Scientific Papers. Series B, Horticulture. Vol. LXV, No. 2, 2021
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

# STUDY ON THE PHENOLOGY AND FERTILITY ELEMENTS OF SOME VINE VARIETIES DURING THE VEGETATION PERIOD

**Grigore-Valentin BELENIUC[1], Georgeta BELENIUC[1], Cristian MĂRĂCINEANU[2], Nicolae GIUGEA[2]**

[1]OVIDIUS University, Faculty of Horticulture, 124 Mamaia Blvd, Constanta, Romania
[2]University from Craiova, Faculty of Horticulture, 13 Al. I. Cuza Blvd, Craiova, Romania

Corresponding author email: georgetabelen@yahoo.com

***Abstract***

*In the 2019 year, the phenology of the white and black grape varieties for wine was studied, from Medgidia centre and the fertility elements for each variety were determined. Also, the climatic elements specific to 2019 compared to the multiannual average were studied. The year 2019 recorded values close to or higher than the multiannual average for almost all climatic elements, except for the sum of annual rainfall from the vegetation period, where the values are much lower, this year being a deficit in rainfall. According to the value of the Real Heliothermic Index (IHr) of 3.13, the year 2019 registered optimal values for the vine. The study shows that: white varieties for wine, sprouted early, between 15 April ('Chardonnay') and 17April ('Muscat Ottonel'); black varieties, sprouted between 15 April ('Merlot') and 18 April ('Cabernet Sauvignon'); the white varieties bloomed on 5 June ('Merlot') and 7 June ('Cabernet Sauvignon'); the ripe, occurred on different dates for different varieties; full maturity was in 8 September for white varieties and between 17-21 September for the black. For the varieties studied, the largest number of fertile shoots were for 'Muscat Ottonel' (22).*

***Key words****: fruit elements, phenology, ripe, thermal balance.*

## INTRODUCTION

Cernavoda, Murfatlar and Medgidia vine centers are part of the Murfatlar vineyard, the only vineyard located in the south-eastern part of Dobrogea spreading on both sides of the Carasu valley. The research in the viticultural field has shown that external ecological factors act on the vine plants. Therefore, there are analysed: - climatic and atmospheric factors, which include: the light, air temperature, atmospheric humidity, precipitation and winds; - pedological factors: soil temperature, soil humidity and air, and physico-chemical characteristics of the soil; - orographic factors: the relief, slope of the land, exposure and altitude; -biotic soil factors composed of: phytocenosis, zoocenosis, microbocenosis, fungocenosis, parasitocenosis. Ecological conditions listed above, influence each phenophase in each period of the annual biological cycle of the vine (Oslobeanu et al., 1980; Olteanu, 2000; Dejeu, 2004; Bucur, 2011). In many wine-growing areas, were recorded more changes in the climate as a result of the high average temperatures, due to low precipitations (Stroe and Cojanu, 2018; Bucur et al., 2019; Bădulescu et al., 2020).

## MATERIALS AND METHODS

The climatic factors evolution in the ecosystem of Medgidia wine center (like temperature, rainfall, humidity, insolation and so on) was monitored using the Weather Master 2000 performance meteorological station; all climate factors in 2019 were compared with the multiannual average from 1999-2018;

The working material was represented by four vine varieties: 'Chardonnay' and 'Muscat Ottonel'- grapes for white wine and 'Cabernet Sauvignon' and 'Merlot'- grapes for red wine. All these varieties are grafted on the rootstock Berlandieri x Riparia Oppenheim Selection 4 and planted at 2.2 m distances between rows and 1.1 m between plants in a row; the area of a vine nutrition is 2.42 $m^2$; the vine number/ha 4,132; rows orientation N-S; support system: concrete pillars; number of wires: 6 (two load-bearing wires and two double rows for off shoots directing); trunk highness: semi-tall with 70 cm; driving form: double Guyot;

The phenological behaviour of the above-mentioned varieties from the Medgidia wine center and the calendar delimitation of the phenophases were followed in the existing plantations (BBCH Monograph, 2018);

For twenty-five vines of each variety, it was performed the fertility elements statistic (total shoots/vine, fertile shoots, sterile shoots, total number of inflorescences, percentage of fertile shoots (FS%), relative and absolute fertility coefficients and relative and absolute productivity indices). The relative fertility coefficient was calculated according to the formula (Oslobeanu et al., 1980; Bucur, 2011; Bădulescu et al. 2020):

$$\frac{\text{no. of inflorescences on the vine plant}}{\text{total no. of shoots (fertile + sterile)}} \neq 1$$

and absolute fertility coefficient:

$$\frac{\text{nr. of inflorescences on the vine plant}}{\text{total nr. of fertile shoots on the vine plant}} \geq 1$$

In order to calculate the productivity indices, the fertility coefficients were multiplied by the weight of a bunch of grapes (in grams) for each variety (Bădulescu et al., 2020);
The standard deviation was calculated using the formula:
=STDEV (number 1; number 2).

## RESULTS AND DISCUSSIONS

Climate characterization of the 2019 year:
The vintage 2019 year started with an average temperature over the normal average of the period. There was an absolute minimum of -10.5°C, which did not affect the fruit buds and the viability being 100%.
Temperatures over 10°C higher than normal were recorded throughout the vegetation period, which led to a normal growth and development of the vine (Table 1).

Table 1. Thermal regime in air and in soil in 2019 compared with the multiannual average (1999-2018)

| Month | Air temperature $^0$C | | | | Soil temperature $^0$C | | | |
|---|---|---|---|---|---|---|---|---|
| | average | | Abs. max | Abs. min. | average | | Abs. max | Abs. min. |
| | Multiann average | 2019 | | | Multiann average | 2019 | | |
| I | 0.5 | 2.5 | 16.9 | -10.5 | 0.7 | 2.5 | 22.4 | -15 |
| II | 1.3 | 5.8 | 20.8 | -5.6 | 3.4 | 6.6 | 33.5 | -8.6 |
| III | 4.2 | 10.8 | 27.0 | -5.5 | 8.1 | 13.2 | 49.6 | -8.4 |
| IV | 10.5 | 12.5 | 27.4 | -4.50 | 13.2 | 17.1 | 53.9 | -8.2 |
| V | 16.2 | 20.11 | 32.8 | 7.5 | 20.8 | 26.0 | 64.9 | 4.1 |
| VI | 20.4 | 27.0 | 38.1 | 14.9 | 27.2 | 33.9 | 69.7 | 12.3 |
| VII | 22.6 | 26.7 | 38.9 | 14.4 | 31.3 | 34.6 | 70.1 | 10.2 |
| VIII | 22,6 | 24.4 | 39.0 | 14.5 | 29.6 | 36.6 | 69.5 | 10.2 |
| IX | 17.6 | 22.8 | 36.1 | 7.0 | 21.6 | 28.5 | 67.5 | 2.7 |
| Annual average | 12.8 | 16.9 | 39.0 | -10.5 | 17.3 | 22.1 | 70.1 | -15.0 |

During the vegetation period, the thermal balances (global, active and useful) registered values were above the normal average of the year (Table 2).

Table 2. The thermal balances (global, active and useful) in 2019 during the vegetation period compared with the multiannual value (1999-2018)

| Month | Global (Σ°C) | | Active (Σ°C) | | Useful (Σ°C) | |
|---|---|---|---|---|---|---|
| | Multiann value | 2019 | Multiann value | 2019 | Multiann value | 2019 |
| IV | 369.7 | 374.2 | 219.8 | 331.5 | 53.8 | 81.5 |
| V | 513.7 | 623.4 | 513.7 | 623.4 | 203.7 | 313.4 |
| VI | 620.1 | 811.2 | 620.1 | 811.2 | 328.1 | 511.2 |
| VII | 726.3 | 829.0 | 726.3 | 829.0 | 416.3 | 519.0 |
| VIII | 671.0 | 853.1 | 671.0 | 853.1 | 361.0 | 543.1 |
| IX | 521.2 | 685.8 | 521.2 | 685.8 | 252.7 | 385.8 |
| Σ°C | **3,422** | **4,176.7** | **3,303.6** | **4,134** | **1,615.6** | **2,435.4** |

In the table 2 it is observed that, in 2019, the global thermal balance was 4,176.7°C compared to multiannual value of 3,422.0°C; the active thermal balance was 4,134.0°C, with 830°C higher than the multiannual value, and the useful thermal balance was almost 820°C higher than the multiannual value. The main climatic elements of 2019 compared to the multiannual average (1999-2018) are presented in the table 3.

Table 3. Synthesis of the main climatic indices of 2019 year compared to multiannual averages (1999-2018)

| The climatic elements analysed | Multiann average | 2019 |
|---|---|---|
| Global thermal balance (Σt°g) | 4,790.7 | 5,058.6 |
| Active thermal balance (Σt°a) | 4,300.7 | 4,134.0 |
| Useful thermal balance (Σt°u) | 2,178.9 | 2,354.0 |
| July average temperature °C | 25,5 | 26,7 |
| August, average temperature °C | 24.4 | 24.7 |
| September average temperature °C | 19.3 | 22.8 |
| Temperature min. absolute in air °C | -22.0 | -10.5 |
| Temp. min. abs. at the soil surface °C | -15.5 | -15.0 |
| Annual average temperature °C | 13.0 | 1.8 |
| Maximum air temperature °C | 44.0 | 39.0 |
| Σ of annual rainfall, mm | 522.6 | 270.6 |
| Σ of rainfall, in the vegetation period, mm | 324.2 | 139.6 |
| Σ of the hours of insolation in vegetat. per | 1,612.1 | 1,329.7 |
| Max. average of temperature in August, °C | 30.8 | 33.8 |
| X. temp. in I-st and II-nd decades of June | 22.9 | 26.3 |
| Nr of days with maximum temp. > 30°C | 51.0 | 98.0 |
| Duration of the bioactive period, days | 188.4 | 162.0 |
| Real heliothermic index (IHr) | 3.6 | 3.13 |
| Hydrothermal coefficient (CH) | 0.8 | 0.3 |
| Bioclimatic index (Ibcv) of vine | 13.2 | 24.3 |
| Oenoclimatic index (IAOe) | 5,178.6 | 5,574.1 |
| Heliothermic Index (HI) Huglin | 3,130.1 | 3,063.6 |
| Night Cooling Index (IF) | 12.8 | 14.4 |
| The year characterization | Optimal values for the vine, rich water resources | Rainfall deficit. Rich in heliother-mal resources |

Due to excessively high temperatures, associated with prolonged pedological and atmospheric drought, the varieties showed a tendency of entering quickly in ripe (end of July – the beginning of August), a phenomenon caused by very high air temperatures and especially by extreme values exceedingly frequently 30°C. The phenomenon is accentuated when there is a water deficit, as it happened in 2019 (Table 3). According to the table 3, the registered values of 2019 year were close to or higher than the multiannual average for almost all climatic elements, except the sum of annual and vegetation rainfall, where the values are much lower, this year being a deficit in rainfall. According to the value of the Real Heliothermic Index (IHr) of 3.13, the 2019 year registered the optimal value for the vine.

Phenological behaviour of the studied white and black varieties:

The phenological behaviour of the white and black varieties studied during the vegetation period and their calendar delimitation (BBCH Monograph, 2018) is presented in the table 4.

Table 4. Phenological behaviour of the white and black varieties studied during the vegetation period varieties in the Medgidia wine center/2019

| Variety | Year | Phenophase/Calendar data | | | | | | Duration of the vegetation period (days) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Sprout | Blooming | Ripe | Full maturity | Harvest | Leaf fall | Sprout-Full maturity | Sprout-Leaf fall |
| White varieties | | | | | | | | | |
| 'Chardonnay' | 2019 | 15.04 | 04.06 | 13.08 | 08.09 | 12.09 | 23.10 | 146 | 191 |
| 'Muscat Ottonel' | 2019 | 18.04 | 04.06 | 11.08 | 08.09 | 12.09 | 25.10 | 143 | 188 |
| Black varieties | | | | | | | | | |
| 'Cabernet Sauvignon' | 2019 | 18.04 | 07.06 | 19.08 | 21.09 | 25.09 | 23.10 | 156 | 188 |
| 'Merlot' | 2019 | 15.04 | 05.06 | 17.08 | 20.09 | 25.09 | 23.10 | 158 | 191 |

The data from the table 4 indicate that: the white and black varieties, sprouted at about the same time first in April 15, 'Chardonnay' and 'Merlot', followed by 'Muscat Ottonel' and 'Cabernet Sauvignon' in April 18. The white varieties bloomed on the same date, June 4, and the black ones at different date (June 5 for 'Merlot' and June 7 for 'Cabernet Sauvignon'. Among the four varieties, 'Muscat Ottonel' reached the ripe earliest August 11, followed by 'Chardonnay' August 13 and then 'Merlot' on August 17 and 'Cabernet Sauvignon' on August 19. Full maturity was reached on September 8 for white varieties and after 12-13 days for the black varieties; harvesting began on September 12 for the both white varieties and after two weeks for the black varieties. Leaf fall began on October 23 for black and white 'Chardonnay' varieties and two days late for 'Muscat Ottonel'. The days number of the vegetation period (from sprout-full maturity, and to sprout-leaf fall) was different for the different varieties (158 days for 'Merlot' and 191 days for 'Merlot' and 'Chardonnay').

Statistics of the fruit elements

Table 5 shows the averages of the data resulting from the evaluation of the fruit elements statistics for the studied varieties.

Table 5. Statistics of the fertility elements and their standard deviation of the black and white varieties in the Medgidia wine center/2019 year

| Variety / Average (X) | | Total nr. of Shoots | Fertile Shoots | Sterile Shoots | Total no. of inflores-cences | % Fertile Shoots | R.F.C* | A..F.C* | weight of a grape (g) | R.P.I* | A.P.I* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| White varieties | | | | | | | | | | | |
| 'Chardonnay' | X | 24 | 19 | 5 | 28 | 79 | 1.2 | 1.5 | 91 | 116 | 144 |
| STDEV* | σ | 0.8485 | 0.9380 | 0.9380 | 0.9164 | 0.7483 | 0.1154 | 0.1252 | 0.8944 | 0.9860 | 0.9120 |
| 'Muscat Ottonel' | X | 26 | 22 | 4 | 34 | 84 | 1.3 | 1.5 | 84 | 109 | 126 |
| STDEV* | σ | 0.8447 | 0.9759 | 0.9583 | 0.9514 | 0.8904 | 0.2136 | 0.1348 | 0.9730 | 0.8650 | 0.9801 |
| Black varieties | | | | | | | | | | | |
| 'Cabernet Sauvignon' | X | 22 | 19 | 3 | 33 | 86 | 1.5 | 1.7 | 88 | 132 | 150 |
| STDEV* | σ | 0.9583 | 0.9380 | 1.058 | 0.9828 | 0.9174 | 0.2653 | 0.5463 | 0,9514 | 0.9964 | 0.9531 |
| 'Merlot' | X | 24 | 20 | 4 | 26 | 89 | 1.1 | 1.3 | 94 | 103 | 122 |
| STDEV* | σ | 0.8484 | 0.9534 | 0.9583 | 0.8325 | 0.9638 | 0.2034 | 0.3142 | 0.9797 | 0.7626 | 0.8990 |

*R.F.C/A.F.C - Relative /Absolute fertility coefficient; R.P.I /A.P.I - Relative /Absolute productivity indices; STDEV-standard deviation

In the case of white varieties, the highest total number of shoots (26) was at 'Muscat Ottonel' variety and of those, 22 were fertile shoots that had a number of 34 inflorescences, with 6 inflorescences more than the 'Chardonnay' variety, while the 'Cabernet Sauvignon' compared to 'Merlot' had a smaller number of total shoots (22) a smaller number of fertile shoots (19), but had a larger number of inflorescences (33), with 7 inflorescences more than 'Merlot'. The highest percentage of fertile shoots had the black varieties 'Merlot' (89%), then 'Cabernet Sauvignon' (86%) followed by the white varieties, 'Muscat Ottonel' (84%) and 'Chardonnay' (79%). Also from the table 5 we can see that: at the white varieties the absolute fertility coefficient had the same value (1.5), but due to the weight of the grapes the highest absolute productivity index was calculated for Chardonnay and for the black varieties the highest fertility coefficients and productivity indices were founded for 'Cabernet Sauvignon' (150) and the lowest for 'Merlot' (122); all the values calculated for standard deviations were subunit and these data show that the dispersion is close to their average value.

## CONCLUSIONS

The registered values of the 2019 year from the climatic point of view were close to or higher than the multiannual average for almost all climatic elements, except the sum of annual and vegetation rainfall, where the values were much lower, this year being a deficit one in rainfall. According to the value of the Real Heliothermic Index (IHr) of 3.13, the 2019 year registered the optimal value for the vine.

In 2019, in the Medgidia wine center, we studied the phenological behaviour of four white and black varieties for wine: 'Chardonnay', 'Muscat Ottonel', 'Cabernet Sauvignon' and 'Merlot'.

The phenophases of sprouting, blooming, ripening and full maturity, were produced at similar data for white varieties and red.

In the same time, we performed the fertility elements statistics of the varieties (total shoots/vine, fertile shoots, sterile shoots, total number of inflorescences, % fertile shoots, relative and absolute fertility coefficients and relative and absolute productivity indices).

The entire study was done in existing plantations

The highest average of fertile shoots was found at the variety 'Muscat Ottonel', 22 fertile shoots/vine. The highest percentage of fertile shoots had the black varieties 'Merlot' (89%), then 'Cabernet Sauvignon' (86%) followed by the white varieties, 'Muscat Ottonel' (84%) and 'Chardonnay' (79%). The highest fertility coefficients and productivity indices were found for 'Cabernet Sauvignon' and the lowest for 'Merlot'.

All the values calculated for standard deviations were subunit and these data show that the dispersion is close to their average value.

## REFERENCES


Badulescu A., Sumedrea D.I., Florea A., Onache A., Tanase A. (2020). Influence of climate factors on yield and quality of some vine cultivars from the Stefanesti center. *RJH Vol. I, 149-156*

Bucur, G. M. (2011). *Viticulture.* USAMV Bucharest, Department of distance education.

Bucur, G. M., Antoce, A. O., Cojocaru, G. A. (2019). The climate change influences and trends on the grapevine growing in Southern Romania: A long-term study. *BIO Web of Conferences 15, 01008. 42nd World Congress of Vine and Wine.*

Dejeu, L. (2004). *Practical viticulture.* Bucharest, RO: Ceres Publishing House.

Oslobeanu, M., Oprean, M., Alexandrescu, I., Banita, P. & Jianu, L. (1980). *General and special viticulture.* Bucharest, RO: Didactic and Pedagogic Publishing House.

Stroe M. V., Cojanu D. N. (2016). Knowledge of quality performance of some table grape varieties grown and obtained in the experimental field from U.A.S.V.M. Bucharest. *Scientific Papers. Series B, Horticulture. Vol. LXII, 2018.*

Uwe Meier Julius Kühn-Institut (JKI) (2018). *BBCH Monograph. Growth stages of mono- and dicotyledonous plants.* Edited by Quedlinburg-Germany.