

THE INFLUENCE OF CLIMATIC CHANGES ON THE BEHAVIOUR OF SOME GRAPE VARIETIES FOR WHITE WINES IN MOLDAVIAN VINEYARDS

Liliana ROTARU¹, Cintia COLIBABA¹

E-mail: lirotaru@uaiasi.ro

Abstract

The climatic phenomena and elements have, in many situations, qualitative limits for the vine and wine domain. The increase of extreme meteorological phenomena and the abrupt climatic forecasts make the research of new scientific themes a main step for the scientists, especially for their impact on viticultural ecosystems. Practising a durable viticulture needs taking into consideration the climatic changes, many unknown issues being able to negatively influence the development of the vine. In time, all the climatic changes will have repercussions on the viticultural environment and on the durability of vineyards. In the present article a few grape varieties from representative Moldavian vineyards, for white wines have been analysed from an agrobiological point of view in order to establish the influence of climatic factors on the vines' phenological cycle and on the grape production.

Key words: climatic changes, vines, phenology, grape production

The vine is a plant with high ecological plasticity, its area for culture being between 20-50^o northern latitude and 20-40^o souther latitude. The plant is relatively pretentious to heat, being able to grow only in area where the annual average temperature is higher than 9^oC, in areas where it surpasses 10^o, quality viticultural and wine-making products can be obtained (*Jones G.V., 2004*).

From the viticultural and geographical analysis of Europe, one can notice that some vineyards from the north of the country are located close to the northern limit of vine culture, at the level of 47^o parallel (Cotnari, Lechința, Valea lui Mihai), so that the presence of other factors that favour the topoclimate is required for a good quality end product (*Cotea D.V. et al., 2005*). at an international level, an increase in global warming is noted, at the same time with the desertification phenomenon (*Chiriac Cristina, 2008*). In this context, the grape varieties are under climatic stress with negative implications on the quality of the obtained products. The study of their behaviour represents the premise of valorification of the new ecoclimatic offer (*Cotea V.V. et al., 2008*).

MATERIAL AND METHOD

In the viticultural region of Moldova Hills, three vineyards were taken into study: Cotnari (northern part), Iasi (central part) and Dealurile Bujorului (southern part).

The annual average temperatures, rainfall regime, sunshining period during 1991-2010 were analysed as well as their evolution tendencies. The studied grape varieties were cultivated for white wines specific to the variety of each vineyard.

The phenological cycle of each grape variety was analysed, as it is a wide known fact that it is influenced by the ecoclimatic characteristics of the vineyard. At the same time, agrobiological parameters were registered: fertility, productivity, quantity and quality of grape production.

RESULTS AND DISCUSSIONS

Temperature represents the main climatic factor that influences physiological and biochemical parameters of the vine, limiting at the same time, the vine's cultivation. Analysing the termic regime, it can be noted that the last 20 years were much warmer, the average being higher to the one of the last 50 years with values of +0,5-0,6^o in all the three studied vineyards. The multiannual graphical representation of temperature for the three vineyards underlines an evolutive direction with accentuated fluctuations between certain years (*fig. 1*). The presence of tropical air masses above our country made possible the appearance of the highest annual average temperature in 2007 in all the three vineyards. An evolution tendency that indicates the rise of the annual average temperature in the studied viticulture area must be noticed.

¹ University of Agricultural Sciences and Veterinary Medicine, Iași

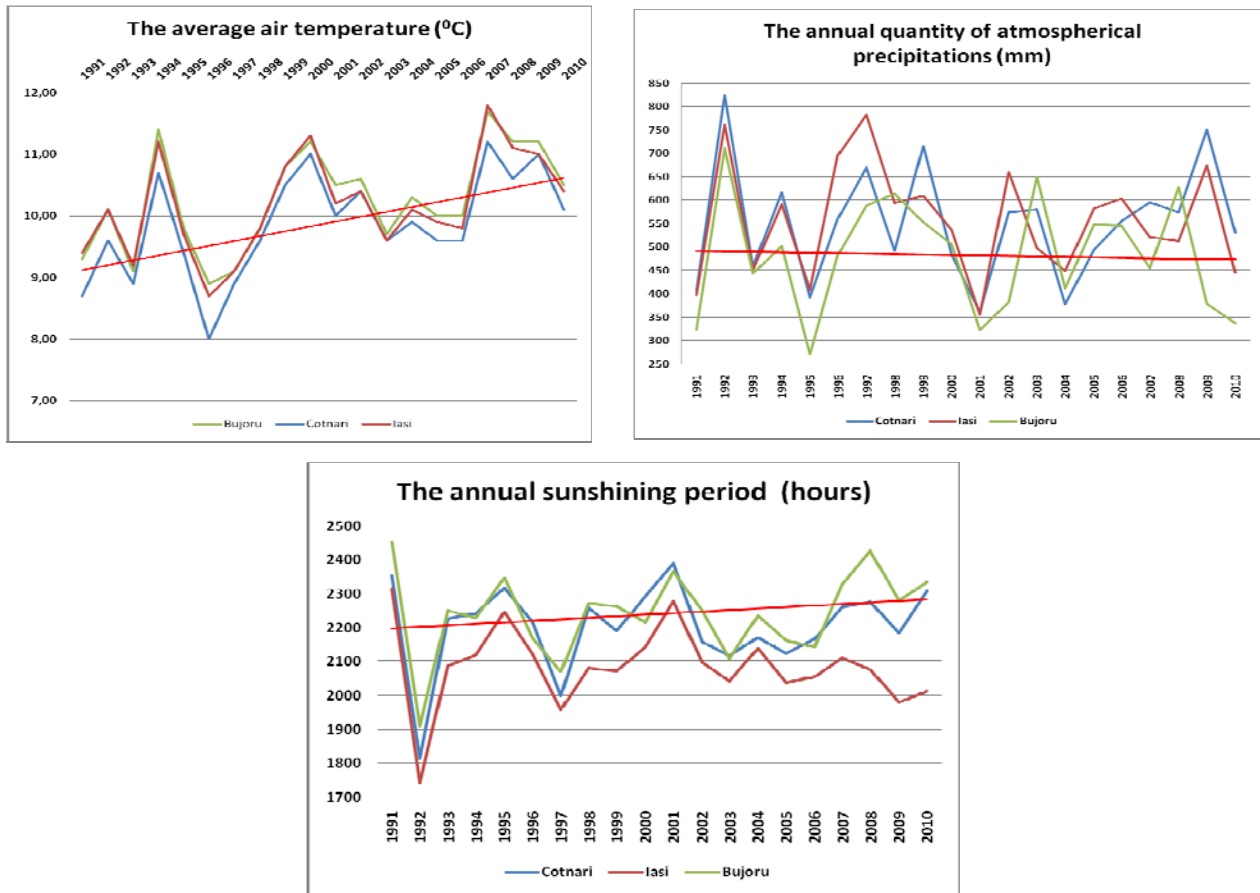


Figure 1 Climatic elements of studied vineyards during 1991-2010

Analysing the rainfall regime (fig. 1), it can be registered that the driest years were 1995, 2001 and 2010, while 1992, 1997 and 2009 were noted as years with a much higher hydric income. All in all, the tendency of the last 20 years underlines, a diminishing of the rainfalls in all studied vineyards.

The spatial distribution and time evolution of the sunshining period are depending on the specific characteristics air masses movements and the climatic phenomena they induce, that gives the day its sunny or cloudy aspect. They also depend on the local geographical factors (geographical positioning, relief, presence of woods, aquatic

units etc.). It can be noted that, during the studied interval (fig. 1), the evolution tendency of this climatic parameter was a rising one, indicating a higher caloric ratio on the vine, fact that doesn't always have the best implications on the vine's physiological processes.

Analysing the data concerning the vegetation phenophases (tab. 1-3) of the studied grape varieties, the following can be said: the phenology of the varieties is precocious in the Dealurile Bujorului vineyard, due to its southern position, compared to Iași and Cotnari vineyards.

Table 1

The phenological evolution of grape varieties in the context of Copou-Iași viticultural centre climatic conditions

| Phenophase | Grapevine variety | | | | | | |
|---------------|-------------------|-----------------|------------------|---------------|---------------|------------------|----------------------|
| | Fetească albă | Fetească regală | Riesling italian | Băbească gri | Frâncușă | Grasă de Cotnari | Tămâioasă românească |
| Vine crying | 28 III-6 IV | 30 III-7 IV | 1 IV-5 IV | 2 IV-10 IV | 31 III-6 IV | 1 IV-7 IV | 31 III-5 IV |
| Bud break | 20-21 IV | 21 -23 IV | 23 -25 IV | 24 -26 IV | 20-24 IV | 23-26 IV | 20-23 IV |
| Flowering | 5 -8 VI | 6 -10 VI | 8 -12 VI | 8 -12 VI | 8-10 VI | 7-11 IV | 6-10 IV |
| Berry growth | 9 VI-13 VIII | 11 VI-18 VIII | 13 VI-19 VIII | 13 VI-20 VIII | 11 VI-22 VIII | 12 VI-24 VIII | 11 VI-21 VIII |
| Veraison | 13 -17 VIII | 18 -21 VIII | 20 -25 VIII | 21 -24 VIII | 23-25 VIII | 25 -27 VIII | 22-24 VIII |
| Full maturity | 18 -21 IX | 22 -23 IX | 20 -23 IX | 22 -26 IX | 21-24 IX | 23-27 IX | 23-26 IX |
| Leaf fall | 18-21 X | 19-25 X | 20-26 X | 25-28 X | 23-26 X | 25-28 X | 21-24 X |

Table 2

Evoluția The phenological evolution of grape varieties in the context of Cotnari vineyard climatic conditions

| Phenophase | Grapevine variety | | | |
|---------------|-------------------|-----------------|------------------|----------------------|
| | Fetească albă | Frâncușă | Grasă de Cotnari | Tămâioasă românească |
| Vine crying | 4 IV-8 IV | 6 IV-8 IV | 5 IV-9 IV | 5 IV-9 IV |
| Bud break | 20 IV-22 IV | 21 IV-26 IV | 21 IV-23 IV | 20 IV-24 IV |
| Flowering | 14 VI-18 VI | 16 VI-23 VI | 13 VI-23 VI | 12 VI-22 VI |
| Berry growth | 18 VI-17 VIII | 9 VI-23 VIII | 13 VI-26 VIII | 22 VI-26 VIII |
| Veraison | 17 VIII-20 VIII | 23 VIII-25 VIII | 26 VIII-29 VIII | 26 VIII-28 VIII |
| Full maturity | 18 IX-21 IX | 24 IX-26 IX | 25 IX-27 IX | 24 IX-26 IX |
| Leaf fall | 15-20 X | 19-23 X | 22-28 X | 22-28 X |

Table 3

The phenological evolution of grape varieties in the context of Bujoru viticultural centre climatic conditions

| Phenophase | Grapevine variety | | | |
|---------------|-------------------|-----------------|------------------|-----------------|
| | Fetească albă | Fetească regală | Riesling italian | Băbească gri |
| Vine crying | 23 III-5 IV | 28 III-7 IV | 26 III-5 IV | 28 III-9 IV |
| Bud break | 18 IV-20 IV | 22 IV-25 IV | 20 IV-26 IV | 23 IV-26 IV |
| Flowering | 31 V-7 VI | 3 VI-9 VI | 5 VI-10 VI | 5 VI-10 VI |
| Berry growth | 7 VI-3 VIII | 9 VI-8 VIII | 11 VI-11 VIII | 12 VI-15 VIII |
| Veraison | 3 VIII-7 VIII | 8 VIII-11 VIII | 11 VIII-15 VIII | 15 VIII-18 VIII |
| Full maturity | 12 IX-15 IX | 17 IX-20 IX | 20 IX-23 IX | 22 IX-26 IX |
| Leaf fall | 15-21 X | 15-24 X | 18-26 X | 23-28 X |

Vine crying starts at the end of March in the vineyard Dealurile Bujorului, then continues with the early varieties from Iași vineyard, while at Cotnari, this phenomenon appears the latest in the first ten days of April. The phenomenon appears due to the fact that, at the level of the adsorbing roots of the vine there are 10⁰C, when the sap can start circulating.

Bud break is conditioned by the accumulation of useful temperatures necessary for the start of this phenophase. Due to the southern positioning of Dealurile Bujorului vineyard, early grape varieties here need a minimum of 130⁰C and this phenophase can start with the second decade of April. The varieties cultivated in Iași and Cotnari vineyards start this phenophase almost at the same time, in the third decade of April.

Flowering starts in Dealurile Bujorului vineyard in the first decade of June, the decisive factor being the termic balance from budbreak to flowering of 350-380⁰C. A few days later this phenophase starts as well in Iași while, only in the second decade of June, flowering appears at varieties from Cotnari.

Berry growth is achieved differently according to variety and temperature, a decisive factor being the temperatures higher than 20⁰C. The phenophase lasts according to grape variety, around 30-40 days at early grape varieties and up to 60 days to late maturity varieties. The earliest sort is Fetească albă, the phenophase of berry growth ending in the first decade of August in Dealurile Bujorului vineyard, the other varieties span being until the half of the same month. In Iași

vineyard, where all the seven grape varieties are experimentally cultivated, this phenophase ends starting with the second and part of the third decade of August. In Cotnari vineyard, this phenophase is finalised in the third decade of August.

Veraison takes place at its earliest at varieties from Dealurile Bujorului vineyard, Fetească albă and Fetească regală, the late Riesling italian and Băbească gri covering then the first days of the third decade of August. In Iași vineyard, this phenophase starts on the 13th of August with Fetească albă and ends at 27th of August with Grasă de Cotnari. In Cotnari, the majority of the grapes reach veraison phase towards the end of August, with the exception of Fetească albă, where this phenophase starts with the final days of the second decade of August.

Full maturity takes place in the second decade of September at grape varieties from Bujoru viticultural center. The first variety that reaches full maturity is Fetească albă on the 13th of September, while the latest for the same vineyard is Băbească gri, 22-26th of September. In Iași, full maturity takes place during the third decade of September, except Fetească albă, where this phenophase started on the 18th of September. At Cotnari, full maturity of grapes takes place at the end of September, but over ripening is necessary sometimes in order to obtain the very high quality wines, specific to this vineyard.

Leaf fall marks the end of the active vegetation period and takes place according to the values of negative temperatures that appear in the

second part of October. This phenophase ends at Dealurile Bujorului vineyard before the appearance of the first autumn frosts, especially at early varieties such as Fetească albă and Fetească regală.

The fertility and productivity elements were studied and were expressed through: percentage of fertile shoots, absolute and relative fertility index, absolute productivity index and the average weight of a grape.

The percentage of fertile shoots represents one of the most important indicators for appreciating the real fertility of a grape variety.

More fertile shoots indicate a higher fertility, therefore a higher production, whereas, fewer fertile shoots indicate a lower fertility, therefore a lower grape production.

Analysing the values of the percentage of fertile shoots (fig. 2), one can register that the Fetească albă variety had the highest values from all the three vineyards, being followed by Frâncușă and Fetească regală. An average fertility degree was found at Băbească gri and Tămâioasă românească.

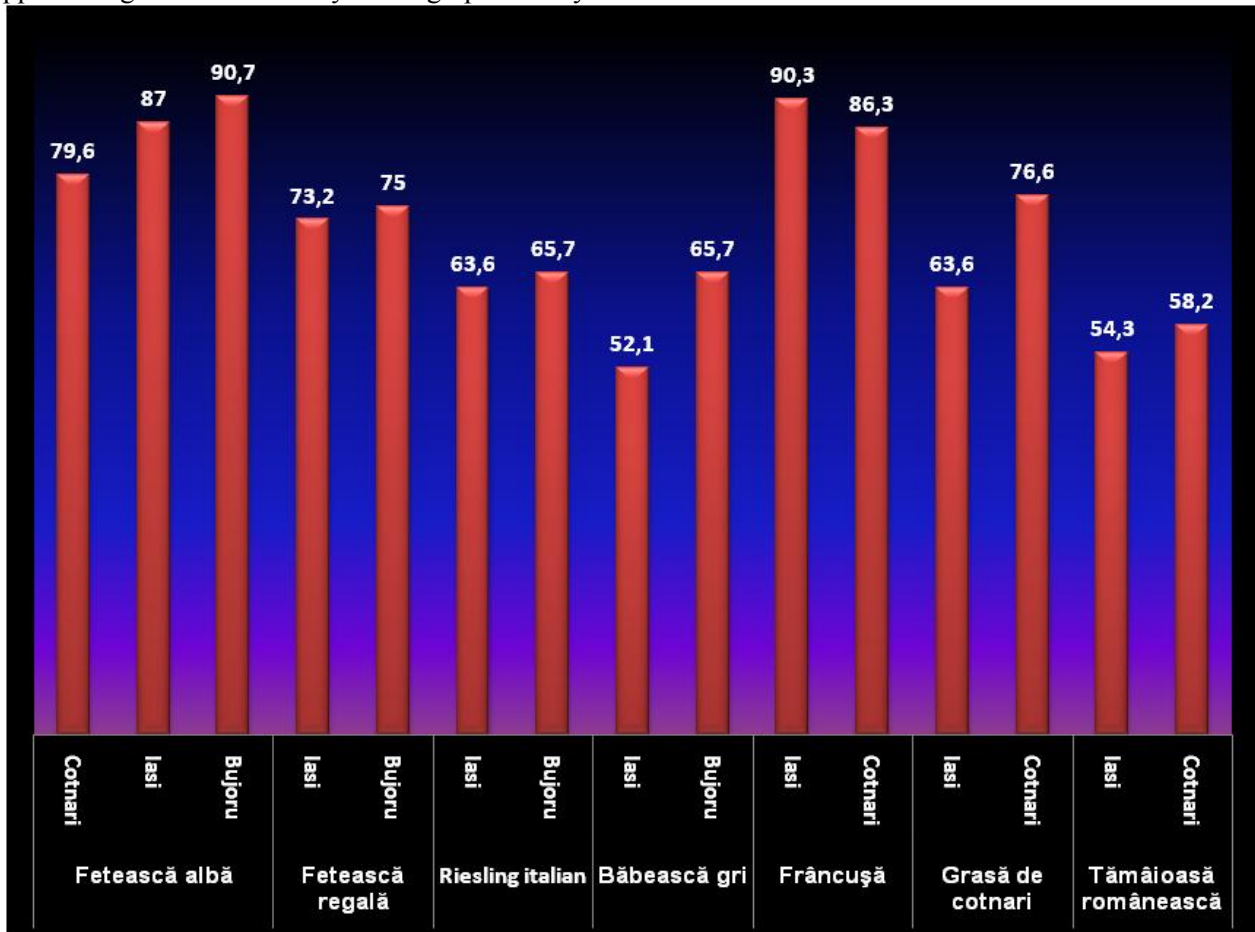


Figure 2 Percentage of fertile shoots at studied grape varieties

The fertility index represents the ratio between the number of inflorescences on the trunk and the total number of shoots on the trunk and indicates the level of grape variety's fertility. This index differs from one variety to the other and from year to year, being highly dependent on pedoclimatic conditions and agrotechnical measures. The relative index (c.f.r.), is represented by dividing the number of inflorescences on the trunk to the total number of shoots per trunk. The absolute index (c.f.a.) is represented by the ratio between the number of inflorescences per trunk

and the fertile shoots. The obtained values of the fertility index (fig. 3) indicate the fact that the highest values were registered at Frâncușă with an average of 1,12-1,64 inflorescences per shoot, whole Tămâioasă românească 0,84-0,91 inflorescences per shoot. The lowest values were registered at Băbească gri (0,6-0,75). The productivity index (fig. 3), indicating the average production\shoot\trunk were the highest at Băbească gri (i.p.r. = 268,3-302,9) while the lowest were at Fetească albă, with values under 160.

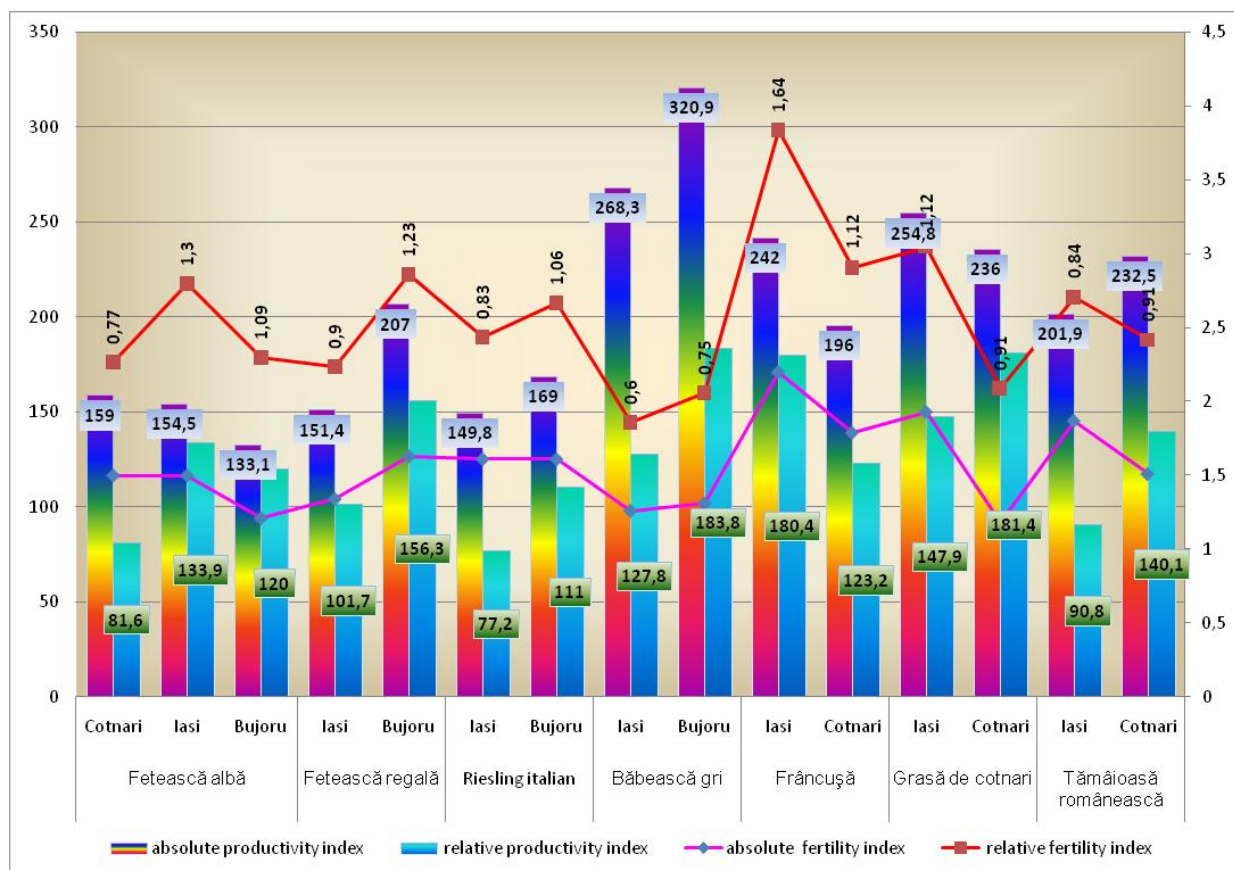


Figure 3 Fertility and productivity of studied grape varieties

The average weight of a grape (*fig. 4*) is mainly influenced by genetical factors and less by the applied agrotechnical measures and environmental factors. The highest values were

registered at Băbească gri (213-245 g), while the lowest values were found in Riesling italian (93-105 g).

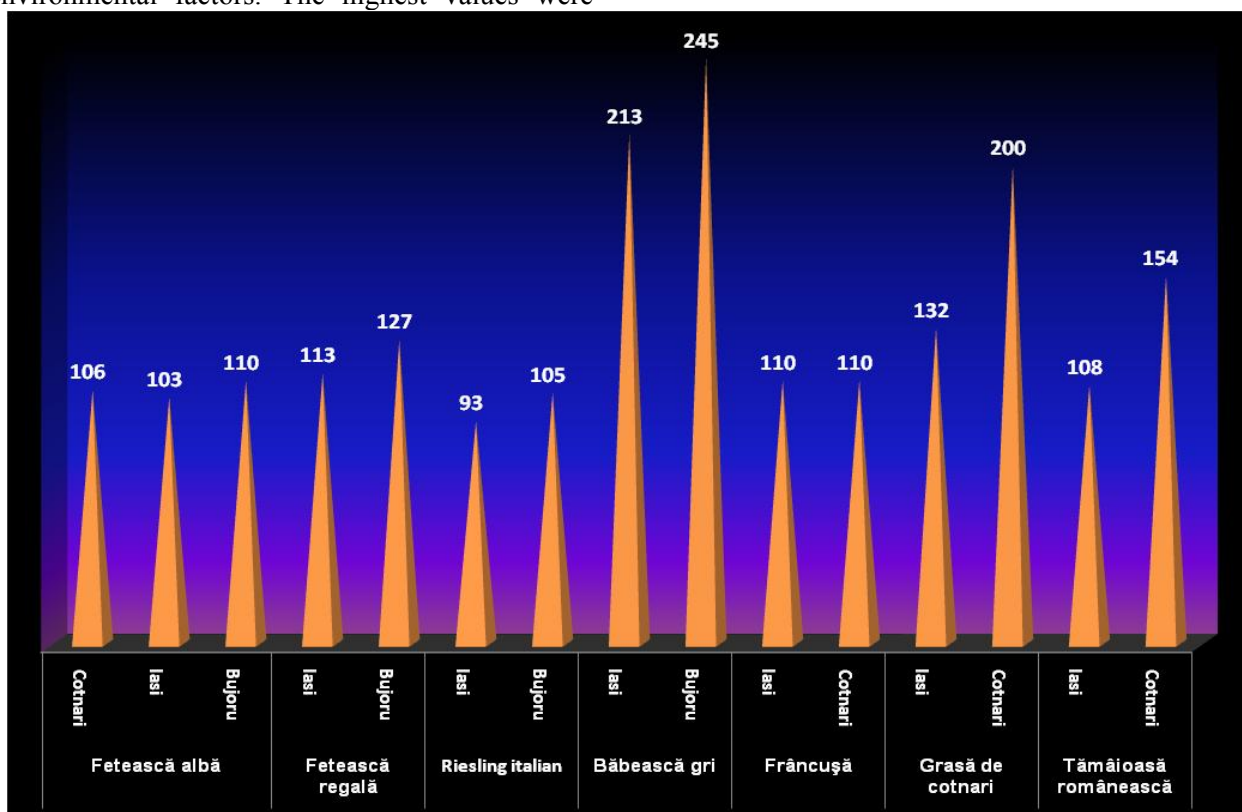


Figure 4 Average weight of a grape at studied grape varieties

The grape production is influenced by fertility of the vine and productivity of the vine., through complex changes in their mechanism, in consecutive phases and in the presence of certain factors. The harvest quantity depends on the grapes' size and their number therefore, grape varieties with the same percentage of fertile shoots or the same fertility index have different grape productions.

The grape production of the studied varieties (fig. 5) varied from one variety to another, being influenced by climatic conditions and the biology of the variety. The highest values were registered

at Frâncușă (8,13-9,2 t/ha), closely followed by Fetească albă and Fetească regală, all three sorts indicating they have a good adaptability to climatic stress.

ACKNOWLEDGMENTS

This study was realised and published within the research project POSCCE-A2-O2.1.2-2009-2 ID.653, code SMIS-CSNR 12596, "Analysis of adapting opportunities of Romanian viticultural ecosystems to the new competitive and environmental context".

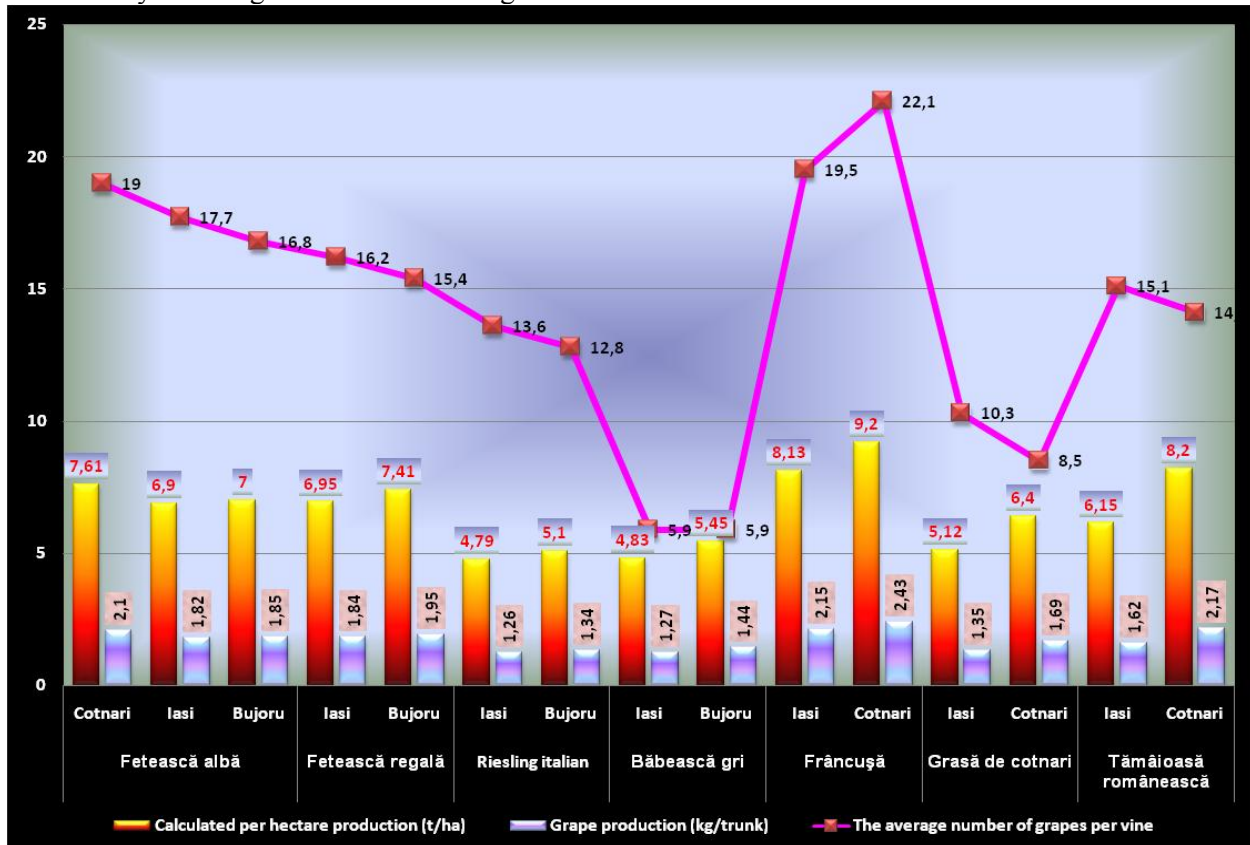


Figure 5 Grape production at studied grapevine varieties

CONCLUSIONS

The results pointed to the fact that, in the viticultural region of the Moldavian Hills, in the last 20 years, a warming phenomenon appeared as well as a diminishing of the rainfalls, with a dryness spell as well.

Global warming had as effect the prolonging of the vegetation period at some grape varieties. The grapes enter early into a forced maturation process due to the dry periods that appear frequently during summer. Therefore, quality can be hindered. At the same time, the grape productions are not consistent from one year to the other, lacking in quality as well.

The grape varieties that indicate a good adaptability to climatic stress are Fetească albă, Fetească regală and Frâncușă.

BIBLIOGRAPHY

- Chiriac, Cristina, 2008 - *Viticultural landscape in the context of climate warming. Study of case: Cotnari vineyard*. Lucrări Șt., seria Horticultură, vol. 51 (1), USAMV Iași, p. 525-530.
- Cotea, D. V., Barbu, N., Grigorescu, C. C., Cotea, V. V., 2005 - *Vignobles et vins de Roumanie*, Ed. Academiei Române, Bucuresti.
- Cotea, V.V., Rotaru, Liliana, Irimia, L.M., Colibaba, Cintia, Tudose, Sandu-Ville, S., 2008 - *The green house effect on the viticultural ecoclimat in northern Moldavia, Romania*. XXXIth – World Congress of Vine and Wine OIV, Verona, 15-20 June.
- Jones, G.V., 2004 - *Making wine in a changing climate*. Geotimes, iss. 49, p. 24-28.