THE WATER REGIME OF SOME GRAPEVINE VARIETIES IN THE PEDOCLIMATIC CONDITIONS OF 2011 IN IASI AND BUJORUL VINEYARDS

Cristina SLABU [1], Carmen Doina JITAREANU[1], Alina MARTA[1], Cristina SIMION[2], Roxana IONAŞCU[2]

e-mail: cristinaslabu@yahoo.com

Abstract

Climatic changes, characterized by extreme meteorological conditions, influence especially growth and development of plants. The meteorological factors act restrictively on their biological cycle as well as on their productive potential. Referring to the grapevine, air temperature is the key factor that limits the areas where grapes can be cultivated, the beginning and the development of the vegetation phases, the production quantity as well as its quality. The research was focused on the effects of the meteorological conditions of 2011 on the plants' water regime at the following grapevine varieties *Fetească albă, Fetească regală, Riesling italian* and *Băbească gri* cultivated in Iasi and Bujorul vineyards.

Key words: climatic changes**,** water regime, grapevine

The plants' growth and development, the vegetation period of species and varieties, their distribution within the country and finally but not last, the harvest, they all depend to a great extend on the clime. Climatic changes, usually characterized by extreme meteorological conditions, influence greatly the plant's growth and its development. Meteorological factors restrict the biological cycle as well as the plant's productive potential. If we refer to the grapevine, air temperature is the main factor that limits the area where it can be cultivated, the beginning and the development of the vegetation phases, the quantity and the quality of the production. Grapevine is considered to be a relatively resistant plant to drought due to its deep root system (Burzo et al., 1999), the years characterized by drought leading to high quality productions. Nonetheless, the prolonged droughts from the past few years have had serious effects on certain *Vitis vinifera* varieties. Recent studies have demonstrated the negative effects the lack of precipitations has on the normal course of physiological processes. Influenced by drought plants experience cellular and tissue dehydration and suffer from the considerable growth of their body temperature; all of them have direct impact on photosynthesis (Toma et al, 2008) and indirect impact on the entire metabolism. The present paper includes the preliminary results of the analyses performed on *Feteasca albă, Fetească regală, Riesling italian* and *Băbească gri* varieties cultivated in different ecological conditions in Iasi and Bujorul vineyards

MATERIAL ŞI METODĂ

This paper focuses on the results of the primary biosynthetical processes that differentiate the grapevine varieties *Feteasca albă, Feteasca regală, Riesling italian* and *Băbească gri* cultivated in Iasi and Bujorul vineyards in the climatic conditions of 2011 during the following phenophases flowering, berry growth and grape maturation.

The climatic conditions of 2011 were analyzed decadal and monthly by determining the average temperature values and the amount of precipitations, values that were afterwards compared to the normal values. The physiological information followed aspects related to the water regime and the photosynthesis. The content of free water in the leaves and the dehydration rhythm of the leaves stand for indicators of the intensity of the sweating process (Jitareanu et al., 2002), and the water use efficiency is correlated to the photosynthetic activity. The water regime indicators were analyzed using gravimetric methods performed at the electronic balance. The dehydration rhythm was evaluated using the Ivanov method (Jitareanu et al., 2010). For free water it was considered that particular quantity of water lost after 24 hours of dehydration of the vegetal material at room temperature; bonded

[1] USAMV Iasi
[2] SCDVV Bujoru – Târgu Bujor

water was considered that quantity of water lost after drying at 105°C until the constant weight of the vegetal material dehydrated for 24 hours. The sweat intensity and the transport activity of the assimilated were estimated in relation to the free water content.

The water use efficiency was calculated as the relation between the intensity of photosynthesis and sweat determined with the LCPro+ device. For establishing the values, the 4th or the 5th leaf from the bottom of the inflorescence and of the cluster, respectively, were used, the paper presenting the average values of the obtained results.

RESULTS AND DISCUSSIONS

The analysis of climatic data pointed out that in Iasi vineyard, the average monthly temperatures were higher than the multiannual average, between May and September, the deviations ranging between 0.1° C to 2.3° C, to which a precipitation deficit was added for the entire active vegetation period, extremely intense in May and July – September (*tab. 1*). The absence of rain and the high diurnal and nocturnal temperatures lead to the appearance of pedological, atmospheric and physiological drought, thus shortening the phenophases (Jităreanu et al., 2009). In Bujoru vineyard, the dynamic study of the average monthly temperatures proved that the average temperatures recorded negative deviations in January – May (0.1° – 1.9° C), while in June – September the values recorded were higher than the normal values recorded in that area with 0.4° – 3.2° C.

The amount of precipitation recorded in the period of time that was analyzed characterized itself by deficit in March, July and August and excess in April – June (*tab. 2*), values that influenced the shoot's growth.

Table 1

Evolution of climatic factors in 2011, in Iasi vineyard

Specification	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Temperatures (° C)												
Dec I	-4,8	2,2	-3,4	9,0	11,7	22,3	20,5	22,0	18,9	14,4	6,0	3,9
Dec II	2,8	-3,8	6,3	8,0	17,0	20,8	25,7	21,2	20,1	6,5	0,9	3,7
Dec III	-4.9	-6,0	7,3	13,8	22,9	19,0	24,7	21,5	15,3	6,4	1,1	4,0
Average	-2,4	-2,3	3,5	10,3	16,7	20,7	22,9	21,6	18,1	8,8	2,7	2,6
Monthly normal	-3,1	-1,2	3,4	10,4	16,3	19,7	21,2	20,5	15,8	10,1	4,4	-0,8
Deviation	0,7	-1,1	0,1	-0,1	0,4	1.0	1,7	1,1	2,3	-1,3	-1,7	3,4
Precipitations (mm)												
Dec I	0,0	0,0	0,4	16,3	19,7	13,1	9,7	23,1	13,8	30,7	0,4	2,1,
Dec II	4,3	6,6	2,5	58,2	11,0	12,9	6,2	9,0	0,0	8,1	0,0	6,0
Dec III	8,9	7,1	5,5	7,7	1,6	58,1	21,9	0,0	4,9	1,4	0,2	0,6
Monthly amount	13,2	13,7	8,4	82,2	32,3	84,1	37,8	32,1	18,7	40,2	0,6	8,7
Normal	30,5	28,4	32,8	49,1	59,1	88,7	82,8	56,9	52,0	32,8	35,1	31,5
Deviation	-17,3	-14,7	-24,4	33,1	-26,8	-4,6	-45,0	-24,8	-33,3	7,4	-34,5	-22,8

Table 2

Evolution of climatic factors in 2011, in Bujoru vineyard

Specification	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Temperatures (° C)												
Dec I	-5,2	-0,2	-3,5	8,4	11,3	20,1	20,1	21,7	19,8	15,4	6,7	2,9
Dec II	2,4	-3,1	5,9	8,1	16,6	20,2	25,2	21,6	21,1	7,1	1,0	3,8
Dec III	-5,7	-6,2	7,2	12,5	21,5	18,7	24,7	22,1	16,6	6,4	0,7	1,0
average	-2,9	-2,9	3,30	9,7	15,9	19,9	22,6	21,8	19,2	9,4	2,8	2,2
Monthly normal	-2,8	-1	3,5	10,3	16	19,5	21,3	20,7	16	10,4	4,4	-0,8
Deviation	-0,1	-1,9	-0,2	-0,6	-0,1	0,4	1,3	1,1	3,2	-1,0	-1,6	3,0
Precipitations (mm)												
Dec I	1,2	0,0	0,3	8,2	32,0	25,4	7,8	12,8	2,6	31,2	0,2	7,5
Dec II	8,3	10,4	1,2	44,8	27,2	7,4	1,2	9,2	0,0	1,0	0,0	6,0
Dec III	18,5	12,2	4,9	2,0	14,0	53,4	5,8	0,0	0,4	0,0	0,3	2,7
Monthly amount	28,0	22,6	6,4	55,0	73,2	86,2	14,8	22,0	3,0	32,2	0,5	16,2
Normal	25,0	24,4	28,4	42,6	57,1	75,4	69,0	57,2	45,7	31,9	32,9	29,2
Deviation	3.0	-1,8	-22,0	12,4	16,1	10,8	-54,2	-35,2	-42,7	0,3	-32,4	-13,0

Foliar dehydration rhythm

The foliar dehydration rhythm, analyzed at intervals of 1, 2, 3, 4 and 24 hours during flowering, presents minimum values at *Fetească albă, Fetească regală* and *Riesling italian* varieties cultivated in Iasi vineyard, compared to the same varieties cultivated in Bujorul vineyard. *Băbească gri* variety recorded almost the same foliar dehydration rhythm, regardless of the vineyard (*fig. 1*). The intense evaporation process present at the three varieties cultivated in Bujorul vineyard might be due to the amount of rain recorded in May (73.2 mm), compared to the data recorded in Iasi vineyard (32.3 mm) as well as to an average monthly temperature lower with 0.6°C, which determined the existence of higher quantities of total water if compared to those existent in Iasi vineyard. Referring to *Băbească gri* variety, the water content in the leaves presented insignificant differences between the two vineyards (*tab. 3*). Observing the behaviour of the previously mentioned varieties in each vineyard, in Bujorul it was noticed a minimum dehydration rhythm at *Băbească gri* and a maximum one at *Fetească albă* and *Riesling italian*. On the other hand, the free water values were exactly the opposite, minimum at *Băbească gri* and very high at the other varieties. In Iasi vineyard, the highest values were recorded at *Frâncuşă* and the lowest ones at *Băbească gri* (*fig. 1 and tab. 3*).

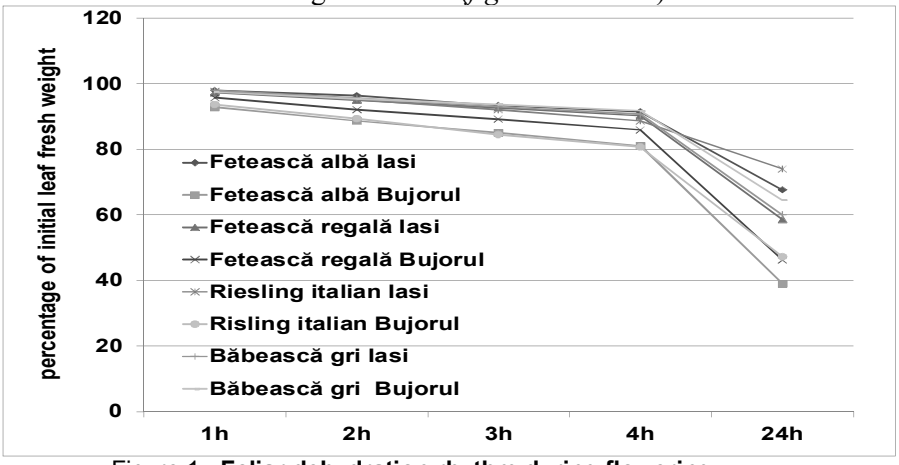

Figure 1. **Foliar dehydration rhythm during flowering**

During the phenophase of berry growth, influenced by the climatic conditions existent in Iasi vineyard, the dehydration rhythm of *Băbească gri*, *Fetească albă* and *Tămâioasă românească* recorded low values. The free water content maintains itself at high quotas at *Fetească regală* and *Băbească gri* (*tab. 3*). In Bujorul vineyard, *Băbească gri* presents an opposite behaviour with respect to the previous phenophase regarding the dehydration rhythm and the free water content (49.9% compared to 36.1 % at flowering).

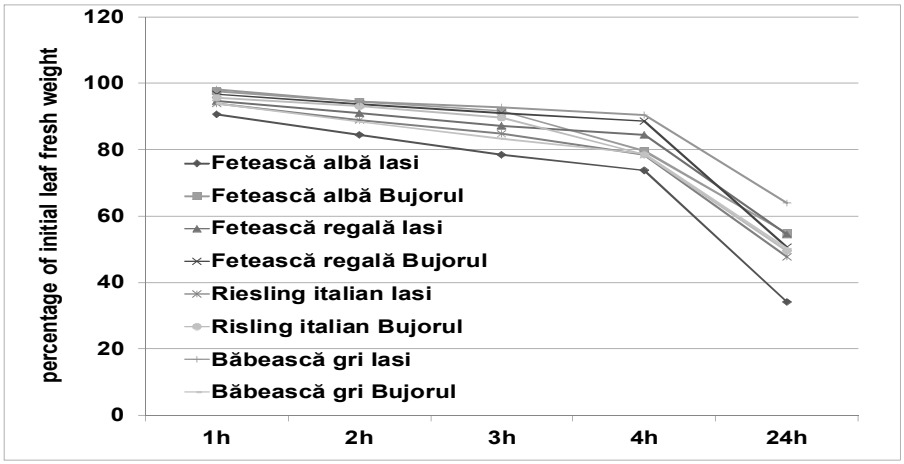

Figure 2. **Foliar dehydration rhythm during berry growth phenophase**

During the grape maturation phenophase, the foliar dehydration rhythm was more intense at *Fetească albă*, the one cultivated in Iasi vineyard, the other varieties presenting almost the same rhythm of losing water, regardless of the vineyard (*fig. 3*).

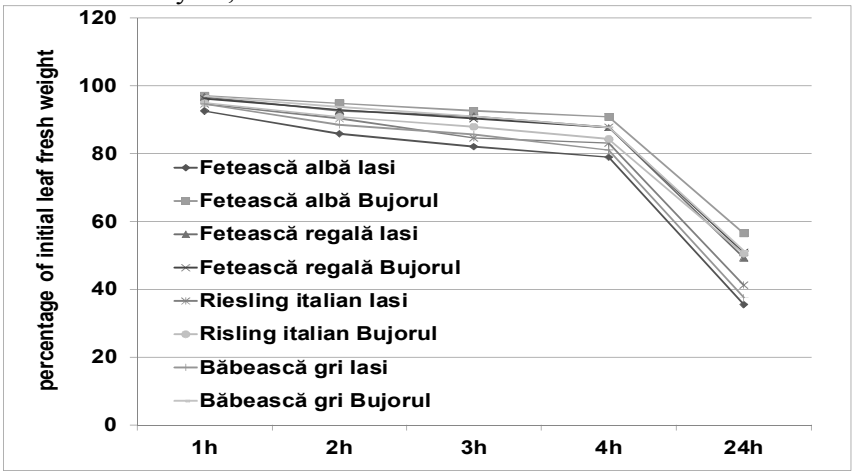

Figure 3. **Foliar dehydration rhythm during grape maturation**

Table 3

The effect of genotype and ecological conditions from the two vineyards on the water content and its states in the leaves (% of fresh weight)

Variety	Vineyard	Phenophase								
		Flowering			Berry growth			Grape maturation		
		Total water	Free water	Bound water	Total water	Free water	Bound water	Total water	Free water	Bound water
Fetească albă	Iasi	33,3	32,4	0,9	66,0	65,8	0,2	71,0	64,6	6,4
	Bujorul	62,3	61,1	1,2	73,3	45,2	28,1	68,2	43,4	24,8
Fetească regală	Iasi	43,4	41,5	1,9	59,0	45,5	13,5	63,8	50,7	13,1
	Bujorul	55,0	53,9	1,1	76,7	49,3	27,4	70,3	49,1	21,2
Riesling italian	Iasi	33,0	25,9	7,1	59,7	52,3	7,4	64,3	58,9	5,4
	Bujorul	58,1	52,9	5,2	70,7	50,5	20,2	66,6	49,6	17,0
Băbeasca gri	Iasi	41,8	40,0	1,8	37,6	36,1	1,5	69,8	62,5	7,3
	Bujorul	38,5	35,5	3,0	69,9	49,9	20,0	70,4	48,7	21,7

Water use efficiency (WUE - µml/mmol) was calculated as the relations between the raw rates of photosynthesis and sweat.

During the flowering phenophase the water use efficiency recorded the highest values at *Fetească regală* variety cultivated in Bujorul vineyard (4.6 µml/mmol) as well as at *Fetească albă* variety from Iasi vineyard (2.6 µml/mmol); at the other varieties, regardless of the area, the values ranged between 0.3 – 1.5 µml/mmol.

During the growth phenophase, the water use efficiency recorded values between 0.3 µml/mmol at *Fetească albă* in Bujorul vineyard and 4.3 µml/mmol at *Băbească gri* in Iasi vineyard. It must be pointed out that the low values of the water use efficiency recorded at all the varieties studied from Bujorul vineyard were caused by the climatic conditions existent when the data were recorded.

During the grape growth phenophase, the varieties cultivated in Iasi vineyard presented higher values of water use efficiency, except from the *Riesling italian* variety (*fig.4*). In this case, the grape production on hectare is lower than the one obtained in Bujoru vineyard, as a consequence of the decrease of the average weight of the grapes *(tab. 4)*.

The research studies of Patakas et al. (1996) demonstrated that for cv. *Roditis* that the water use efficiency level was higher in the fully developed leaves (35 days after their appearance) and remained relatively high in the older leaves. In this case, the water use efficiency levels differ more from one variety to the other depending also of the vineyard and less of the phenophase, due to the different values of the climatic factors (temperature, light and CO_2 supply) in different phenophases. It must be noticed the eco-physiological reaction of *Băbească gri* cultivated in Bujorul vineyard, at which the water use efficiency during the berry growth phenophase was lower, after which it recovered during the berry maturation phenophase, which made the average vine production to be similar to the one in Iasi; this is probably due to a more efficient transport system of the assimilated during grape

maturation. The average weight of a grape from Bujorul was of 235 g comparative to 198 g recorded at Iasi (*tab. 4*).

Generally speaking, 2011 favoured the production of high quality wines. As far as the quantities of grapes are concerned, the grapevine varieties cultivated in Bujorul vineyard did not reach their genetic production potential because of the inauspicious meteorological conditions, mainly drought (Donici Alina, 2012).

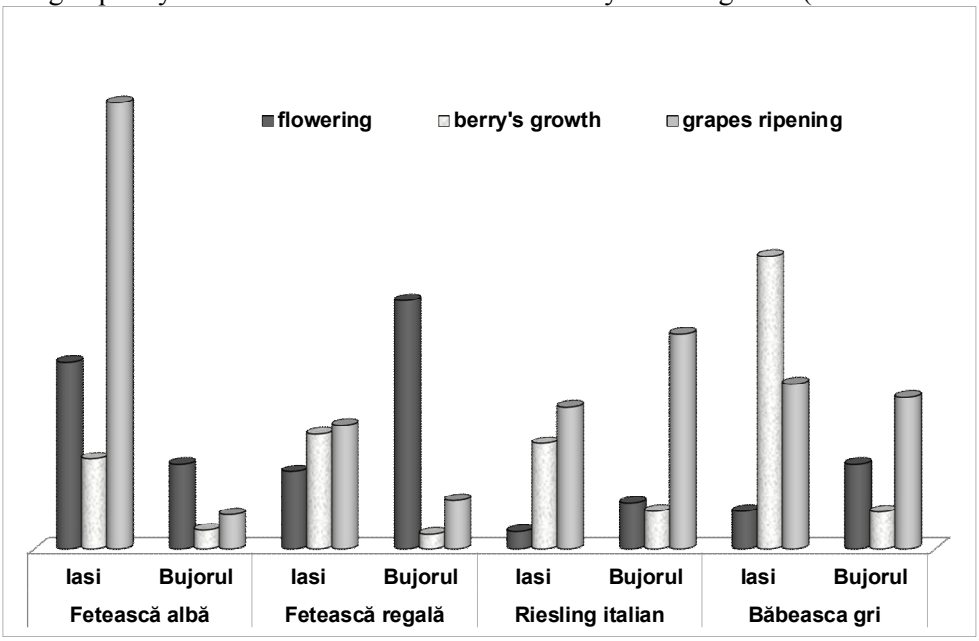

Figure 4. **Eficienţa utilizării apei în procesul de fotosinteză**

Table 4

The grape production of the studied grapevine varieties

Soiul	Podgoria	Producţia de struguri (kg/butuc)	Nr. mediu de struguri pe butuc	Greutatea medie a unui strugure (g)
Fetească albă	Iasi	2,77	26,4	105
	Bujoru	2,21	21,3	104
Fetească regală	Iaşi	3,77	32,8	115
	Bujoru	3,02	22,4	135
Riesling italian	Iasi	1,98	21,8	91
	Bujoru	1,92	20,4	94
Băbească gri	Iasi	4,62	23,3	198
	Bujoru	4,83	20,5	235

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CONCLUSIONS

The climatic conditions of 2011 were characterized by thermic and hydric stress on the grapevine varieties in both cultivated areas.

1. The plants' water regime represented by the foliar dehydration rhythm, water content and states depended by the soils characteristics and the climatic conditions of the area.
2. The grape production at *Fetească albă, Fetească regală* and *Riesling italian* was influenced especially by the lower number of clusters on the vine, consequence of the drought recorded during the flowering phenophase, while the grape production of *Băbească gri* was influenced by the lower average grape weight influenced by the troubled transport of assimilated.

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