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# Influence of the Climatic Conditions of the Year 2022 on the Grapevine Phenology at SCDVV Blaj

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RESEARCH ARTICLE

## Abstract
The present article attempts to describe how the effects of climate conditions affect the evolution of the grapevine phenological period in 2022. The cultivars used were Selena, Blasius, Rubin, Radames and two clones obtained approved-in SCDVV Blaj: Sauvignon blanc 9Bl and Fetească albă 29 Bl. The experiment was carried out at SCDVV Blaj and included field observations, monitoring weather conditions such as temperature and precipitation. For the onset of the phenological phases: budding, flowering, veraison (colour change of grape berries) and ripening-maturation. The phenological phases of the grapevines were monitored for a growing season according to the protocol established, taking into account the BBCH grade. Temperature and precipitation are the two main climatic factors that affect the growth and development of the grapevines. Due to existing thermal conditions and continued global warming, the Târnave vineyard region is a recommended place for white grape cultivation.

**Keywords:** climatic conditions, grapevine phenology, Târnave vineyard

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## INTRODUCTION

The climate of the growing area and the selection of suitable cultivars is one of the most important factors affecting the yield of grapes and the type and quality of the wine produced (Koźmiński et al. 2020). In recent years, the overwhelming scientific evidence shows that periods of global warming are caused by a combination of natural factors and human activities. Increasing emissions of carbon dioxide and other greenhouse gases are altering the composition of the atmosphere. It is very likely that most of the global warming since the mid-20th century is due to increases in greenhouse gases from human activities (Webb et al. 2007). Inland climate change is having critical–consequences for already relatively hot and dry agriculture and rangeland (Cyr et al., 2010). Worldwide, average climatic conditions in wine regions determine to a large degree the grape varieties that can be grown there, while wine production and quality are chiefly influenced by site-specific factors, husbandry decisions and short-term climate variability (Gladstones, 1992). While grapevines respond to numerous climate influences, temperature is the most influential factor in the overall growth and productivity of grapevines (Mullins et al. 1992). If phenological stages advance, the maturation of berries is likely to take place under warmer conditions. (Mori et al. 2007) At the global scale, the general bounds on climate suitability for viticulture are found between 12–22° C for the growing season in each hemisphere. The 12–22°C climate bounds depict a largely mid-latitude suitability for winegrape production; however, many sub-tropical to tropical areas at higher elevations also fall within these climate zones (Jones et al. 2012). The increase in temperatures is likely to continue, allowing future wine production in areas that are presently too cold for vine cultivation, whereas the present grape growing regions will have to adapt to these changes (Duchêne et al. 2010).

As the most important wine region in Transylvania, the famous Tarnave vineyards are famous for their excellent wines with special taste and good sugar-acid balance, mainly from grape cultivars Fetească albă, Fetească regală, Traminer roz, Pinot gris, Sauvignon blanc, Neuburger, Italian Riesling, Muscat Ottonel, (Iliescu et al. 2010; Cudur et al. 2014; Donici et al. 2019). In this scientific article, we try to describe how the effects of climate conditions will affect the evolution of the grapevine phenological period in 2022. The viticultural area of the Târnave vineyards is characterized by a mild continental temperate climate with oceanic influences, but if the technique of partial mechanized protection of the vines at the foot of the slope is recommended, it will not affect the growth of the vines, (Iliescu et al. 2010). The environmental dynamic, with late spring freezes, heatwaves, droughts, early fall frosts, and pest infestations on the background of new and irregular temperature and humidity regimes, require its fast and appropriate adapting measures from the viticulturists, (Jones & Webb, 2010; Chedea et al. 2021).

These risks include, among others, the possibility of winter injury and frost damage, severe heat, drought or cooler temperatures during the growing season and excessive rainfall during the spring or harvest periods. Climate change has the potential to increase the variability and magnitude of these weather factors, and consequently the severity of the risks they pose to grape yield and wine quality (Jones et al. 2005; Shultz, 2000). According to the literature preferable temperatures range from 17°C to 24°C are recommended for optimal development of the grapevines (Asseng et al. 2021).

The aim of the paper is to create the data and to correlate them with the abiotic factors to understand the effects of climate conditions on grapevine.

## MATERIALS AND METHODS

The experiment was conducted at SCDVV Blaj - and it consisted in field observations, monitoring the weather conditions (temperature and rainfall) and the soil humidity. The location of the experimental plots was selected both at the experimental base Crăciunelu de Jos and SCDVV Blaj and consisted in choosing at least five grapevines on the row in three repetitions, for each cultivar. The samples were analysed according to the table which contains the BBCH scale. The weather data were taken with the help of the weather station Adcon telemetry GmbH, located at SCDVV Blaj. Initially the form of pruning the grapevine was low, the Classic Guyot cutting system, but now the training and pruning system are demi-high Guyot system with periodic replacement arms. The soil alternates between grass strips, *Phacelia tanacetifolia* and tillage field. For the starting of the phenology: budburst, flowering, veraison (change of colour of the grape berries) and harvest we used the observations from the SCDVV Blaj database. The cultivars that were selected were Selena, Blasius, Rubin, Radames, and two clones approved at SCDVV Blaj: Sauvignon blanc 9Bl and Fetească albă 29 Bl.

The monitoring of the phenological stages of the grapevines was carried out throughout a growing season according to the protocol that was created in the frame of the project taking into consideration BBCH scale. The BBCH scale was used to present the phenological stages (Hack et al. 1992, Meier 2001). The Global Phenological Monitoring Network has introduced the BBCH scale as a standard system for describing the phenological stages of plant development (Meier et al., 2009). The decimal code, which is divided into principal and secondary growth stages, is based on the well-known cereal code developed by (Zadoks et al. 1974). The grapevine buds are composed of several buds, of which one is the main, followed by secondary buds, tertiary, etc. In order to check the viability of the grapevine's buds, they are cross sectioned, then watched which buds are viable.

The s phenology according to grapevine BBCH scale are described below:

PRINCIPAL GROWTH STAGE 0: SPROUTING/ BUD DEVELOPMENT

**BBCH05:** "Wool stage" brown wool clearly visible

PRINCIPAL GROWTH STAGE 6: FLOWERING

**BBCH65:** 50% of flower hoods fallen

PRINCIPAL GROWTH STAGE 8: RIPENING OF BERRIES

**BBCH83:** Berries developing colour

## RESULTS AND DISCUSSIONS

The monitoring of the phenological phases by year, the creation of time series of data and the correlation of these with various abiotic factors, as well as their use in forecasting models of phenological phases will contribute to the understanding of the effects of climate conditions on grapevine cultivars and generally to the ecosystem. The time of bud development, leaf development, the time of the flowering, the time of development of fruit, the time of harvest consist the main observations of grapevine phenology. The recording of the start date of phenological stages and relating them to temperature play an important role in plant phenology study.

The budding started later. Flowering also started later, and due to the rains, it was particularly uneven and the completion of phenology was delayed. There were losses when trying to some varieties vinifera.
The technological maturity of the grapes was achieved late. The accumulation of sugars in the grapes was slow, so the harvesting ~~picking~~ spread over a longer period Table 1.

**Table 1.** Development of vegetation phenologys of the studied genotypes – 2022

| Cultivar | Budding (BBCH 0) | | Flowering (BBCH 65) | | Veraison (BBCH 83) | | Ripening maturation (BBCH 89) | |
|---|---|---|---|---|---|---|---|---|
| | Date | Useful temp. sum (Σ ºt) | Date | Useful temp. sum (Σ ºt) | Date | Useful temp. sum (Σ ºt) | Date | Useful temp. sum (Σ ºt) |
| **Selena** | 29.04 | 20.24 | 06.06 | 289.46 | 12.08 | 1069.4 | 19.09 | 1373.58 |
| **Blasius** | 03.05 | 35.27 | 09.06 | 320.78 | 14.08 | 1092.6 | 29.09 | 1412.51 |
| **Rubin** | 27.04 | 17.64 | 06.06 | 289.46 | 12.08 | 1069.4 | 29.09 | 1412.51 |
| **Radames** | 27.04 | 17.64 | 06.06 | 289.46 | 12.08 | 1069.4 | 28.09 | 1412.34 |
| **Sauvignon blanc 9 Bl** | 02.05 | 31.22 | 09.06 | 320.78 | 17.08 | 1124.9 | 22.09 | 1382.69 |
| **Feteasca alba 29 Bl** | 02.05 | 31.22 | 09.06 | 320.78 | 17.08 | 1124.9 | 29.09 | 1412.51 |

Temperature and precipitation are the two main climate factors that affect the growth and development of the grape vine. According to the literature on the subject, the air temperature during the vegetative state should be greater than 17º C. At the start of the vegetative period, the soil drought was at its least severe, but it became more severe in the first ten days of August. The air temperature during the vegetative period of the growing year expressed as the active heat balance has a greater impact on a specific harvest of wine (grape composition, wine quality) than cultivation technology. When it comes to thermal resources, it should be noted that excessive heat during the vegetative period can cause the grapes to mature earlier, have a higher sugar content and have a lower acidity. In contrast, insufficient active heat can lead to delayed or limited maturation and, as a result, the wine produced will have a low alcohol concentration Figure 1.

The differences between multiannual and monthly data are slightly distinct, except for June when there were less precipitations than the average annual precipitations and September, when the precipitations exceeded the average annual precipitations Figure 1.

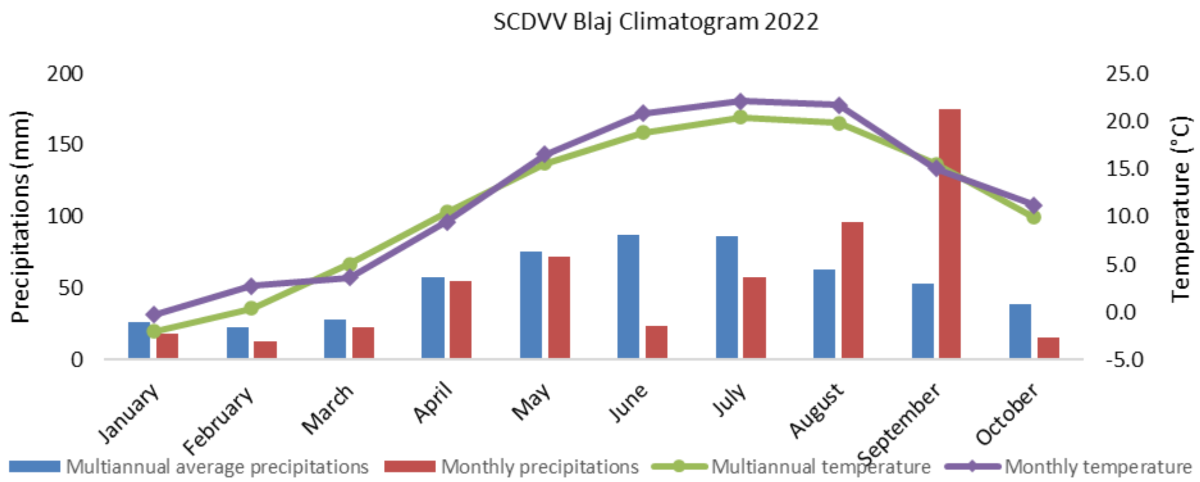


**Figure 1.** Climacteric evolution of precipitations and temperatures in the period January – October in the year 2022

In Figure 2, the temperatures registered at SCDVV Blaj in 2022 are shown. In the Târnave vineyard, temperature changes between January and October 2022 were favourable for the vine's growth and development. The winter was warmer, with the absolute minimum temperature of -18.56º C, in January, a temperature that did not affect the viability of the fruit buds. In March and April of 2022, temperatures were generally lower. The most critical period, the climate, with negative effect on the plant, was the period of heavy rains in the spring. Thus, delays were observed in the onset of flowering in the vine and slight losses when tying. Also, the postponement of the flowering period, created a disturbance in the grape stream. The entry of the grapes into the maturation period was particularly atypical and uneven.

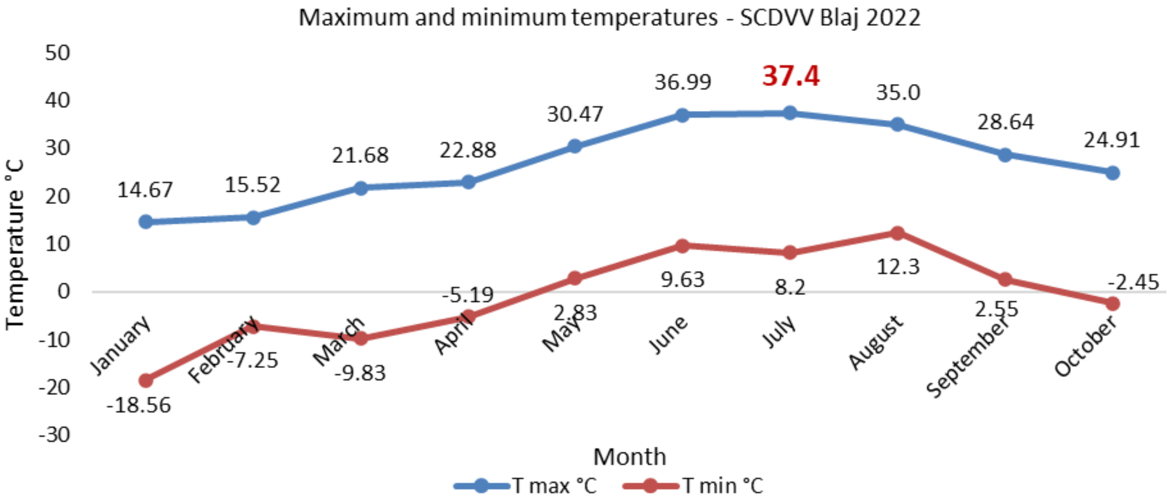


**Figure 2.** Maximum and minimum temperatures registered at SCDVV Blaj in the period January – October 2022

In the Târnave vineyard, the evolution of the meteorological factors (temperature, precipitation) during January to September 2022 was favourable for the vine's growth and development Table 2. The winter was warmer than in the multiannual average, with the absolute minimum temperature of -18.56º C, in January, a temperature that did not affect the viability of the fruit buds Table 2. The main bud is the most important because is carrying the bunches with flowers, the secondary ones also carry, sometimes, fruiting bunches. It's called a viable bud the one which present a green part. It is considered a dead bud the one which present a brown colour with no green areas. Compared to the multiannual average, the spring of 2022 saw significantly lower temperatures in March and April. Table 2. May, June, July, and August had average monthly temperatures that were higher above the multi-year average.

**Table 2.** Thermal regime in the period (January – September 2022)

| Month | Air temperature, ºC | | | |
|---|---|---|---|---|
| | | | Average | |
| | Normal | 2022 | Abs. Maxim | Abs. Minim |
| **I** | -2,0 | - 0.3 | 14.67 | -18.56 |
| **II** | -0,4 | 2.7 | 15.52 | -7.52 |
| **III** | 5,0 | 3.6 | 21.68 | -10.78 |
| **IV** | 10,5 | 9.4 | 22.88 | -5.9 |
| **V** | 15,6 | 16.5 | 30.47 | 2.83 |
| **VI** | 18,8 | 20.8 | 36.99 | 9.63 |
| **VII** | 20,4 | 22.1 | 37.4 | 8.2 |
| **VIII** | 19,8 | 21.6 | 35.0 | 12.3 |
| **IX** | 15,5 | 15.0 | 28.6 | 2.6 |

The values for the active and useful thermal balance over the growing season are slightly higher than the multiannual values (calculated as a reference value for the wine-growing zone) due to the higher temperatures in May-August Table 3. The global thermal balance sheet has lower values in April, after which it passes the multi-year average in June – August. Useful temperatures are the sum of temperatures that exceed the biological threshold of 10 degrees. With its help, caloric resources can be evaluated according to the specific requirements of a variety or group of varieties and can be determined for each phenophase of the vine or for several phenophases (Alexandrescu et al. 1994). Grapevines are climatically sensitive crops, so the quality production is achieved mostly in mid-latitude regions due to high climatic variability which conduct to a relatively large differences in quality and productivity (Jones et al. 2012).

**Table 3.** Values of thermal balances (global, active and useful) during the growing season - year 2022

| Month | Sum of temperature degrees, °C | | | | | |
|---|---|---|---|---|---|---|
| | Global | | Active | | Useful | |
| | Normal | 2022 | Normal | 2022 | Normal | 2022 |
| **IV** | 405.90 | 283.24 | 46.90 | 102.9 | 6.09 | 22.91 |
| **V** | 458.20 | 512.24 | 373.20 | 512.24 | 113.20 | 202.24 |
| **VI** | 572.10 | 625.24 | 572.10 | 625.24 | 272.10 | 325.24 |
| **VII** | 643.63 | 684.9 | 643.63 | 684.9 | 333.63 | 338.9 |
| **VIII** | 635.88 | 671.0 | 635.88 | 671.0 | 325.88 | 361 |
| **IX** | 470.31 | 450.1 | 465.67 | 412.66 | 205.67 | 152.66 |
| **SUM** | 3186.00 | **3190.72** | 2737.4 | **3008.94** | 1256.6 | **1419.65** |

Climate change in Europe and its effect on thermal resources for grapevine and other crops was already analysed in a previous work by (Mariani et al. 2012; Cola et al. 2016), mainly discussing the latitudinal effect of climate change on NHH (normal heat hour) availability. The work applied a similar approach to a single country characterized by a small latitudinal extension but also by relevant altitudinal effects related to the presence of the Caucasus chain (e.g., foehn-stau effect, convective enhancement, drainage of cold air masses) and longitudinal effects produced by the Western proximity to the Black Sea, the main source of moisture for weather systems responsible for precipitation in Georgia (Cola et al. 2016) These results state that thermal resource for grapevine are strongly controlled by large-scale atmospheric circulation, in agreement with the conclusions of (Santos et al. 2012). Some foreign articles showed an increase of about 1 °C when compared to the 1951– 1987. As shown in this work, the most likely year of thermal discontinuity in Georgia was 1994. The delay between Georgia and Western Europe could be considered the effect of the progressive dilution of the Oceanic signal as it moves into the European continent (Cola et al. 2016).

## CONCLUSIONS

The delay of budburst due to the climate conditions delayed the other phenofases. The temperatures from the vegetation period were, however, slightly higher than multiannual values, which fact gave time to the grapevines to accumulate enough sugars, so the balance between sugar and acidity was at its optimal. The region of the Târnave vineyard is a desirable place for viticulture for white grapevines. There are efforts to increase the areas for the red grape types due to the current heat conditions and ongoing global warming.

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**Conflicts of Interest**
The authors declare that they do not have any conflict of interest.

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