ECO-PHYSIOLOGICAL RESPONSE OF VINE VARIETIES DURING THE GROWING SEASON OF 2011

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Abstract

Climatic changes, characterized by extreme weather conditions, particularly influences plant growth and development. Extreme meteorological conditions acting on both biological cycle and their productive potential. In recent years global warming has produced many disturbances in ecosystems vine, vine varieties being forced to change their conduct annual cycle of vegetation, with consequences often negative for the quality and quantity, including the grape wines production results. The research aimed at the effect of the meteorological conditions of 2011, on physiological processes represented the intensity of photosynthesis, transpiration rate and water use efficiency in red wine cultivars, *Coarnă neagră*, *Gelu*, *Moldova* and *Purpuriu*, grown in the vineyards of Copou, Iasi.

Key words: *climatic changes, grapevine , physiological processes*

Meteorological factors acts restrictive on the biological cycle and the productive potential of plants. In vines cultivation, temperature is the main factor limiting crop area, starting and completion phases of vegetation, quantity and quality of production. Vine is a plant considered relatively resistant to drought due to deep root system (Burzo et al., 1999), resulting in dry years production of a high quality. In recent years prolonged droughts have negative effects on some varieties of *Vitis vinifera*, recent research demonstrating the negative effects of lack of rainfall over the normal physiological processes. Under the drought action plants suffer from dehydration of plant cells and tissues and cause considerable increase their body temperature, with direct implications on photosynthesis process (Thomas et al., 2008) and indirectly effects on the whole metabolism. This paper contains results obtained in 2011, directed determined in the field, red wine cultivars *Coarnă neagră*, *Gelu*, *Moldova* and *Purpuriu* grown in Copou, Iaşi.

MATERIAL AND METHOD

Four red wine cultivars, *Gelu*, *Coarnă neagră*, *Moldova* and *Purpuriu*, were studied in the Iaşi wine growing region at the Science Center, Farm SDE of the U.Ş.A.M.V. Iasi. Temperature and rainfall were recorded decades in spring-autumn season and average temperature values and monthly rainfall amount reported average annual values. Analysis of physiological processes, represented by the intensity of photosynthesis, transpiration rate and water use efficiency were obtained LCpro + - Intelligent portable photosynthesis determination. Field measurements were conducted in three distinct phenophases: flowering and shoot growth, growth and ripening grapes.

RESULTS AND DISCUSSION

Evolution of climatic conditions in Iasi vineyard

Temperatures recorded in 2011 in Copou, Iasi area were higher than the annual average with +0.4 ^{o} to +3.4°C, in 8 of the 12 months of the year. Lower than the annual average temperatures were observed in February, April, October and November (tab. 1). The highest values of deviations occurred in the autumn-winter with +2.3° C in September and +3.4° C in December. Lowest monthly minimum temperature was observed on January 5, 2011, of -16.6°C and maximum monthly 20th July was +35.5^{o}C. Tempearatures high above the annual average of the month were recorded in all months analyzed (*tab. 1*). In terms of temperatures, the year 2011 can be characterized as a year above the annual average, but not a hot oe very warm one.

Regarding rainfall in Copou, Iasi area in 2011, we can say that the year was particularly dry. In two months (April and October) of the 12 analyzed were recorded excess fluid, in the other deficits were observed between -4.6 mm and -45.0 mm of precipitation (*tab 2*). The biggest deficit of the year was in July, -45.0 mm of annual average

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amount. In total fluid deficit of 2011 to the amount of the annual average rainfall was -248.2 mm (*tab.2*).

Table 1

Climatic conditions – temperature – in Iasi vineyard in 2011

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Temperature ^{o}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
Monthly 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
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 from normal	0,7	-1,1	0,1	-0,1	0,4	1.0	1,7	1,1	2,3	-1,3	-1,7	3,4
Minimum	-16,6 on 5	-13,1 on 16	-15,7 on 3	1,5 on 12	3,8 on 6	10,7 on 15	10,4 on 4	10,2on 30	4,9 on 26	-3,7 on 27	-7,9 on 30	-10,2 on 25
Maximum	10,3 on 18	15,3 on7	21,6 on 15	24,7 on29	31,6 on 30	34.6 on 24	35,5 on 20	33,1 on 23	31,9 on 12	28,5 on 5	14,3 on 4	15,6 on 4

Table 2

Climatic conditions – humidity – in Iasi vineyard in 2011

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Monthly amount of 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 from normal	-17,3	-14,7	-24,4	33,1	-26,8	-4,6	-45,0	-24,8	-33,3	7,4	-34,5	-22,8

Analysis of physiological processes with LCpro + - Intelligent portable photosynthesis determination

Tabel 3

Dynamics of average values of photosynthesis (A), transpiration and water use efficency –(WUE) in all phenophases analyzed

	Qleaf	Tch	Tl	ci	E	A	A/E
Coarna neagră - bloom	156,00	30,89	29,63	316,89	0,43	0,72	1,65
Coarna neagră – growth	126,42	27,92	25,90	337,32	0,36	1,09	3,03
Coarna neagră - fruit maturation	119,40	28,40	26,80	355,90	0,24	0,17	0,71
Moldova - bloom	520,40	32,01	30,28	339,30	0,79	0,07	0,09
Moldova – growth	120,18	27,87	25,45	342,77	0,57	0,78	1,38
Moldova - fruit maturation	172,50	28,90	26,70	360,65	0,87	0,76	0,87
Gelu - bloom	277,00	31,99	29,72	362,00	1,28	0,04	0,03
Gelu – growth	114,22	29,64	27,44	347,20	0,60	0,45	0,74
Gelu - fruit maturation	120,15	27,70	25,75	397,15	0,36	-0,02	-0,04 denota fotorespiratie
Purpuriu - bloom	152,67	33,48	30,37	355,44	1,86	0,47	0,25
Purpuriu – growth	94,04	28,26	26,13	331,17	0,55	2,15	3,89
Purpuriu - fruit maturation	156,45	28,80	26,75	368,70	0,48	0,41	0,85

Analysis of physiological processes, represented by the photosynthesis intensity of (A), transpiration rate and water use efficiency (WUE) highlights differences between species and between phenophases of the same variety.

Gross photosynthesis rate (A)

Intensity of carbon assimilation or gross photosynthesis rate (A) varied from one variety to another and from one to another phenophase throughout the growing season of 2011. The lowest values were recorded in all phenophases variety *Gelu* with flowering and ripening fruit trough, phenophases thermally characterized by high temperatures and significant water deficit, which had the effect of reducing leaf-level of carbon assimilation in *Gelu* particular variety, semi-early variety with medium vegetation period (*fig.1*). High values were observed at *Moldova*, *Coarnă neagră* cultivars and maximum value on *Purpuriu* (2.15 mole CO^2 $m^{-2}s^{-1}$) (*fig.1*). The most intense of carbon assimilated occurred mainly in the phenophase of growth of berries all varieties

analyzed, a period characterized by temperatures up to 1.7° C compared to the annual average, with peaks of 35.5° C and the high water deficit of 2011. Weather conditions did not significantly affect carbon assimilation in this phenophase due to the increased need for assimilate biosynthesis to effect the growth of berries. In *Gelu* variety, in September there was a massive attack of mildew, which negatively influenced the rate of photosynthesis, the plants being practical photorespiration as a form of plant resistance to biotic stress.

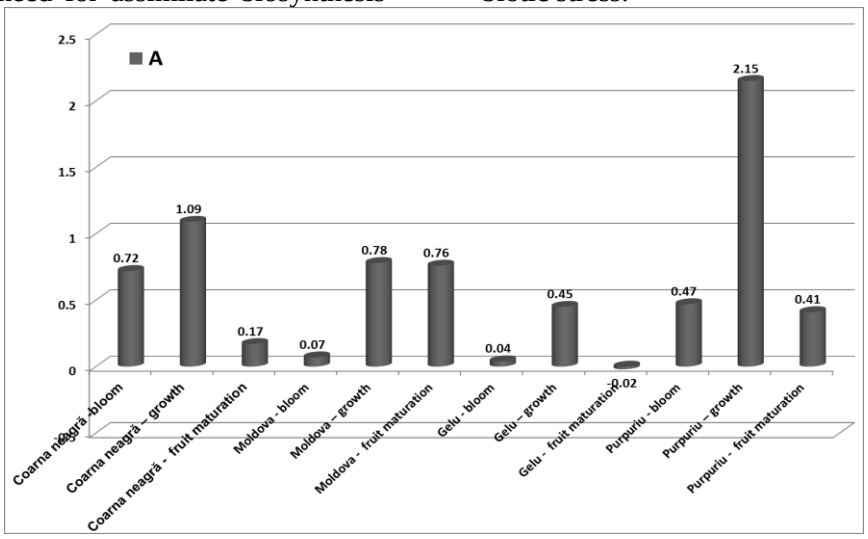

Figure 1**. Dynamics of gross photosynthesis (A)**

Transpiration rate (E)

Leaf removing water level recorded maximum values at all analyzed varieties in flowering phenophase, influenced less by temperature (normal this time), and to a greater extent, poor rainfall regime and the foliar characteristics, in the process of cell extension, which is poorly developed cuticle. The lowest values were found in fruit maturation phenophase to all varieties analyzed, due to leaf maturation and development of defense tissues, and the drought intensified in this period (*fig.2*).

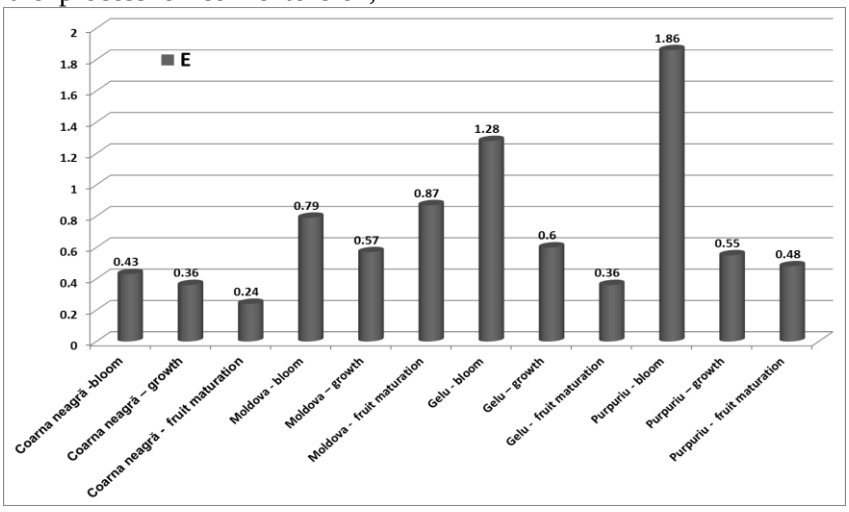

Figure 2. **Dynamics of transpiration rate (E)**

Leaf removing water level recorded maximum values at all analyzed varieties in flowering phenophase, influenced less by temperature (normal this time), and to a greater extent, poor rainfall regime and the foliar characteristics, in the process of cell extension, which is poorly developed cuticle. The lowest values were found in fruit maturation phenophase to all varieties analyzed, due to leaf maturation and development of defense tissues, and the drought intensified in this period.

Water use efficency –WUE

Calculated as the ratio of photosynthesis rate (A) and transpiration rate (E), depending on the biological characteristics of the variety, the WUE has minimum or maximum values in different phenophases. The highest values were recorded in growth phenophase to all varieties analyzed, with a maximum at *Purpuriu* variety.

The lowest values were observed in phenophase of flowering (bloom) in most varieties except *Coarnă neagră* variety, results influenced by water deficit recorded throughout the growing season, but more pronounced towards the end (*fig. 3*). High values of WUE can be interpreted as a result of increased atmospheric CO_2 (Eamus D., 1991), due to its location near the experimental field of urban area. Reducing the amount of water in the soil is reflected by increased plant WUE as a reaction to the reduction of field potential and drought (Blum A., 2005).

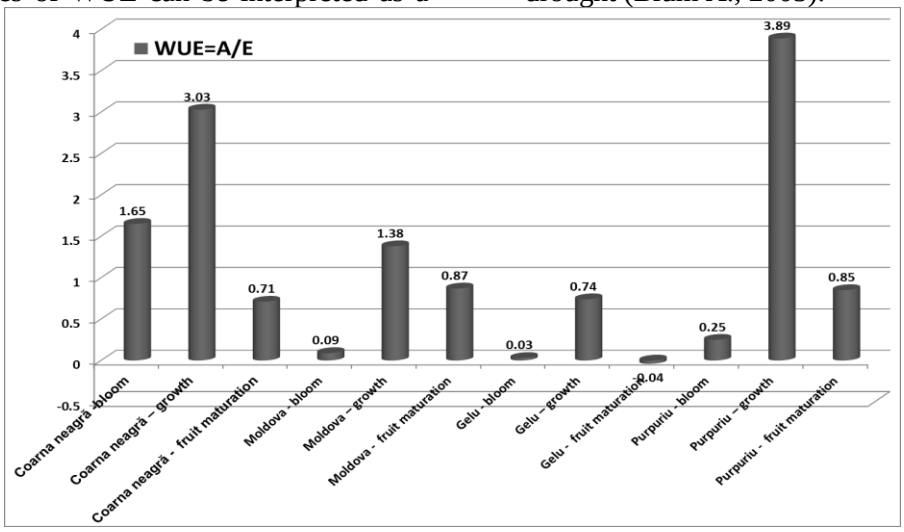

Figure 2 **Dynamics of water use efficency –WUE**

CONCLUSIONS

1. Weather conditions of 2011 did not significantly affect carbon assimilation (A), the most intense recorded in the comparable growth phenophase of all varieties analyzed, high values were observed for cultivars *Moldova* and *Coarnă neagră* and maximum value in *Purpuriu* (2.15 mol $CO_2\ m^{-2}\ s^{-1}$).

2. Leaf transpiration (E) recorded maximum values at all analyzed varieties in flowering (bloom) phenophase influenced by the poor rainfall regime and foliar characteristics, in the process of cell extension, which cuticle is underdeveloped.

3. Dynamics of water use efficiency (WUE) shows the highest values in growth phenophases in all cultivars analyzed, with a maximum for *Purpuriu* cv. and lowest in phenophase of flowering in most varieties, except the variety *Coarnă neagră*, water deficit influenced results recorded throughout the growing season, but stressed to the end.

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