - Full flowering: 50% of flowerhoods fallen
	69 - End of flowering
7: Development of fruits	71 - Fruit set: young fruits begin to swell, remains of flowers lost
	75 - Berries pea-sized, bunches hang
	79 - Majority of berries touching
8: Ripening of berries	81 - Beginning of ripening: berries begin to develop variety-specific colour
	85 - Softening of berries
	89 - Berries ripe for harvest

Table 3: Duration of the stages, thermal requirements (growing degrees-days, GDD), and statistical analysis in the vineyard. The values of the Test ANOVA were also showed and calculated by stage: Df=degrees of freedom; Sum Sq=sum of square; Mean Sq=mean square.

	days	GDD
Stage 0 (St 0)	24	1164
Stage 1 (St 1)	27	1613
Stage 5 (St 5)	19	2316
Stage 6 (St 6)	11	2763
Stage 7 (St 7)	37	3447
Stage 8 (St 8)	45	5097

ANOVA Tests						
Source of Variation	**Sum Sq**	**df**	**Mean Sq**	**F**	**P-value**	**F crit**
Between Groups	5052251,75	5	1010450,35	0,225	0,938	4,387
Within Groups	26907756,5	6	4484626,08			
Total	31960008,3	11				

Results

Phenological behaviour of grapevines

The vegetative growth period of the Mencía variety was calculated from the end of bud swelling, when the buds were swollen but not green (Ph 03), to the berries ripe for harvest phase (Ph 89). In 2021, the vegetative cycle of the vines took place between April and September. The longest stage was the ripening of berries stage (St 8), with 45 days, while the phenological phase with the longest duration also took place at this stage, Ph 85 (softening of berries) with a duration of 30 days. The shortest stage was flowering (St 6) with a total of 11 days, in which also the two shortest phenological phases of the whole vegetative cycle took place, Ph 65 and 69 (Full flowering: 50 % of the flowerhoods fallen and end of flowering); with a duration of two days per phase. The difference between the longest and the shortest stage was 34 days (St 8: ripening of berries and St 6: flowering), while the difference between the longest and the two shortest phenological phases was 28 days (Ph 85: softening of berries and Ph 65: Full flowering: 50 % of flowerhoods fallen; Ph 69: end of flowering). The Mencía variety in the O Mato vineyard only needed two days for Ph 65 and Ph 69 (the shortest), whilst for Ph 85 (the longest) it needed 30 days. For the rest of the phenological phases, no notable differences were observed Table 4, Figure 2.

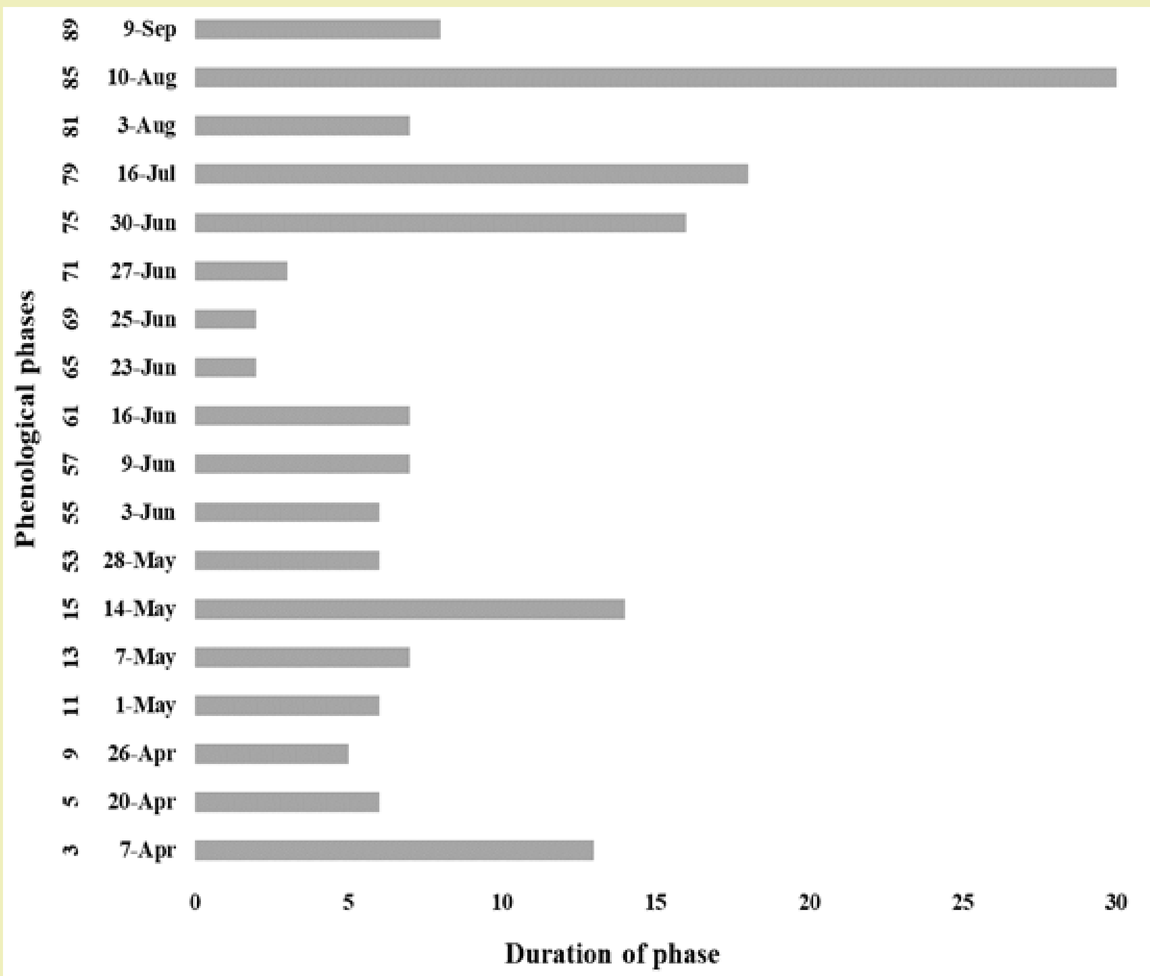

Figure 2: Start date and duration (days) of each phenological phase during the whole vegetative cycle (April to September).

Table 4: Average dates of the beginning of each phenological phase and duration in the vineyard studied for the Mencía variety.

Mencía O Mato				
Stages	**Phases**	**Start Date**	**Duration of phase**	**Duration of stage**
0	3	07-Apr	13	24
	5	20-Apr	6	
	9	26-Apr	5	
1	11	01-May	6	27
	13	07-May	7	
	15	14-May	14	
5	53	28-May	6	19
	55	03-Jun	6	
	57	09-Jun	7	
6	61	16-Jun	7	11
	65	23-Jun	2	
	69	25-Jun	2	
7	71	27-Jun	3	37
	75	30-Jun	16	
	79	16-Jul	18	
8	81	03-Aug	7	45
	85	10-Aug	30	
	89	09-Sep	8	
Cycle Duration			**163**	

Analysis of meteorological parameters

The phases included in the main stage 0 (St 0) take place from the beginning of April to the beginning of May Table 4, Figure 2. During this stage, the lowest mean maximum and minimum temperatures (19.29°C and 9.81°C, respectively) are recorded. Stage 1 (St 1) takes place between the beginning of May and the end of May. From this time until mid-June, stage 5 (St 5) takes place. The highest precipitation value (44.5mm of rainfall) is recorded in stage 1. The next stage 6, (St 6) runs from mid-June to the end of June. Stage 7 (St 7), runs from the end of June to the beginning of August and has the highest mean maximum, minimum, and average temperatures (31.41°C, 14.05°C, and 22.22°C, respectively). This stage also has the lowest annual precipitation (1.0mm rainfall) (Table 1). The last main stage 8 (St 8), occurs between early August and mid-September. The heat units accumulated for the ripening of berries (St 8) reached levels of around 5097 GDD in the year 2021. Regarding the heat requirements needed to overcome the various phenological stages, the Mencía variety needed from 1164 GDD for stage 0 (St 0) to 3447 for stage 7 (St 7) Table 3.

Discussion

The active vegetative period of the vine (from sprouting to harvest) lasted 163 days. Previous studies carried out in this wine region for the same Mencía variety reported very similar results to those obtained here, in 2018 (165 days), 2017 (167 days), and lower than those obtained in 2016 (183 days).[15] The shorter vegetative cycle in 2021 can be attributed to the higher minimum temperatures recorded throughout the vegetative cycle in this area, leading to a shorter development time of the different phenological phases. The lower minimum temperatures in 2016 would explain the longer cycle during this year. Studies prior to 2016 were also carried out in this geographical area and for the Mencía variety also reported values similar to those obtained in this study.[16] The longest cycle length was observed in parallel studies in the same wine region carried out with other red varieties, such as Brancellao and Merenzao, where a vegetative cycle length of 200 days has been found.[1] However, other red varieties such as Maturana and Tempranillo, grown in one of the areas with the highest wine production in Spain, Rioja, have cycles with a similar length to those of our study (158 and 172 days, respectively).[8] A significant difference has been observed in the date that defines the beginning of phenological stage 0 (St 0). The beginning of sprouting (St 0) normally takes place in March, but as a consequence of the low spring temperatures recorded during 2021, it was delayed to the beginning of April, however, the high temperatures throughout the vegetative cycle allowed the phenological phase (Ph 89) to take place at the beginning of September, a more frequent and usual date in this wine-growing region.

Thermal heat requirements, the daily sum of maximum temperatures, fluctuated from sprouting stage (St 0) to ripening of berries (St 8), in values between 1164 GDD and 5097 GDD. In previous studies carried out in this geographical area, the heat accumulation values recorded for the same variety showed similar values for the sprouting stage (St 0), between 1104 and 1601 GDD, in line with those obtained in our study (1164 GDD). The thermal requirements needed to induce flowering (St 6) were 2763 GDD, also similar to those obtained in previous studies, which ranged between 2892 and 3218 GDD. The date of initiation of the flowering stage is very important in determining the harvest date, as there is a constant number of temperature units accumulated between the two events.[17] Finally, the accumulated heat units for ripening of berries (St 8) reached values of 5097 GDD, a value slightly lower than the 5395 and 5432 GDD reported in Ribeira Sacra in 2017 and 2018.[1] In previous studies conducted in this same wine region during the period 2009-2012, more significant differences were reported in the heat units required for the ripening of berries according to the Ribeira Sacra subzone.[12] Vineyards located on the banks of the Sil river required the lowest thermal demand in the 2012 campaign, while other studies in the upper Ribeira Sacra subzone (Amandi) recorded the highest thermal demand in 2007.[12]

Conclusion

The phenological behaviour of the Mencía variety is linked to climatic conditions, with the temperature being the main meteorological parameter responsible for the inter-annual differences that occur in the vineyard, with the delay in the start of the phenological phase (Ph 3) to the month of April, compared to other years, which usually occurs in March. The flowering phenological stage (St 6) was the shortest of the vegetative cycle, while the longest was the ripening of berries (St 8). In terms of thermal requirements to complete the ripening of berries, more than 5,000 heat units (GDD) were necessary.

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Conflicts of Interest

The authors declare no conflict of interest.

References

1. Cortiñas JA, Fernández M, González E, et al. Phenological behaviour of the autochthonous godello and mencía grapevine varieties in two designation origin areas of the NW Spain. *Sciencia Horticulturae*. 2020b;265:109–221.
2. Verdugo Vásquez N, Acevedo Opazo C, Valdés Gómez H, et al. Spatial variability of phenology in two irrigated grapevine cultivars growing under semi-arid conditions. *Precis Agric*. 2016;17:218–245.
3. Duchêne E, Huard F, Dumas V, et al. The challenge of adapting grapevine varieties to climate change. *Clim Chang Res Lett*. 2010;41:193–204.
4. Santos JA, Malheiro AC, Karremann MK, et al. Statistical modelling of grapevine yield in the Port Wine region under present and future climate conditions. *Int J Biometeorol*. 2011; 55(2):119–131.
5. García de Cortázar Atauri I, Duchêne E, Destrac Irvine A, et al. Grapevine phenology in France: from past observations to future evolutions in the context of climate change. Oeno One. 2017;51(2):115–126.
6. Defila C, Clot B, Jeanneret F, et al. From Weather Observations to Atmospheric and Climate Sciences in Switzerland. Book Swiss Society for Meteorology, 456 pp. Phenology in Switzerland since 1808. 2016; pp. 291–303.
7. Teslić N, Zinzani G, Parpinello GP, et al. Climate change trends, grape production, and potential alcohol concentration in wine from the "Romagna Sangiovese" appellation area. Italy. *Theor Appl Climatol*. 2018;131(1-2):793–803.
8. Martínez A, Aleixandre Tudó JL, Aleixandre Benavent JL. Efectos de los fenómenos producidos por el cambio climático sobre la calidad de los vinos. *Enoviticultura*. 2016;42:4–26.
9. Nicholas KA. ¿Cómo afecta el cambio climático a los vinos? Invest. *Cienc*. 2015;2:40–49.
10. Baggiolini M. Les stades reperes dans le developpement annuel de la vigne et leurutilisation pratique. Revue Romande d'Agriculture de Viticulture et d´Arboriculture. 1952.
11. Cortiñas JA, Fernandez Conde ME. Sustainable use of plant protection products in Heroic Viticulture areas. Reducing risks to the environment and winemaking. *SunText Rev Biotechnol*. 2021;2(2):125.
12. Rodríguez Vega I. Composición Bioquímica De La Variedad Mencía (Vitis Vinifera L.) En La D.O. Ribeira Sacra: Influencia del Terroir y Adaptación al Cambio Climático. Doctoral Thesis. Universidade de Vigo. 2014.
13. Lorenz DH, Eichorn KW, Bleiholder H, et al. Phänologische Entwicklungsstadien der Weinrebe (Vitis vinifera L. Ssp. vinifera). Codierung und Beschreibung nach der erweiterten BBCH-Skala. *Vitic Enol Sci*. 1994;49:66–70.
14. Galán C, Cariñanos P, García-Mozo H, et al. Model for forecasting Olea europaea L. Airborne pollen in South-West Andalucía. *Spain Int J Biometeorol*. 2001;45:59–63.
15. Cortiñas JA, González E, Fernández M, et al. Fungal diseases in two north-west spain vineyards: relationship with meteorological conditions and predictive aerobiological model. *Agronomy*. 2020a;10(2):219.
16. Cunha M, Marçal ARS, Silva L. Very early prediction of wine yield based on satellite data from Vegetation. *Int J Remote Sens*. 2010;31(12):3125–3142.
17. Martínez J, Rubio P, Chavarri JB, et al. Minoritarias Tintas En La DOC Rioja (España). XXXVI World Congress of Vine and Wine, 11th General Assembly of the OIV. 2013.