THE INFLUENCE OF IRRIGATION AND OF TECHNOLOGICAL ELEMENTS ON GRAPEVINE'S PRODUCTION LEVEL, IN MURFATLAR'S CONDITIONS

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Abstract. *The research underlying this paper has aimed to give a concrete answer a current issue, namely the influence of the irrigation regime and of some technological elements on grapevine production in Murfatlar's conditions. For this, research was conducted in the experimental fields of the Viticulture and Winemaking Research - Development Station of Murfatlar, during 2007 - 2009, on two vine varieties established in the area, the Columna and the Cabernet Sauvignon.*

Keywords: irrigation regime, grapevine production, vine, Murfatlar Vineyard.

INTRODUCTION

Murfatlar wine center is located in the central part of Dobrogea platform, along the slope lines that margin the Black Sea Danube Canal. The ecoclimatic description in recent years and its trend to remain favorable for all cultured species, primarily for grapevine as a multi-annual and helio-thermophilic plant, can be considered prospective for both crop productivity and quality of grapes including structure improvement in the big grape assortment of table grapes and seedless trends and also for high-quality wines (A. Ionescu, 1984).

The research that this paper is based on are to complete previous research done in the field (Ionescu 1984, Luca and Nagy 1999, Costea and Grigorescu 2002, Aurora Ranca 2011)trying to give a concrete answer a current issue, that of the influence of the irrigation regime and of the technology elements of production on the grapevine under the conditions of Murfatlar. For this, research was conducted in the experimental fields of the Viticulture and Winemaking Research - Development Station of Murfatlar, during 2007 - 2009, on two vine varieties established in the area, the Columna and the Cabernet Sauvignon.

The main objectives of the experimental research were: determining the influence of biological material, fertilization, fruit load and the irrigation system on grape production, optimization of technological factors to increase production quality and quantity for the vine culture, determination of vine's water consumption by soil water balance method, determining the economic efficiency of irrigation of vines under the conditions of Murfatlar.

From the (preliminary) climate aspect throughout the years 2007 to 2009 when the research was organized and carried out, the main ecoclimate, heat, light and fluid indicators of the Murfatlar Vine Center were relatively similar, but with some obvious particularitie, obvious on vegetation ranges (Ionescu, 1984).

MATERIAL AND METHOD

To achieve the objectives established field research was conducted and statistical calculations were done. The field experiences took three years (2007-2009) and included research in two major wine varieties and great prospects for the vineyard's range, the *Columna* variety, created by the Murfatlar Center and the *Cabernet Sauvignon* variety.

For this study, considering the standards for experimental technique in the actual field conditions, the following devices were selected and materialized - research site that includes 18 variables for each variety, arranged in two blocks and six experimental plots.

The experimental factors studied were:

Factor A - Irrigation method with three graduations:

- a_1. unirrigated,
- 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.

The statistical interpretation of experimental data was based on variation analysis for the interaction influence of the three factors on the production of grapes in each year of the experiment.

Water consumption was calculated by soil water balance method.

Experimental data were collated and processed by computer operated programs for experimental techniques and interpreted statistically. Economic efficiency calculation was based on technico-economical indicators of field crops, irrigated and unirrigated.

RESULTS AND DISCUSSION

Observations on growth vigor for the Columna and Cabernet Sauvignon varieties.

Average annual growth vigor of Columna and Cabernet Sauvignon vine varieties in the Murfatlar conditions established within the research, both by the amount of new wood removed in spring when cutting the production in the dry on the 18 experimental variants is shown in Figure 1. Interpreting the presented data, it is confirmed on the experimental assembly, a medium-large vigor on the Columna

variety and a middle vigor for the Cabernet Sauvignon variety which, in fact, are biologically characteristic for these varieties.

On the experimental blocks and plots, the highest growth vigor is obtained on the sprinkler irrigated and fertilized variants both for the Columna and the Cabernet Sauvignon variety (V7-13), while the smallest effect occurred in the unirrigated and unfertilized variant (V16).

Comments on the stump fertility and productivity

The medium values for stump fertility, namely the absolute and relative fertility quotients inthe reasearch timeframe for both varieties were relatively good, characteristic of their particular biological traits as described and their ampelographic presentation;

Vine stump productivity achieved and expressed through the value of both absolute and relative productivity indices performed on 18 variables grouped into three experimental blocks and six plots in 2007-2009, was generally good, better results are obtained in variants that had localized drop irrigation, which were fertilized and were assigned low production load (75%), the worst results were recorded in variants irrigated, fertilized and that had the production load enhanced (125%);

Research results on the influence of irrigation, fertilization and production load on the production of grapes, 2007 – 2009

Production, specifically the final harvest, based on the fertility and productivity processes of the Columna and Cabernet Sauvignon varieties, was initially determined as an average kg per vine stump at the grape berries full maturity by weighing, for each of the 18 variables, based on production element statistics and following the ripening evolution, according to the methodology of experimental techniques.

For good and edifying comparative analysis between varieties, blocks, plots and experimental variants, the average yield of grapes per vine stump was extrapolated by calculation per hectare for each of the two varieties. The data obtained is presented on blocks / non-irrigated, irrigated by sprinkler and localized irrigation (drip), on plots (unfertilized and fertilized) and variants by combining the five factors mentioned with 3 different production loads (normal, low and amplified).

From the data presented (Tables 1 and 2) for the two varieties, the biggest grape production on average over the reaserch period (2007-2009) is achieved by the variants from the localized drip irrigation block (9388 kg/ha for Columna and 6939 kg/ha for Cabernet Sauvignon), followed by the block with the sprinkler irrigation (8100 kg/ha for Columna and 6212 kg/ha for Cabernet Sauvignon) and on the last place came the unirrigated block with 7056 kg/ha for Columna and 5534 kg/ha for the Cabernet Sauvignon.

Table 1.

Determining variance analysis for the average production of *Columna* variety grapes (t / ha) (Murfatlar, average data from 2007 to 2009)

Variability Cause	SP	GL	SP/GL	Proba F
0	1	2	3	4
TOTAL	7,08	17	0,39	
Variants	5,84	8	0,73	6,71 (4,17)
Repetitions	0,44	4	0,11	
Error	0,80	5	0,16	

Variant	Production obtained (calculated) per hectar/ tone	Relative production %	Diferences + (-) t/ha	Meaning
0	1	2	3	4
V18	10,70	139,10	3,01	xxx
V17	10,21	132,76	2,52	xxx
V15	9,66	125,58	1,97	xx
V14	9,59	124,70	1,90	xx
V11	9,12	118,55	1,43	xx
V16	8,82	114,66	1,13	-
V12	8,50	110,50	0,81	-
V8	8,06	104,8	0,37	-
V10	7,93	100,07	0,24	-
V9	7,82	101,66	0,13	-
MEDIA	7,69	100,00	-	mt
V5	7,60	98,83	-0,09	-
V13	7,34	95,47	-0,35	-
V2	7,20	93,60	-0,49	-
V7	7,17	93,24	-0,52	-
V6	7,14	92,87	-0,55	-
V3	7,06	91,73	-0,63	-
V4	0,66	86,58	-1,03	-
V1	6,46	83,98	-1,23	-
DL 5% = 0,82		DL 1% = 1,40	DL 0,1% = 2,51	

Table 2.

Determining variance analysis for the average production of grapes for the *Cabernet Sauvignon* variety (t / ha) (Murfatlar, average data from 2007 to 2009)

Variability Cause	SP	GL	SP/GL	Proba F
0	1	2	3	4
TOTAL	6,45	17	0,28	
Variants	4,72	8	0,59	5,67 (3,97)
Repetitions	0,68	4	0,17	
Error	1,05	5	0,21	

Variant	Production obtained (calculated) per hectar/ tone	Relative production %	Diferences + (-) t/ha	Meaning
0	1	2	3	4
V18	7,85	126,07	1,62	xxx
V17	7,58	121,77	1,35	xx
V14	6,74	108,24	0,51	-
V16	6,72	108,00	0,49	-
V15	6,68	107,19	0,45	-
V11	6,67	107,05	0,44	-
V12	6,56	105,26	0,33	-
V6	6,55	105,12	0,32	-
V5	6,50	104,36	0,27	-
V8	6,28	100,80	0,05	-
MEDIA	6,23	100,00	-	Mt
V9	6,11	98,14	-0,12	-
V13	6,06	97,24	-0,17	-
V10	6,01	96,48	-0,22	-
V7	5,65	90,76	-0,58	-
V2	5,33	85,64	-0,90	-
V4	5,19	83,41	-1,04	-
V3	5,09	81,77	-1,14	-
V1	4,54	72,85	-1,69	-
DL 5% = 0,53		DL 1% = 1,32	DL 0,1% = 1,60	

The highest yielding plots are made of fertilized variants (8518 kg/ha for the Columna variety and 6626 kg/ha for the Cabernet Sauvignon variety) oppozite the unfertilized ones (7818 kg/ha for the Columna variety and 5831 kg/ha for the Cabernet Sauvignon variety). For the experimental variations, the grape production amplitude is between 6420 and 10700 kg/ha for the Columna variety and between 4537 kg/ha and 7852 kg/ha for the Cabernet Sauvignon variety.

Of the 18 experimental variations, regarding the production of grapes made, the higher was the first 5 variants (in increasing order) as follows: the Columna variety with V18 (10700 kg/ha), V17 (10212 kg/ha), v15 (9660 kg/ha), V14 (9592 kg/ha) and V11 (9120 kg/ha), Cabernet Sauvignon and the variants V18 (7852 g/ha), V17 (7584 kg/ha), V14 (6741 kg/ha), v15 (6676kg/ha) and V11 (6667 kg/ha).

In terms of combining the factors investigated, the above mentioned valuable variants point out through the production level achieved in both varieties the decisive influence of using irrigation, fertilization and rational (normal) distribution of a production load, an aspect which is obvious in the grape berries' size, in the number of grapes on the block and their average weight.

The data presented shows that only the production obtained for the following variants are certain from the statictical point of view, as follows: from the Columna variety, V18 and V17 variants and from the Cabernet Sauvignon, variant V18 has made very significant gains by comparison to the controll variants; for the Columna variants V15, V14 and V11 for the Cabernet Sauvignon variety, variant V17 has

made significant gains by comparison to the controll variants. All other 13 variants of the Columna variety and the 16 ones from the Cabernet Sauvignon assured on the statistical-mathematical terms, the difference threshold (DL) beeing below 5%.

CONCLUSIONS

1. Grape production, as an average, in the period of the reasearched years, is obtained by the variants from the drip irrigation block, followed by the block is irrigated by sprinklers, and last falls the unirrigated block.

The highest yielding plots are made of the fertilized ones, and of the 18 experimental variations, from the ones with normal or amplified production load;

2. Testing statistical and mathematical assumptions on production differences between the versions, in terms of the experimental "variance" method has shown that only five variants have statistical assurance: the V18 and V17 variants of the Columna variety with the "very significant" note, and V15 , V14 and V11 with the notation "distinctively significant" and from the Cabernet Sauvignon variety, V18 as "very significant" and V17 as "distinctly significant" – all of these variants belonging to irrigated blocks, all other variables being labeled as unassured statistically and mathematically;

3. Mechanical analysis of the 1 kg grapes sample and 100 grape berries in full maturity to determine the technological indices of the structure (composition) of the grape, grain composition, the yield of grain and the must (unfermented wine) sugar content and total acidity revealed that the two varieties have very good suitability for wine in order to obtain higher quality wines with controlled origin appelation.

Average annual water consumption during the active growing season was approximately equal for the two varieties studied, namely 1447 mm for the Columna variety and 1433 mm for the Cabernet Sauvignon variety;

Irrigation efficiency in both varieties was followed and expressed by analyzing the valorification of irrigation water. Irrigation water use coefficient determined on each experimental variant through the study years between indicate a more efficient use on the locally irrigated variants compared to the sprinkled ones and especially on those from the fertilized plot, best results beeing obtained in the variants V17 and V18, with a consumption of 0.07 m/ha for the Columna variety and 0.09 mc/ha for the Cabernet Sauvignon variety.

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