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CLIMATIC CONDITIONS - IMPORTANT FACTOR OF THE GRAPES AND WINE TERROIR

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Abstract

The influence of terroir on the growth, development and productivity of the vineyard has been known since ancient times, but due to the increasingly changing climate, it is becoming an increasingly indispensable subject to study. The European continent remains to be affected by climate change, and the countries in the south-eastern part the most, or this was mentioned in the report `Climate change, impacts and vulnerability in Europe 2020`. The frequency and intensity of climate changes will impose the need to adapt technologies, the diversification of vine varieties or the adaptation of existing ones. The average air temperature on the territory of the Republic of Moldova registers an average increase of approximately 0.01°C/year during the period 1887-2010. Recent years have also seen an increase in temperatures of over 1°C compared to 10-15 years ago. The amount of water coming from the precipitation is less and less, and reaches the lower limit of non-irrigated vine cultivation.

Key words*: Climate change, Grapes, Terroir, Viticulture, Wine.*

INTRODUCTION

Climate change affects the entire agricultural sector, having consequences on food security and the economy of countries in vulnerable regions, including the Republic of Moldova. Climate change does not avoid the vine culture either, which reacts significantly to it.

The climate and climatic changes are included in the category of risk factors that contribute to the development of agro-food enterprises, a fact confirmed in various studies (Godoroja et al., 2022; Godoroja et al., 2023; Midari et al., 2022; Mogildea, 2023; Mogildea et al., 2023; Nicolaescu et al., 2023; Nicolaescu et al., 2022).

The final quality of grapes and wine, respectively, depends on several factors. We can talk about the grape variety, the type of soil, the cultivation technique but also the climatic conditions. The last one is a very important factor. Alternating periods of water stress with sudden changes in temperature have a negative influence on the health of the barrels and subsequently of the wine.

Plants that are more vulnerable during these times will be more fragile and more susceptible to disease. Some pests that are not present in certain areas will migrate and be potential vectors of viruses on crops.

The purpose of the research reflected in this article is to study the role of climatic conditions and their changes through the prism of the development of the wine sector.

MATERIALS AND METHODS

For the study of this article, the following databases and information were used:

- Data from local meteorological stations;
- National Bureau of Statistics (NBS) of the Republic of Moldova;
- Ministry of Agriculture and Food Industry of the Republic of Moldova;
- Food and Agriculture Organization of the United Nations (FAO Faostat);
- International Organisation of Vine and Wine (OIV);
- Official documents and special literature etc.

MS Office Excel (2019) was used for the mathematical processing of the data.

RESULTS AND DISCUSSIONS

During the analysed period, 2017-2022, in the Central part (Codru Region) of the Republic of Moldova the average annual temperature was

11.6^{0}C. The minimum average temperature for this period was 10.6^{0}C for 2021, and the maximum 12.7^{0}C for 2020.

In the period, 2017-2022, the average temperature of January was -0.95^{0}C. The average minimum temperature for this period was -4.2^{0}C for 2017, and the maximum 1.5^{0}C for 2020. The average temperature of February was 1.37^{0}C. The average minimum temperature for this period was -1.3^{0}C for 2018, and the maximum 4.4ºC for 2020. The average temperature of March was 5.32^{0}C. The minimum average temperature for this period was 0.8^{0}C for 2018, and the maximum 8.4^{0}C for 2020. The average temperature of April was 10.98^{0}C. The average minimum temperature for this period was 8.5^{0}C for 2021, and the maximum 15.1^{0}C for 2018. The average temperature of May was 16.55ºC. The average minimum temperature for this period was 14.4^{0}C for 2020, and the maximum 19.4^{0}C for 2018. The average temperature of June was 21.83^{0}C. The minimum average temperature for this period was 20.2^{0}C for 2021, and the maximum 23.5^{0}C for 2019. The average temperature of July was 23.0^{0}C. The average minimum temperature for this period was 22.1^{0}C for 2019, and the maximum 24.0^{0}C for 2021. The average temperature of August was 23.58^{0}C. The average minimum temperature for this period was 21.7^{0}C for the year 2021, and the maximum 24.6^{0}C for the year 2018. The average temperature of September was 17.95^{0}C. The minimum average temperature for this period was 15.7ºC for 2021, and the maximum 20.8^{0}C for 2020. The average temperature of October was 12.3^{0}C. The minimum average temperature for this period was 10.2^{0}C for 2021, and the maximum 14.6^{0}C for 2020. The average temperature of November was 5.48^{0}C. The minimum average temperature for this period was 2.1ºC for 2018, and the maximum 7.9^{0}C for 2019. The average temperature of December was 1.72^{0}C. The minimum average temperature for this period was -0.8^{0}C for 2018, and the maximum 3.5ºC for 2019 (Figure 1).

During the analysed period, 2017-2022, in the South and South-East part (Valul lui Traian and Stefan Regions), the average annual temperature was 12.13^{0}C. The minimum average temperature for this period was 11.4^{0}C for 2021, and the maximum 13.1^{0}C for 2020 (Figure 2).

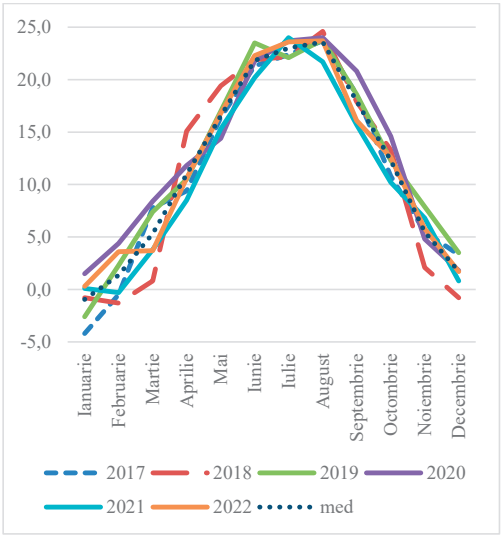

Figure 1. The mean temperature in the Central part (Codru Region) of the Republic of Moldova for the 2017-2022 years
Source: NBS & local meteorological stations (i-Metos), processed by authors

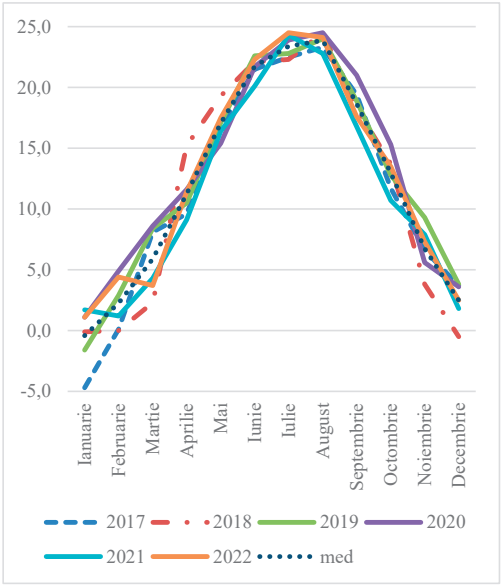

Figure 2. The mean temperature in the South and South-East part (Valul lui Traian and Stefan Regions) of the Republic of Moldova for the 2017-2022 years
Source: NBS & local meteorological stations (i-Metos), processed by authors

In the period, 2017-2022, the average temperature of January was -0.42^{0}C. The minimum average temperature for this period was -4.7^{0}C for 2017, and the maximum 1.7^{0}C for 2021. The average temperature of February was 2.25^{0}C. The average minimum temperature for this period was 0^{0}C for 2018, and the maximum 4.9^{0}C for 2020. The average temperature of March was 5.9^{0}C. The minimum average temperature for this period was 2.3^{0}C for 2018, and the maximum 8.6^{0}C for 2020. The average temperature of April was 11.23^{0}C. The minimum average temperature for this period was 9.1^{0}C for 2021, and the maximum 15.2^{0}C for 2018. The average temperature of May was 17.07^{0}C. The minimum average temperature for this period was 15.4^{0}C for 2020, and the maximum 19.3^{0}C for 2018. The average temperature of June was 21.72^{0}C. The minimum average temperature for this period was 20.1^{0}C for the year 2021, and the maximum 22.6^{0}C for the year 2019. The average temperature of July was 23.38^{0}C. The average minimum temperature for this period was 22.3^{0}C for the year 2019, and the maximum 24.5^{0}C for the year 2022. The average temperature of August was 23.87^{0}C. The minimum average temperature for this period was 22.8^{0}C for 2021, and the maximum 24.5^{0}C for 2020. The average temperature of September was 18.67^{0}C. The minimum average temperature for this period was 16.8°C for the year 2021, and the maximum 21.0^{0}C for the year 2020. The average temperature of October was 12.95°C. The minimum average temperature for this period was 10.7^{0}C for 2021, and the maximum 15.3°C for 2020. The average temperature of November was 6.75°C. The minimum average temperature for this period was 3.8^{0}C for 2018, and the maximum 9.3^{0}C for 2019. The average temperature of December was 2.48^{0}C. The minimum average temperature for this period was -0.5^{0}C for 2018, and the maximum 3.8^{0}C for 2019.

In the analysed period 2017-2022, in the Central part (Codru Region), the deviation of the average monthly temperature compared to the previous year of the same period (Figure 3), had values between -1.8 and 4.1^{0}C for the month of January. For the February, the average monthly temperature deviation compared to the previous year of the same period, had values between -4.7 and 3.9^{0}C, March, the values between -7 and 6.6^{0}C, in April, the values between -4.6 and 5.7^{0}C. In the May, the average monthly temperature deviation compared to the previous year of the same period, had values between -2.6 and 3^{0}C. In the June, the average monthly temperature deviation compared to the previous year of the same period, had values between -1.7 and 2.1^{0}C. In the July, the average monthly temperature deviation compared to the previous year of the same period, had values between -0.4 and 1.6°C. In the August, the average

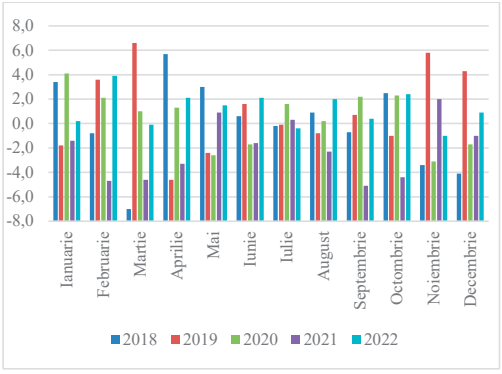

Figure 3. The difference in average temperature, for the same period, compared to the previous year in the Central part (Codru Region) of the Republic of Moldova for the 2018-2022 years
Source: NBS & local meteorological stations (i-Metos), processed by authors

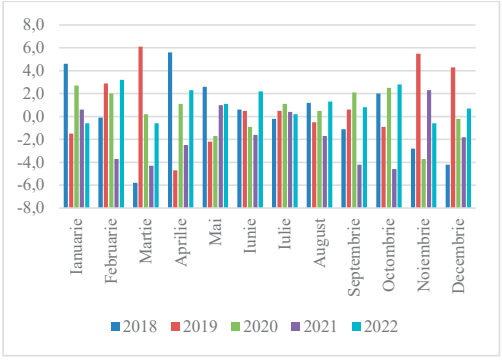

Figure 4. The difference in average temperature, for the same period, compared to the previous year in the South and South-East part (Valul lui Traian and Stefan Regions) of the Republic of Moldova for the 2018-2022 years
Source: NBS & local meteorological stations (i-Metos), processed by authors

monthly temperature deviation compared to the previous year of the same period, had values between -2.3 and 2^0C. In the September, the average monthly temperature deviation compared to the previous year of the same period, had values between -5.1 and 2.2^0C. For the month of October, the average monthly temperature deviation compared to the previous year of the same period, had values between -4.4 and 2.5^0C. For the month of November, the average monthly temperature deviation compared to the previous year of the same period, had values between -3.4 and 5.8^0C. In the December, the average monthly temperature deviation compared to the previous year of the same period, had values between -4.1 and 4.3^0C.

In the analysed period 2017-2022, in the South and South-East part (Valul lui Traian and Stefan Regions), the deviation of the average monthly temperature compared to the previous year of the same period (Figure 4), had values between -1.5 and 4.6^0C for the month of January. In February, the values between -3.7 and 3.2^0C, in March, the values between -5.8 and 6.1^0C, in April, the values between -4.7 and 5.6^0C, in May, the values between -2.2 and 2.6^0C, in June, the values between -1.6 and 2.2^oC. For the July, the average monthly temperature deviation compared to the previous year of the same period, had values between -0.2 and 1.1^0C, in August, the values between -1.7 and 1.3^0C, in September, the values between -4.2 and 2.1^0C, in October, the values between -4.6 and 2.8^oC, in November, the values between -3.7 and 5.5^0C and in December, the average monthly temperature deviation compared to the previous year of the same period, had values between -4.2 and 4.3^0C.

Based on the multi-year data, a trend of increasing the average annual and monthly temperature and reducing the minimum temperatures is established.

The existing global warming makes the vegetation period shorter, the winemaking campaign starts earlier in the case of wine varieties.

The reduction of absolute minimum temperatures requires technological elements to increase the resistance of plants to frost and the selection of varieties with increased resistance to frost.

For the analysed period 2017-2022, the amount of precipitation in the Central Region (Codru) constituted values between 403 and 666 mm, and for the South and South-East Region, the precipitation was within the limits of 352 and 574 mm. The average amount of precipitation for the Central Region (Codru) was 553.17 mm, and for the South and South-East - 448.33 mm (Figure 5).

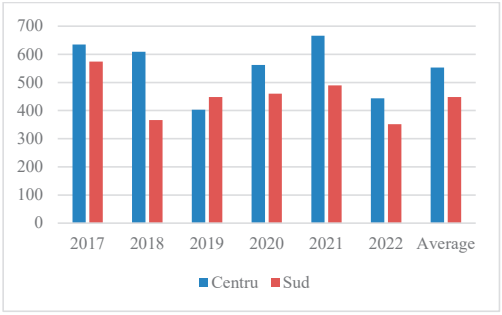

Figure 5. The yearly quantity of precipitation in the Central part (Codru Region), South and South-East part (Valul lui Traian and Stefan Regions) of the Republic of Moldova for the 2017-2022 years
Source: NBS & local meteorological stations (i-Metos), processed by authors

For January, the average amount of precipitation in the Central Region (Codru) was 33.17 mm, the limits of the values between 9 and 83 mm, and for the South and South-East Region, the average was 18.33 mm, the limits of the values between 5 and 31 mm (Figure 6, Figure 7). For the month of February, the average amount of precipitation in the Central Region (Codru) was 31.33 mm, the limits of the values between 6-55 mm, and for the South and South-East Region, the average was 26.5 mm, the limits of the values between 3 and 63 mm. For the month of March, the average amount of precipitation in the Center Region (Codru) was 33 mm, the limits of the values between 1-103 mm, and for the South and South-East Region, the average was 25 mm, the limits of the values between 5 and 50 mm. For the April, the average amount of precipitation in the Central Region (Codru) was 46.83 mm, the limits of the values between 4 and 127 mm, and for the South and South-East Region, the average was 41.17 mm, the limits of the values between 4 and 85 mm. For May, the average amount of precipitation in the Central Region (Codru) was 50.17 mm, the limits of the values between 18-101 mm, and for the South and South-East Region, the

average was 44.33 mm, the limits of the values between 28-77 mm.
For the month of June, the average amount of precipitation in the Central Region (Codru) was 80.83 mm, the limits of values between 7 and 151 mm, and for the South and South-East Region, the average was 80.33 mm, the limits of values

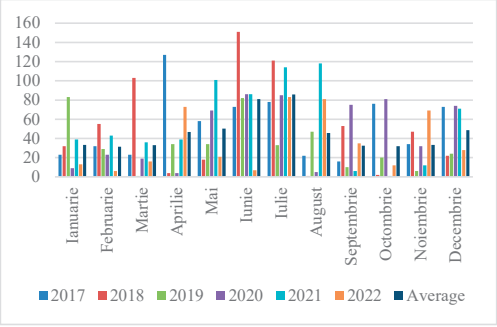

Figure 6. The month quantity of precipitation in the Central part (Codru Region) of the Republic of Moldova for the 2017-2022 years
Source: NBS & local meteorological stations (i-Metos), processed by authors

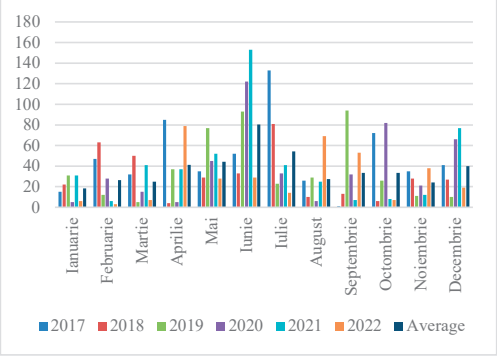

Figure 7. The month quantity of precipitation in the South and South-East part (Valul lui Traian and Stefan Regions) of the Republic of Moldova for the 2017-2022 years
Source: NBS & local meteorological stations (i-Metos), processed by authors

between 29 and 153 mm. For the month of July, the average amount of precipitation in the Central Region (Codru) was 85.67 mm, the limits of the values between 33 and 121 mm, and for the South and South-East Region, the average was 54.17 mm, the limits of the values between 14 and 133 mm. For the month of August, the average amount of precipitation in Central Region (Codru) was 45.67 mm, the limits of the values between 1 and 11 mm, and for the South and South-East Region, the average was 27.5 mm, the limits of the values between 6 and 69 mm. For the month of September, the average amount of precipitation in the Central Region (Codru) was 32.5 mm, the limits of the values between 6 and 75 mm, and for the South and South-East Region, the average was 33.33 mm, the limits of the values between 1 and 94 mm. For the month of October, the average amount of precipitation in the Central Region (Codru) was 32 mm, the limits of the values between 1 and 81 mm, and for the South and South-East Region, the average was 33.5 mm, the limits of the values between 6 to 82 mm. For the month of November, the average amount of precipitation in the Central Region (Codru) was 33.33 mm, the limits of the values between 6 to 69 mm, and for the South and South-East Region, the average was 24.17 mm, the limits of the values between 11-38 mm. For the December, the average amount of precipitation in the Central Region (Codru) was 48.67 mm, the limits of the values between 22 and 74 mm, and for the South and South-East Region, the average was 40 mm, the limits of the values between 10 and77 mm.
Based on the multi-year data, a tendency is established to reduce the annual amount of precipitation, which makes it saincreasingly necessary to irrigate the vineyards.

CONCLUSIONS

The average temperature in the analysed years was 11.6^{0}C for the Central Region (Codru) and 12.1^{0}C for the South and South-East Region.
Based on the multi-year data, a trend of increasing the average annual and monthly temperature and reducing the minimum temperatures is established.
The existing global warming makes the vegetation period shorter and the winemaking campaign starts earlier in the case of wine varieties.
The reduction of absolute minimum temperatures requires technological elements to increase the resistance of plants to frost and the selection of varieties with increased resistance to frost.

The average amount of precipitation in the analysed years was 553 mm for the Center Region (Codru) and 448 mm for the South region.

Based on the multi-year data, a tendency is established to reduce the annual amount of precipitation, which makes it increasingly necessary to irrigate the vineyards.

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