THE INFLUENCE OF IRRIGATION AND OF TECHNOLOGICAL ELEMENTS IN THE GRAPEVINE PRODUCTION QUALITY, UNDER THE CONDITIONS OF MURFATLAR

Boloș P.[1)], E. Luca[2)], A. Ionescu[1)], Laura Luca[2)]

[1)] *Research and Development Station for Viticulture and Winemaking Murfatlar*

[2)] *University of Agricultural Science and Veterinary Medicine, Cluj-Napoca, Calea Mănăştur nr. 3-5, 400372, Romania; email:emil.luca@yahoo.com*

Abstract. *This paper presents the results of the research conducted at the Research and Development Station of Viticulture and Winemaking Murfatlar, during 2007 - 2009, on two vine varieties established in the area, the Columna variety and Cabernet Sauvignon variety. In addition to production results, studies and analysis have been conducted on its quality, specifically the influence of the irrigation regime and technology elements on the concentration of sugars in grapes.*

Keywords: production quality, concentration of sugars in grapes, irrigation regime.

INTRODUCTION

The reasearch carried out so far in the Murfatlar vineyard shows that the grapevine varieties for wine making get sufficient water from the precipitation if it does not exceed during the growing season (April-October) 300 mm and it does not to fall below 200 mm, when the effect of drought begins to feel. If the vine receives sufficient rainfall over the winter (November to March) respectively a minimum of 150-200 mm, it will easily resists to drought in summer (Ionescu 1984 Ranca Aurora 2011).

It is noted that in recent decades drought years frequency is appreciably higher, this due to increasing solar activity and its conjugation with increasing pollution of the environment (air and soil). Rarefication of the ozone protective layer and the greenhouse effect currently growing year by year is already felt by increasing water scarcity, an indispensable element for animal and plant life.

If you reached the stage in which the vine - a moderate water-consumer compared to many other agricultural plant species (especially annual) - feels the lack of water, you have to consider it an urgent wake-up call both for rational resource management and also for developping and appliing new technologies of culture, on the concept of fighting drought to restrict to a minimum evapotranspiration and unproductive consumption of water and increase its specific and productive consumption and for the dry synthesis of crops (Luca and Nagy 1999, Luca et al. 2008).

As a result, it was considered appropriate, current and stringent implementation of the present study to specify the conditions of irrigation and nonirigation using different production loads and fertilization variants to determine the effect of these factors on the quality of wine production in two varieties of high perspective belonging to the Murfatlar vineyard range.

MATERIAL AND METHOD

The biological material tested in the experiments conducted at Murfatlar between 2007 -2009 was represented by the *Columna* and *Cabernet Sauvignon* varieties.

These experiments monitored the effect of three factors on the quality of grape production: Factor A - Irrigation method with three graduations: a_1. nonirrigated, a_2. sprinkler irrigation providing between 50-75% of I.U.A. applied in the last decade, for wine varieties 800-1200 m^3 (cubic meters) water per hectare (depending on weather conditions); a_3. drip irrigation (localized) with standard irrigation IUA keeping to a minimum of 50% and CC at best); Factor B - Fertilization method with 2 graduations: b_1. unfertilized, b_2. minerally fertilized with N50, P50, K50 per hectare with the annual autumn tillage; Factor C - production load with three graduations: c_1 - reduced load (75%), c_2 - normal load (100%) and c_3 – amplified load (125%) for each of the two varieties studied.

Experimental data were collated and processed by computer operated programs for experimental techniques and interpreted statistically.

RESULTS AND DISCUSSION

Regarding the quality of the raw materials – the grapes, expressed primarily through the sugar content and total acidity of the grape berries must at full phenophase maturity, as the variance analysis, respectively the data in Tables 1 and 2 shows, in the average results on period 2007 - 2009, only a statistic partial insurance, as follows: for the Columna variety, variant V18 and variant V3 for the Cabernet Sauvignon, achieved significant gains compared to the control variants; for the Columna variety, variants V12 and v15 and for the variety Cabernet Sauvignon, variant V2 have made significant increases to control variants. The remaining variants had no statistical insurance.

Since the quality of the wine grapes production as raw material for winemaking is also assessed in terms of its technological characteristics, for this purpose annual determinations were made.

These consisted of physical analysis of a kg of grapes to determine the weight of the clusters, the number and weight of the grains, the amount by weight and volume of unfermented wine (must) as well as the weight of the marc of grapes, of the seed, peel and core (from the marc of grapes).

Simultaneously an analysis also was performed on 100 grape berries and the total weight, weight of skin, the pulp (core), seeds, the number and weight of 100 seeds were determined.

The average results obtained during the analysis are listed for each variety, in Tables 3 and 4.

The knowledge of the parameters of these technological elements that deepen the quality of grapes for wine production was used to calculate the main technological indices, namely: grape berries composition index = mass of berries / cluster mass; grape berry composition index = mass of the berry core / skin mass;

berry index = no. grains per 100 g grape; grape yield index = weight of the grape must / marc weight (skin + seed + cluster).

The technological indices complete, along with the sugar content and total acidity of the must, the degree of grape quality suitability for wine production and they are directly reflected in the value of the must yield of the grapes, a valuable element in the oenology process.
Data concerning the value of these average technological indices determined during the research circumscribed within typical values for wine grape varieties of higher quality.

Table 1.

Determining variance analysis for the sugar concentration of Columna variety grapes (g/l) (Murfatlar, average data from 2007 to 2009)

Variability Cause	SP	GL	SP/GL	Probe F
0	1	2	3	4
Total	5,98	17	0,35	
Variants	5,11	8	0,64	5,74 (4,87)
Repetitions	0,32	4	0,08	
Error	0,55	5	0,11	

Variant	Production obtained (calculated) per hectar/ tone	Relative production %	Diferences + (-) t/ha	Meaning
0	1	2	3	4
V18	203,4	108,65	16,2	xx
V12	194,6	103,95	7,4	x
V15	193,9	103,58	6,7	x
V9	191,7	102,40	4,5	-
V6	191,5	102,29	4,3	-
V8	188,7	100,80	1,5	-
V4	188,3	100,58	1,1	-
V3	187,6	100,21	0,4	-
Media	187,2	100,00	-	Mt
V11	186,7	99,73	-0,5	-
V1	184,8	98,72	-2,4	-
V5	184,7	98,66	-2,5	-
V16	184,0	98,29	-3,2	-
V10	183,5	98,02	-3,7	-
V14	183,5	98,02	-3,7	-
V2	182,0	97,22	-5,2	-
V17	181,1	96,74	-6,1	-
V13	180,9	96,63	-6,3	-
V7	179,0	95,62	-8,2	-
DL 5% = 5,2 g/l		DL 1% = 10,7 g/l	DL 0,1% = 16,8 g/l	

Table 2.

Determining variance analysis for the sugar concentration of Cabernet Sauvignon variety grapes (g/l) (Murfatlar, average data from 2007 to 2009)

Variability Cause	SP	GL	SP/GL	Proba F
0	1	2	3	4
Total	5,44	17	0,32	
Variants	4,20	8	0,52	4,48 /3,78)
Repetitions	0,49	4	0,12	
Error	0,75	5	0,15	

Variant	Production obtained (calculated) per hectar/ tone	Relative production %	Diferences + (-) t/ha	Meaning
0	1	2	3	4
V3	203,2	103,09	6,1	xx
V2	201,1	102,03	4,0	x
V15	199,8	101,36	2,7	-
V8	199,3	101,12	2,2	-
V6	199,1	101,01	2,0	-
V14	198,6	100,76	1,5	-
V4	198,3	100,60	1,2	-
V5	197,5	100,20	0,4	-
Media	197,1	100,00	-	Mt
V17	196,9	99,89	-0,2	-
V12	196,8	99,85	-0,3	-
V1	196,2	99,54	-0,9	-
V18	196,0	99,44	-1,1	-
V16	195,6	99,24	-1,5	-
V11	195,5	99,19	-1,6	-
V13	195,1	98,98	-2,0	-
V10	194,5	98,68	-2,6	-
V9	194,2	98,53	-2,9	-
V7	190,6	96,70	-6,5	0
DL 5% = 3,2 g/l		DL 1% = 4,5 g/l	DL 0,1% = 8,3 g/l	

Table 3.

Main technological characteristic at the full maturity of the *Columna* grape variety – mechanical analysis (Murfatlar average data 2007-2009)

Block and experimental plot	Variante no.	Weight of rachi des g	Analyzed elements									
			Granes		Must		Skin g	Seeds		Rape	Must content :	
			Weig ht g	No.	Volum cm^3	Weig ht g		Weig ht g	No.		Sugar g/l	Acidi-taty g/l H_2SO_4
0	1	2	3	4	5	6	7	8	9	10	11	12
Nonirrigated	1	43,8	956,2	555	663	789,6	132,9	33,7	1028	210,4	184,8	5,15
- Unfertilized	2	43,4	956,6	558	661	791,0	132,1	33,5	1041	209,0	182,0	5,25
	3	43,0	957,0	567	671	779,2	142,4	35,4	1102	220,8	187,6	5,08
Average X		43,4	956,6	560	665	786,6	135,8	34,2	1057	213,4	184,8	5,16
	4	40,9	959,1	571	672	775,7	145,7	37,7	1127	224,3	188,3	5,18
- Fertilized	5	41,6	958,4	564	660	784,3	139,1	35,0	1096	215,7	184,7	5,33
	6	42,0	958,0	563	654	782,4	140,3	35,3	1101	217,6	191,5	5,07
Average X		41,5	958,5	566	662	780,8	141,7	36,0	1108	219,2	188,2	5,19
Average block		42,4	957,6	563	663	783,7	138,7	35,2	1082	216,3	186,5	5,17
Sprinkler irrigated	7	42,7	957,3	532	646	762,2	122,6	34,9	1005	200,2	179,0	5,70
- Unfertilized	8	42,1	957,9	557	685	808,5	133,5	37,2	1109	212,8	188,7	5,14
	9	41,8	958,2	555	682	804,7	133,0	36,8	1186	211,6	191,7	5,08
Average X		42,2	957,8	548	671	791,8	129,7	36,3	1110	208,2	186,5	5,31
- Fertilized	10	39,8	960,2	540	669	787,6	137,1	35,5	1088	212,4	183,5	5,81
	11	41,7	958,3	560	680	792,3	128,4	37,6	1155	207,7	186,7	5,16
	12	40,9	959,1	553	685	790,0	130,3	38,8	1189	210,0	194,6	5,01
Average X		40,8	959,2	551	678	790,0	131,9	37,3	1144	210,0	188,3	5,33
Average block		41,5	958,5	549	674	791,0	130,8	36,8	1122	209,0	187,4	5,32
Irrigated locally	13	42,6	957,4	537	656	767,2	123,7	35,1	1004	201,4	180,9	5,57
- Unfertilized	14	41,9	958,1	542	683	809,0	127,8	36,9	1098	206,6	183,5	5,51
	15	41,5	958,5	538	695	805,8	131,9	36,6	1186	210,0	193,9	5,12
Average X		42,0	958,0	539	678	794,0	127,8	36,2	1096	206,0	186,1	5,43
- Fertilized	16	38,1	961,9	536	671	804,5	118,1	39,3	1079	195,5	184,0	5,42
	17	40,9	959,1	555	685	801,3	125,8	32,0	1168	198,7	181,1	5,56
	18	41,3	958,7	550	690	797,2	119,7	41,8	1140	202,8	203,4	5,08
Average X		40,1	959,9	547	682	801,0	121,8	37,1	1189	199,0	189,5	5,35
Average block		41,0	959,0	543	680	797,5	124,8	36,6	1112	202,5	187,8	5,39

Table 4.

The main technological features at full maturity of the *Cabernet Sauvignon* variety – mechanical analysis for 1 kg grapes (Murfatlar, average data 2007-2009)

Block and experimental plot	Variante no.	Weight of rachides g	Analyzed elements									
			Granes		Must		Skin g	Seeds		Rape	Must content :	
			Weight g	No.	Volum cm^3	Weight g		Weight g	No.		Sugar g/l	Acidi-taty g/l H_2SO_4
0	1	2	3	4	5	6	7	8	9	10	11	12
Nonirrigated	1	54,2	945,8	930	672	730,4	161,1	54,3	1612	269,6	196,2	4,49
- Unfertilized	2	55,9	944,1	928	671	735,3	156,7	52,1	1578	264,7	201,1	4,45
	3	58,8	941,2	926	670	733,0	155,6	52,6	1586	267,0	203,2	4,41
Average X		56,3	943,7	928	671	732,9	157,8	53,0	1590	267,1	200,2	4,44
	4	52,1	947,9	934	678	747,8	149,7	50,4	1514	252,2	198,3	4,52
- Fertilized	5	55,4	944,6	932	676	738,0	150,8	55,8	1720	262,0	197,5	4,59
	6	57,2	942,8	929	671	720,6	159,5	62,7	1830	279,4	199,1	4,65
Average X		54,9	945,1	932	675	735,5	153,3	56,3	1688	264,5	198,3	4,59
Average block		55,6	944,4	930	673	731,4	155,5	54,6	1639	265,7	199,2	4,51
Sprinkler irrigated	7	54,8	945,2	913	686	748,7	138,2	58,3	1621	2513	190,6	4,83
- Unfertilized	8	57,4	942,6	911	677	725,4	159,3	57,9	1704	274,6	199,3	4,75
	9	59,4	940,6	909	671	720,8	168,9	50,9	1719	279,2	194,2	4,77
Average X		57,2	942,8	911	678	731,6	155,5	55,7	1681	268,4	194,7	4,78
- Fertilized	10	54,4	945,6	930	697	759,8	138,5	47,3	1655	240,2	194,5	4,75
	11	56,2	943,8	928	684	742,4	156,6	44,8	1794	257,6	195,5	4,73
	12	57,7	942,3	926	682	744,5	149,5	48,3	1878	255,5	196,8	4,74
Average X		56,1	943,9	928	688	748,9	148,2	46,8	1775	251,1	195,6	4,74
Average block		56,6	943,4	919	683	740,2	151,8	51,4	1728	259,8	195,1	4,76
Irrigated locally	13	54,9	945,1	918	696	776,8	122,0	46,3	1678	223,2	195,1	4,72
- Unfertilized	14	57,2	942,8	916	671	721,1	178,5	43,2	1642	278,9	198,6	4,68
	15	58,3	941,7	916	673	746,7	150,9	44,1	1638	253,3	199,8	4,59
Average X		56,8	943,2	917	680	748,2	150,5	44,5	1653	251,8	197,8	4,66
- Fertilized	16	53,8	946,2	933	703	727,6	172,4	46,2	1724	272,4	195,6	4,76
	17	55,9	944,1	931	688	746,6	147,1	50,4	1701	253,4	196,9	4,76
	18	57,1	942,9	930	632	780,0	107,7	55,2	1669	220,0	196,0	4,78
Average X		55,6	944,4	931	691	751,4	142,4	50,6	1698	248,6	196,1	4,77
Average block		56,2	943,8	924	686	749,8	146,5	47,5	1675	250,2	196,9	4,71

Grape structure index ranges between 21,8 (V1) and 25,2 (V16) for the Columna variety and 15,8 (V9) and 18,2 (V4) for the Cabernet Sauvignon variety and reflects a good rapport berry to cluster weight; the berry index ranges between 53 (V7) and 57 (V4) berries in 100 g grapes for the Columna variety and 91 berries (3 variants V7-9) and 93 (in 9 variants, V4-6, V10-12 şi V16-18), ampelographic values characteristic for these varieties; the berry compozition index ranges between 8,47 (V3) and 9,81 (V16) for the Columna variety and 7,26 (V9) and 10,24 (V18) for the Cabernet Sauvignon variety, also typical values, where as the yield index ranges between 3,46 (V4) and 4,11 (V16) for the Columna variety and between 2,58 (V6, 9, 14) and 3,54 (V18) for the Cabernet Sauvignon variety.

CONCLUSIONS

In terms of production quality, expressed through sugar content during 2007 - 2009, the variants on drip and sprinkler irrigation and the fertilized variant significantly exceeded the control variant.

All indices determined, except the “berry index" show higher values for the Columna variety compared with the Cabernet Sauvignon one, where the berry index shows higher values due exclusively to its biological characteristics on grain size, which are smaller. It should be noted that the maximum values of all these indices are found exclusively in both varieties in the irrigated and fertilized variations, which highlights the combined positive influence in reaching production and grape quality.

It can be therefore appreciated that the technological characteristics and size index calculations considered for the two species studied are entirely characteristic of producing high quality wines.

REFERENCES

1. Ionescu, A. (1984). Experimental vineyards from Murfatlar - National Symposium on Agricultural History and Retrology of Romania, vol. Papers presented, Constanta.

2. Luca, E. and Z. Nagy (1999). Crop irrigation, Genesis Tipo Publishing House, Cluj-Napoca;

3. Luca, E. *et al.* (2008). Exploitation of land reclamation, Risoprint Publishing House, Cluj-Napoca.

4. Ranca, Aurora and I. Toncea (2011). Organic viticulture and winemaking, Totol Publishing House, Bucharest;