EFFECTS OF CLIMATE CHANGE ON GRAPE YIELD AND QUALITY ON A LONG-TERME EXPERIENCE

INFLUENȚA SCHIMBĂRILOR CLIMATICE ASUPRA PRODUCȚIEI ŞI CALITĂȚII STRUGURILOR, PE BAZA UNEI EXPERIENȚE DE LUNGĂ DURATĂ

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***Abstract**. Starting with the fundamental influence of climatic factors on the territorial repartition, on the quantity and quality of viniviticultural products, there were studied the effects of global warming on grapevine, in the last decade. The research concerned the variety Fetească regală, clon 21 Bl, grafted on Kober 5 BB rootstock, on the experimental plantation of the University of Agronomical Sciences and Veterinary Medicine Bucharest, in 2001-2012. Following the evolution of climatic indicators in this period, as compared to the annual average, we can notice the frequence of the years with high temperature at maturation, which led to increased sugar accumulation in the grapes, lowering the acidity of the must, together with the speed-up of the fenophasis and the extension of favourable areas for viticulture.*
***Key words:** climate change, vine, grape quality*

Rezumat. Începând cu influența fundamentală a factorilor climatici asupra repartizării teritoriale, a cantității şi calității produselor vitivinicole, au fost studiate influențele încălzirii globale asupra viței-de-vie, în ultima decadă. Cercetările au fost efectuate la soiul Fetească regală, clona 21 Bl, altoită pe portaltoiul Kober 5 BB, în plantația experimentală a Universității de Ştiințe Agronomice şi Medicină Veterinară Bucureşti în perioada 2001-2012. Urmărind evoluția indicatorilor climatici în această perioadă, comparativ cu media multianuală, s-a constatat o frecvență mai mare a anilor cu temperaturi ridicate în perioada de maturare a strugurilor, fapt ce a condus la acumulări sporite de zaharuri în boabe, reducerea acidității mustului, alături de o desfăşurare mai rapidă a fenofazelor şi extinderea zonelor favorabile pentru viticultură.
***Cuvinte cheie:** schimbări climatice, vița-de-vie, calitate struguri*

INTRODUCTION

The influence of climate changes on grapevine, obvious recent decades is the concern of many researchers, in order to establish strategies to adapt to this phenomenon (Burzo and Dobrescu, 2011; Bock et al., 2011; Retallack, 2012; Salazar-Parra et al., 2012). The impact of these changes was studied on both grapevine (phenology, yield quality, diseases, erosion) and wine (typicity, microbiology, color, flavors) etc (Cotea et al., 2008; Dejeu et al., 2008; Bucur et al., 2012).

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This works aims at evaluating the main climate changes occurred during the last 52 years (1961-2012), as well as their influence on grapevine, in a long term experience (2001-2012).

MATERIAL AND METHOD

The experience was conducted in the experimental plantation of the Horticulture Faculty within USAMV Bucharest, during 2001-2012. Plantation was established in 1994, with the variety of Fetească regală, clone 21 Bl, grafted on Kober 5 BB, planted at distances of 2.2/1.2 m (3787 vines/ha), with spur – pruning cordon and loading of 10 eyes/m^2.

The following parameters were taken into consideration for a period of 52 years (1961-2012): the average annual temperature; the average temperature during the growing season (IV-X); average temperature of the hottest month (July or August) and on seasons (spring III-V, summer VI-VIII, autumn IX-XI and winter XII-II); annual precipitations, during the growing season and on seasons.

Using the information from a long term experience (2001-2012), a series of correlations were established between: precipitations and the wood eliminated annually after pruning; average temperature during growing season (IV-X) and sugars accumulated in grapes; average temperature during summer (VI-VIII) and sugar concentration; average temperature during the hottest month (VII or VIII) and titratable acidity; rainfall in summer (VI-VIII) and sugars; annual rainfall and titratable acidity.

RESULTS AND DISCUSSIONS

On climatic conditions. Following the evolution of average annual temperature during the 52 years (fig. 1) there is a significantly distinct heating especially during the last decade with approximately 0.8ºC from the beginning of the study period.

An obvious warming can be noticed also concerning the average temperature during growing season, the difference being that, for the same interval, of 1.0-1.1ºC (fig. 2).

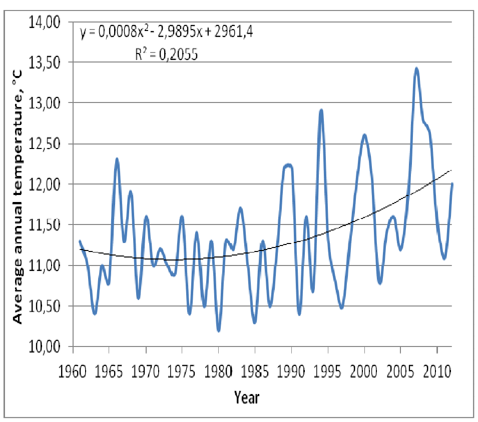


Fig. 1 - Average annual temperature evolution, ºC (1961-2012)

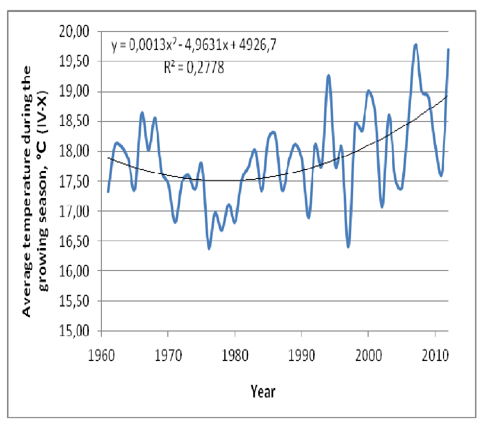


Fig. 2 - Evolution of the average temperature during the growing season (IV-X)

The warming is even more accentuated during summer (VI-VIII), highlighted by a difference of almost 2ºC and the highest degree of significance (fig. 3). It is known that climate changes manifest also by an increased frequency of extreme phenomena (accentuated winter frosts, severe summer drought, storms etc.). In our case we noticed an increased frequency during the last decade of minimum harmful temperatures for grapevine (< -20ºC), but also by lower values (fig. 4).

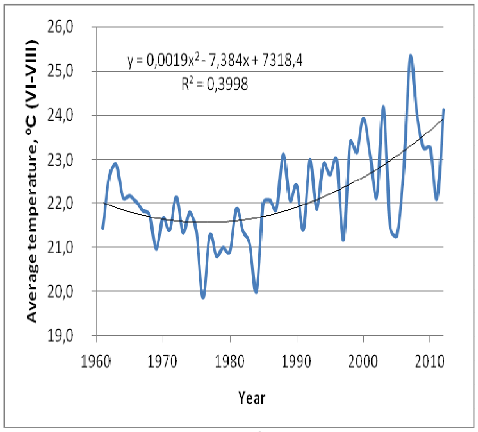


Fig. 3 - Evolution of the average temperature in summer season, ºC (VI-VIII, 1961-2012)

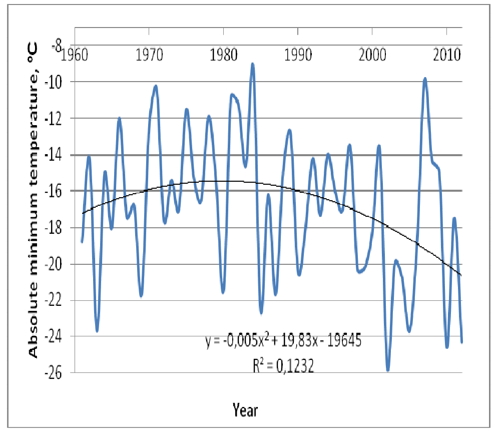


Fig. 4 - The absolute minimum temperature evolution, ºC (1961-2012)

Related to the annual rainfall during growing and the season of summer, there are no significant changes, except for higher variations from one year to another (fig. 5, 6 and 7).

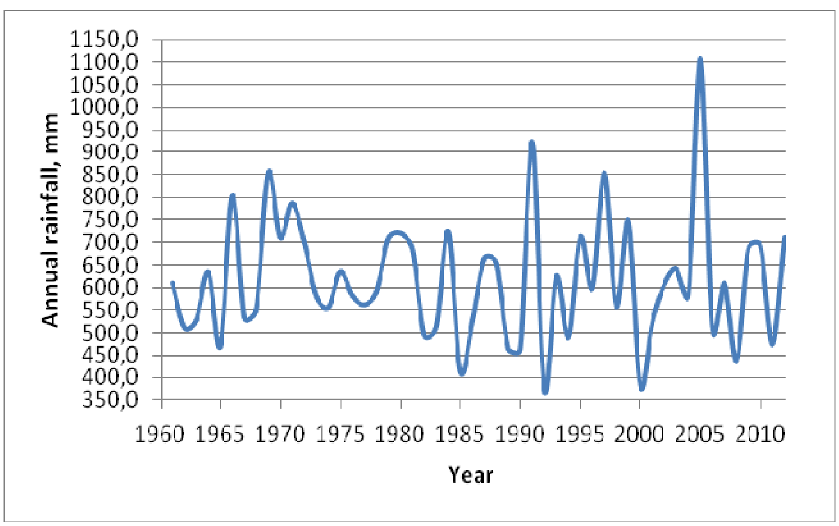
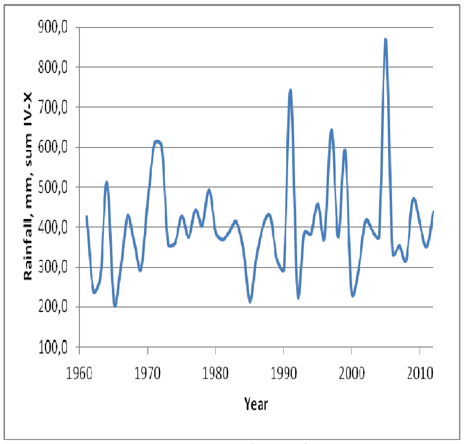


Fig. 5 - Evolution of annual rainfall (mm)



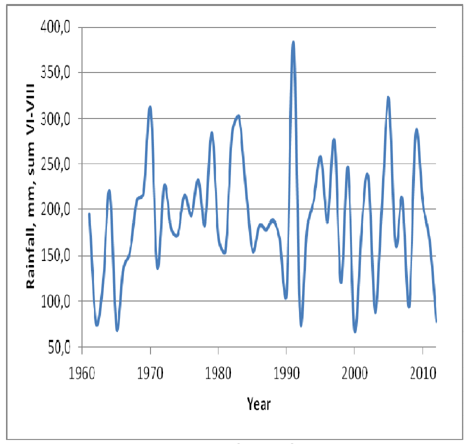


Fig. 6 - Evolution of rainfall (mm) in the growing season (IV-X)

Fig. 7 - Evolution of rainfall (mm) during the summer (VI-VIII)

Related to the influence of climate changes on grapevine. A distinctly significant correlation was established between spring rainfall (III-V) and the quantity of annual wood eliminated at pruning (fig. 8).

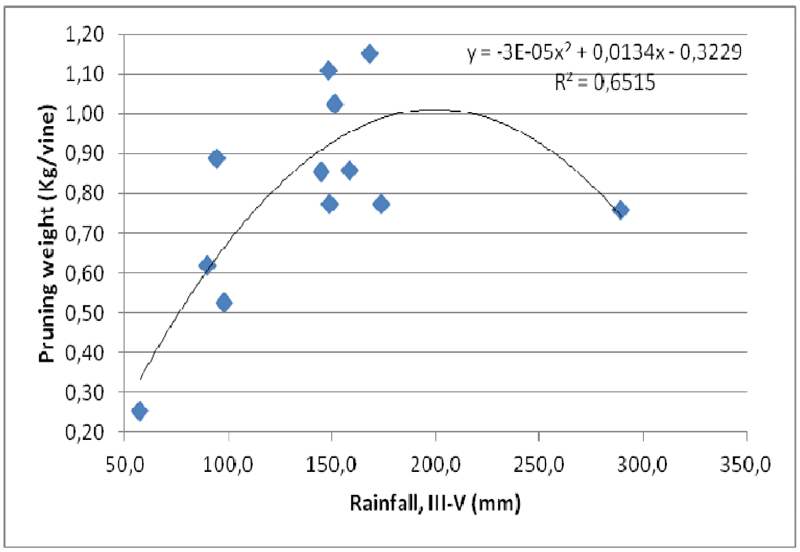
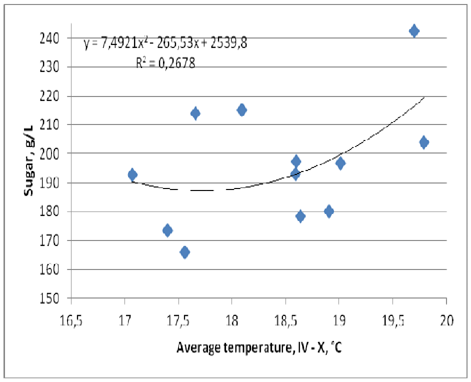


Fig. 8 - Correlation between spring season rainfall (mm, III-V) and pruning weight (kg/vine)

Higher temperatures during growing season, but especially during summer are positively correlated with the accumulation of sugars in grapes (fig. 9, 10).



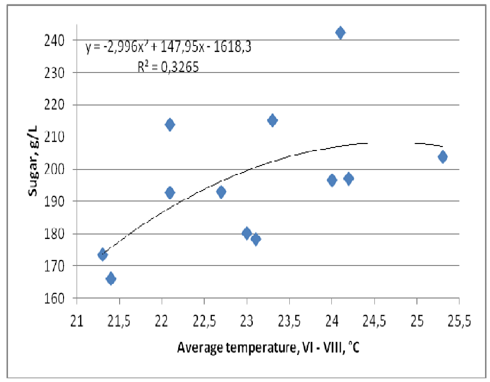
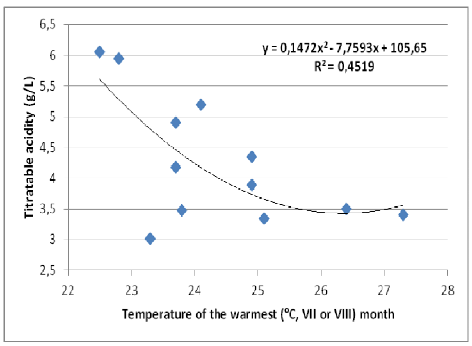


Fig. 9 - Correlation between average growing season temperature (ºC, IV-X) and sugar accumulation in grape berries (g/L)

Fig. 10 - Correlation between average summer temperature (ºC, VI-VIII) and sugar accumulation in grape berries (g/L)

A significant parabolic correlation was determined between the average temperature in the warmest month (July or August) and the titratable acidity of the must (fig. 11).

Increasing the amount of rainfall from 30 to 110 mm, has determined a lower accumulation of sugar with approximately 30 g/L (fig. 12).



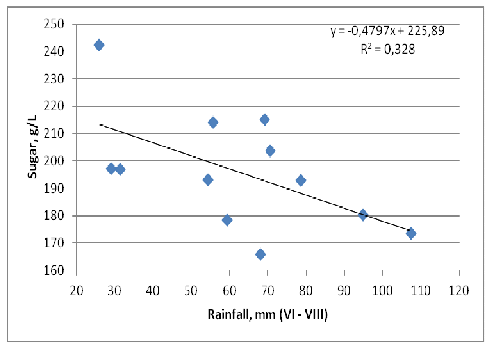


Fig. 11 - Correlation between temperature of the warmest month (VII or VIII) and titratable acidity (g/L)

Fig. 12 - Correlation between summer rainfall (mm, VI-VIII) and sugar accumulation in grape berries (g/L)

CONCLUSIONS

1. Study of the evolution of climate elements during a long period of time (1961-2012), has highlighted an increase of the average annual temperature with approximately 0.8ºC, of that during growing season with 1.0-1.1ºC and with almost 2ºC of that during the summer season (VI-VIII).

2. Also, a higher frequency was observed during the last decade of the minimum harmful temperatures for grapevines (under -20ºC).

3. Analyzing the evolution of rainfalls, no significant changes are found, except for bigger oscillations, related to both the annual quantum, and to that of the growing period (IV-X) and from the season of summer (VI-VIII).

4. The existence of a distinctively significant correlation was established between the quantum of rainfalls during the season of spring (III-V) and the quantity of annual wood eliminated at pruning.

5. Accumulation of sugars in grapes increases as the average temperature grows during April-October, but especially with that of the summer season (June-August).

6. Increasing the temperature during the warmest month (July and August), obvious in the last decade, has determined an accentuated reducing of the titratable acidity.

7. Increasing rainfalls during summer season (June-August), from 30 to 110 mm, has determined more reduced accumulations of sugars (from 210 g/L to 180 g/L).

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