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PHENOLOGICAL OBSERVATIONS ON SYRAH RED WINE VARIETY CLONES

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Abstract

Vine undergoes seasonal changes repeated annually in a certain sequence. In the spring time, the shoots' development and inflorescences begin, flowering occurs, and in the summer the berry size increases, after the grapes and shoots ripen. This period of active life is called the growing season. The main phenological stages duration: bud burst, first leaf appearance, first inflorescens appearance, flowering, bunch clossure and technological maturity (veraison) differ for each variety (clone). The length of the growing season for each variety is directly related to the vineyard location, air and soil temperature, soil moisture and management practices. This study aims to compare the main phenological stages and determine the differences between clones from the Syrah variety, regarding the influence of air temperature.

Keywords: grapevine phenology, clones, climate change, air temperature, Syrah

INTRODUCTION

The variability of the grapevine phenological stages under climate change has been studied in many winegrowing regions, with many authors reporting advances in the major phenological stages (Cameron et al., 2021). The influence of climate on phenological stages is of considerable interest in the study of the effects of climate changes on vine growth (Chuine et al., 2004; Jones, 2003; Jones et al., 2005; Van Leeuwen & Darriet, 2016). The opportunity for a better prediction of the phenological weather is important for achiving a more efficient vineyard management, including better short and long term planning (Caffarra & Eccel, 2010; Petrie & Sadras, 2008) and introduction of good practices for natural resources usage. In this context, phenology is described as one of the main factors to be investigated for varietal adaptation (Duchêne et al., 2010). Vine undergoes morphological and physiological changes resulting from the different stages of its vegetative and reproductive cycles. The duration of each phenological stage differs according to each variety, which is usually tied to the thermal conditions of the particular region. Predicting stage evolution is of paramount importance in viticultural activities and for taking winemaking decisions. The length of the growing season for each variety is directly related to the average temperature. In addition, the length of the growing season can also be related to soil moisture, air temperature and crop management practices. Air temperature is considered the most important factor for the overall growth and wine grapes productivity. In fact, vine physiology and fruit composition are strongly influenced by the average temperature during the growing season. Although this culture has a good adaptation to environmental stresses, withstanding extremely low temperatures for short periods during winter, negative temperatures in spring could seriously damage developing buds and leaves. This plants are also very sensitive to late spring frosts and hail. However, winter cold is an important aspect of development as it determines bud dormancy by initiating carbohydrate reserves for the

following year. Similarly, 10˚ C is the required biological temperature for grapevine (Fraga et al., 2012). Regina et al., (2005), investigated the phenological behavior, agronomic characteristics and net photosynthesis in 3 clones of the Syrah variety. The plants were grafted onto the SO4 rootstock, grown on well-moistened sandy soil. Clone 470 was the earliest and strongest, but with least productivity among the others. This clone has also shown a potential to produce good quality grapes. The photosynthesis varied significantly between the clones. Bock et al. (2011) found out that the vines were most affected by the average maximum temperatures preceding the event rather than the average or minimum temperatures, with rain and sunlight being of secondary importance. They found that the climate variables using the maximum temperatures of previous months yielded significant regression coefficients with start dates of different phenological stages, for example, bud burst correlated with an average maximum temperature from February to April, and flowering with the maximum temperatures from April to July. The length of time between the phenological stages is important because during this period significant changes occur in the plant (Duchêne & Schneider, 2005). Eearly grape harvest due to a warmer period could have an impact on the grape composition and quality (Coombe, 1987; Jackson & Lombard, 1993), with significant changes in the grape composition such as sugars, anthocyanins, aroma compounds and tannins occurring between ripening and harvest (Bindon et al., 2013; Keller, 2010).

Typically, growers use phenology to select a variety that is suitable for their vineyards and they adapt their practices to variations in environmental and weather conditions during the growing season. Phenology is considered the first biological indicator of the climate change (Menzel et al., 2006).

MATERIALS AND METHODS

For this research, the Syrah variety clones numbered 100, 174, 470 and 524 have been used, grafted on the Berlandieri x Riparia SO4 rootstock, planted in April 2011 in the Training-experimental and implementation base for viticulture of the Agrarian University - Plovdiv, located in the land of Kuklen town, on the border with the village of Brestnik, Rodopi municipality. The vineyard was in full fruition. The planting distance was 3.0 m between the rows and 1.00 m between the vines in each row - 3330 plants per ha. The vines were trained with high trunk. The training system was a double-sided cordon with the corresponding trellis system. The bud loading in all variants was carried out by spur pruning with two winter buds each, a total of 6 spurs or 12 winter buds per vine. The inter-rows were grass covered, the soil surface between the vines was kept clean by applying herbicides.

The rows direction was northwest - southeast, with a terrain slope to the east - 3.2% or 1.8º and an average altitude of 194 m (Figure 1).

The data on air temperature during the study period was collected from the meteo station located at the university vineyard.

The phenological observations of the main phases of development during the growing season, for the period 2020 and 2021, were carried out on the studied clones. For this purpose, normally developed, fully fruiting vines were selected. The phase started on the day when 5% of the vines entered it, mass entry - 50% of the vines, and end when 95% of the vines entered the corresponding phase. The data was recorded in a phenological observation log book. The indicators were studied according to the generally accepted methods described in the Manual for Exercises in Viticulture (Roychev et al., 2004).

Fig.1. Vineyard location

RESULTS AND DISCUSSION

The average monthly air temperature reported by the meteo station for 2020 was 14.3ºC. It varied from 3.7ºC to 25.1ºC (Table 1, Figure 2).

In 2021, the average monthly air temperature was 13.6ºC, the lowest being in January 4ºC, and the highest in July 26.3ºC (Table 1, Figure 3). The higher the temperature is, the earlier SAP movement begins and the faster it passes, bud burst occurs and the shoots growth begins.

In 2020, the vines from clones 174 and 470 started SAP 6 days earlier compared to clones 100 and 524. The onset of budding occurred earlier, again in clones 174 and 470, while in 100 and 524 a few days later. From the mass budding to its end it was 6 days in all variants. The same chronology was observed at the appearance of 1st leaf and 1st inflorescens, when the active process of plant development continued. The phases proceeded relatively intensively. The duration of the bud burst phase was about 10 days, and the flowering stage - about a week. The rapid progress of flowering was due to the favorable climatic conditions during this period, mainly, average daily air temperature at the end of May 23 - 24ºC. In the period of berry growth to "pea" size, we had an equal entry into the phase with clone 174 and clone 470 on June 19, and 3 days later on June 22, vines from 100 and 524 also.

Table 1. Average monthly air temperature, ºC, for the period 2020 and 2021

Meteo station Brestnik village	Year	Months												Average period
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
	2020	3,7	7,1	9,4	11,6	17,8	21,3	24,4	25,1	22,0	15,6	7,5	5,6	**14,3**
	2021	4,0	6,1	6,7	11,0	18,1	21,7	26,3	25,9	19,4	11,5	8,3	4,8	**13,6**

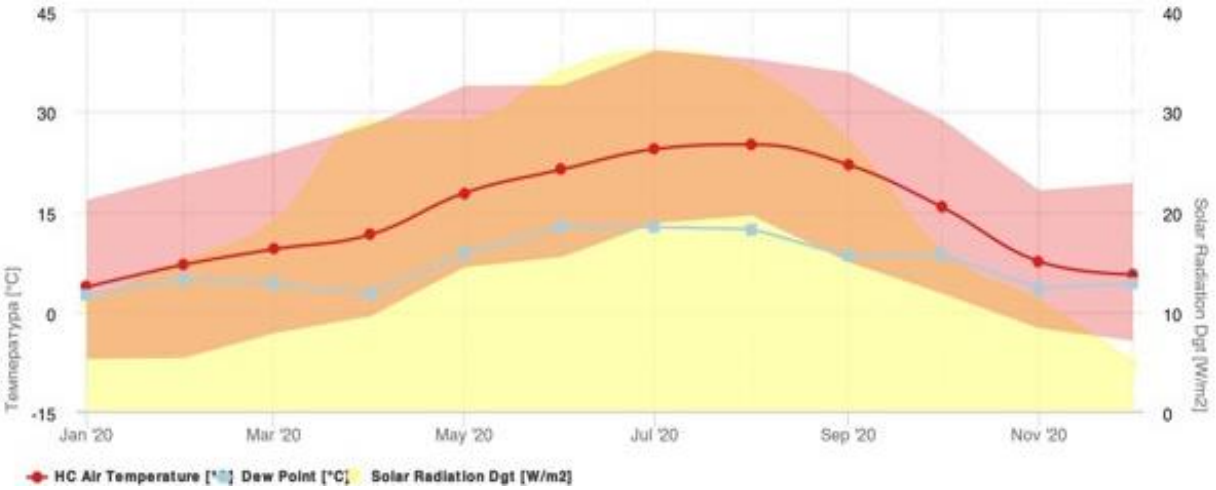

Figure 2. Average monthly air temperature for 2020,ºC.

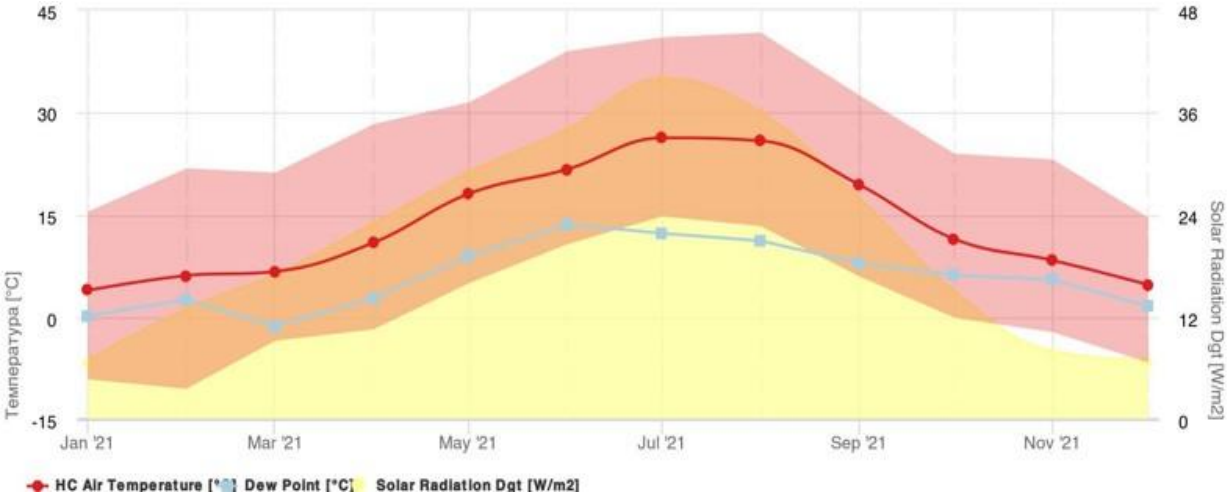

Figure 3. Average monthly air temperature for 2021, ºC.

The veraison first began at clones 174 and 470, and 4 days later we observed the same at 100 and 524.

During this stage, the large amount of carbohydrates made by the leaves were redirected to the growing bunches and berries. The berries sugar content increased, and the total acidity decreased. Colour and aromatic substances increased as well. After 30-40 days from the beginning of the process, technological maturity also occured. This is the time when the grapes are most suitable for making red table wines. To establish the technological maturity, the dynamics of sugars and acids are monitored.

The average date of permanent temperatures retention above 10ºC for the year 2020 was 21st of March, which was considered the beginning of the vine growing season. With the rise of the average daily air temperatures in spring, SAP movement began, which in clones 174 and 470 occured a few days earlier, compared to 100 and 524. In the same chronology, bud burst, first leaf appearance, first inflorescens and flowering. The permanent lowering of the average daily air temperatures below 10ºC in autumn occured in the first ten days of November, and below 5ºC in the last ten days same month. During this period, the end of leaf fall was also recorded. In 2020, the total temperature sum for the period with average daily air temperatures higher than 10ºC for 230 days was 4375ºC (Table 4).

Table 2. Phenological stages from the beginning of SAP movement to the first leaf appearance, 2020 and 2021

Syrah clone	Period (Year)	SAP		Bud burst			First leaf appereance	First inflorescens appereance
		begining	mass	begining	mass	end		
100	2020	12.03	31.03	10.04	15.04	21.04	23.04	26.04
	2021	01.04	05.04	15.04	23.04	25.04	29.04	02.05
174	2020	09.03	25.03	31.03	06.04	10.04	17.04	24.04
	2021	29.03	02.04	12.04	21.04	23.04	27.04	30.04
470	2020	09.03	25.03	31.03	06.04	10.04	17.04	24.04
	2021	29.03	02.04	12.04	21.04	23.04	27.04	30.04
524	2020	12.03	31.03	10.04	15.04	21.04	23.04	26.04
	2021	01.04	05.04	15.04	23.04	25.04	29.04	02.05

Table 3. Phenological stages from the beginning of flowering to the end of leaf fall, 2020 and 2021

Syrah clone	Period (Year)	Flowering			"Pea" size	Veraison			Technological maturity	Leaf fall
		start	mass	end		start	mass	end		
100	2020	29.05	03.06	06.06	22.06	03.08	09.08	14.08	09.09	16.11
	2021	03.06	06.06	11.06	06.07	04.08	10.08	16.08	07.09	03.11
174	2020	26.05	31.05	03.06	19.06	30.07	06.08	12.08	09.09	13.11
	2021	01.06	04.06	09.06	01.07	02.08	08.08	14.08	07.09.	05.11
470	2020	26.05	31.05	03.06	19.06	30.07	06.08	12.08	09.09	13.11
	2021	01.06	04.06	09.06	01.07	02.08	08.08	14.08	07.09.	05.11
524	2020	29.05	03.06	06.06	22.06	03.08	09.08	14.08	09.09	16.11
	2021	03.06	06.06	11.06	06.07	04.08	10.08	15.08	07.09.	03.11

Table 4. Average daily air temperature above 10ºC, number of days and temperature sum 2020 and 2021.

Meteo station Brestnik village	Beginning of growing season	End of growing season	Days with temperature above 10^0c	Active temperature sum
	21.03.2020 г.	05.11.2020 г.	230	2075
	28.03.2021 г.	09.11.2021 г.	227	1971

For the separate growing stages, the active temperature sum gives us a better idea of the temperature stress, which in the first experimental year was 2075ºC. This is the sum of the temperature above the vine biological zero, when more heat is needed for flowering, grapes ripening, emergence of technological and physiological maturity. The long, dry and relatively warm autumn helps to accumulate significant amounts of sugars and other active substances, especially necessary for the timely and complete grapes and shoots ripening. The total temperature sum for the year 2021 with an average daily temperature higher than 10ºC is 4241ºC, and the active temperature sum was 1971ºC (Table 4).

CONCLUSION

The location of the Syrah variety clones is characterized by favorable climatic conditions for growing red wine varieties. With a total temperature sum of 4241ºC and an average day-night temperature in July of 25ºC, the duration of the frost-free period was 228 days. The vines of clones 100 and 524 have got

bud burst 10 days later than 174 and 470, which is of great practical importance when establishing vines in terrains with frequent recurrence of late spring frosts.

The late bud burst would reverse frost damage to some extent and reduce the economic losses from yield reduction naturally, without chemical retarders or bud protection usage.

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