WATER REGIME OF SOILS IN VINEYARD PLANTATIONS IN COPOU IASI WINE CENTER, FROM THE PERIOD 2016 – 2020

REGIMUL HIDRIC AL SOLURILOR ÎN PLANTAȚIILE VITICOLE DIN CENTRUL VITICOL COPOU IAȘI, DIN PERIOADA 2016 – 2020

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Abstract. *The multiannual average of the precipitations, for the Copou Iaşi viticultural center, is of 579.6 mm (value calculated for the period 1981 - 2010), out of which in the vegetation period (April-September) of 398.1 mm. From the analysis of the data registered at SCDVV Iasi, in the last decades, it is found an increased frequency of the dry years. Decreasing rainfall and high temperatures have led to a sharp decline in soil moisture levels, well below the optimal values for vines (50-80%) and increasing deficits. In the paper are presented: the distribution of precipitation from 2016 to 2020, compared to the multiannual average, accessible humidity and water deficit in the soil.*

Keywords: precipitation, vines, accessible soil moisture

Rezumat. *Media multianuală a precipitațiilor, pentru centrul viticol Copou Iaşi, este de 579,6mm (valoare calculată pentru perioada 1981 – 2010), din care în perioada de vegetație (aprilie-septembrie) de 398,1 mm. Din analiza datelor înregistrate la SCDVV Iaşi, în ultimile decenii, se constată o frecvență sporită a anilor secetoşi. Cantițățile tot mai mici de precipitații şi temperaturile mari au dus la scăderea accentuată a valorilor umidității accesibile din sol, cu mult sub valorile optime pentru vița de vie (50 – 80%) şi creşterea deficitului. În lucrarea sunt prezentate: distribuția precipitațiilor din perioada 2016 -2020, comparativ cu media multianuală, umiditatea accesibilă şi deficitul de apă din sol.*

Cuvinte cheie: precipitații, viță de vie, umiditate accesibilă sol

INTRODUCTION

Although the vine is considered a plant resistant to water stress, long-drawn pedological drought can significantly affect the vegetation status of the stumps and their production capacity (Pîrcălabu *et al,* 2004).

Drought can be a destructive phenomenon for vineyards, when in autumn and winter of the previous year there is a deficit of precipitation, and the quantities recorded in spring fail to restore the water supply from the deep layers of the soil from which the vine stems are fed (Zaldea *et al,* 2017). During an agricultural year, the autumn and winter seasons constitute the period of formation of the soil moisture reserve, due to the relatively more abundant precipitations and especially to the reduced water losses by evaporation (Berbecel

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et al., 1970). The optimal soil moisture for the vine culture is between 50 - 80% of the useful water capacity of the soil (CAU), higher values being favorable for growing shoots and lower for grain maturation (Moțoc, 1968).

MATERIAL AND METHOD

For the analysis of the precipitations, the data registered at the Agroexpert automatic station of SCDVV Iasi and those from the Regional Meteorological Center of Moldova Iasi were used. In order to establish the soil moisture, samples were taken in layers every 10 cm to a depth of 150 cm, for each month of the vegetation period. The results were expressed, first, as a percentage by weight of dry soil, then as a percentage by volume. With the help of the values of the hydrophysical indices, the accessible humidity existing in the soil at a given moment was calculated (Uacc), expressed in mm and the deficit in m^3/ha and %. In order to establish the degree of water supply accessible to the plants, the momentary humidity (Uacc) was related to the useful water capacity (UWC), previously calculated for the Copou Iasi wine center.

RESULTS AND DISCUSSIONS

The panel of the precipitations registered in the period 2016 - 2020, shows us the fact that they were very unevenly distributed, with months when very small quantities were registered compared to normal, only 7.2 L/m^2 in December 2016, 3.0 L/m^2 in August 2018, 3.6 L/m^2 in January 2020 and Monday when double or triple quantities were registered, respectively October 2016, June and July 2018 (fig. 1).

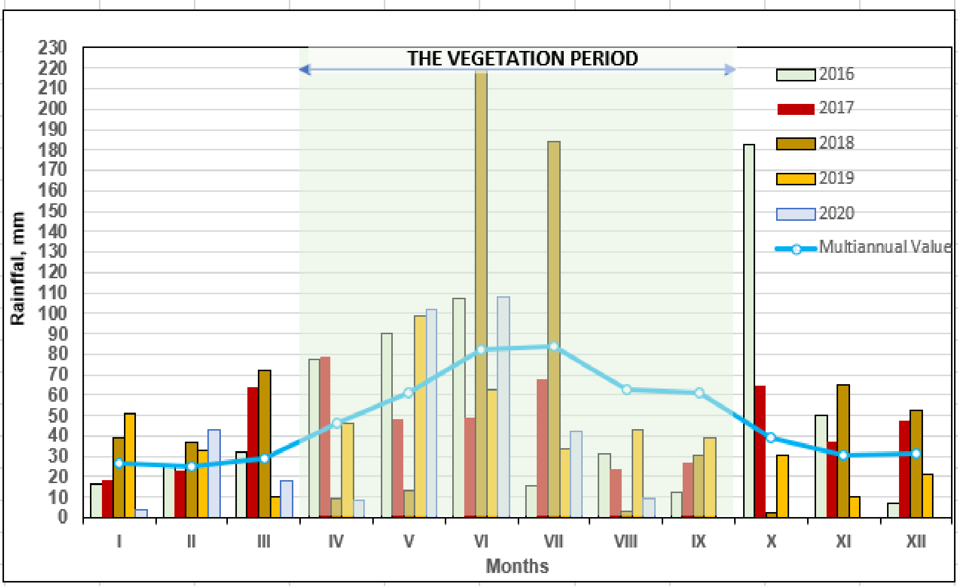

Fig. 1 - Monthly rainfall distribution in the period 2016 – 2020

There is also a reduction in rainfall from autumn, continuing in winter and spring of next year, situations recorded in 2016-2017 and 2019-2020.

Depending on the annual rainfall and the vegetation period, the years observed were characterized as "dry" 2017 and 2020, "slightly drier" in 2016 and 2019, and 2018 as a "rainy" year (tab. 1).

Table 1

The precipitation regime from 2016 to 2020

Month	Multiannual Value	Year				
		2016	2017	2018	2019	2020
January	26.7	16.0	18.1	38.8	50.6	3.6
February	24.9	25.0	22.7	37.0	32.8	43.2
March	29.2	31.8	64.0	72.2	9.8	18.2
April	46.5	77.6	78.4	9.2	46.0	8.4
May	61.4	90.2	47.8	13.6	98.6	102.2
June	82.5	107.0	49.0	219.6	63.0	108.4
July	83.8	15.4	67.6	184.2	33.8	42.0
August	62.7	31.4	24.0	3.0	43.2	9.2
September	61.1	12.2	26.6	30.4	38.8	7.2
October	38.9	182.2	64.2	2.6	30.6	-
November	30.8	50.2	37.0	64.6	10.2	-
December	31.0	7.2	47.2	52.6	21.3	-
Annual rainfall	579.6	646.8	546.6	727.8	478.7	-
Precipitation during the vegetation period	398.1	333.8	293.4	460.0	323.4	277.4
Annual characterization	-	slighty drier	dry	rainy	slighty drier	dry

The evolution of precipitation had a direct influence on soil moisture. Thus, Uacc values were usually higher in the first month of the vegetation period (April), after which there was a decrease from one month to another and an increase in the deficit to the deep layers (tab. 2 and tab.3). In April, the normal humidity values are between 70 - 90%, on the depth 0 - 100 cm, and from 100 - 150 cm there must be excess humidity, values over 100%.

In 2016, as a result of the small amounts of precipitation from July to September and the high temperatures, there was a sharp decrease in soil moisture values, well below the optimal values. In the first layers they were located at the level of the withering coefficient (CO) values, and from 20 - 150 cm depth they were between 22 - 42% (tab. 2).

The precipitation deficit registered both in winter 2016 - 2017 and in the months of the vegetation period: May, June, July, August and September 2017 determined the decrease of accessible soil moisture with a negative influence on the phenophases of shoot growth and grape ripening. Under these conditions, the water deficit in the soil showed values between 55 - 92%, for September (tab. 3).

Table 2

Accessible soil moisture during the growing season (2016 - 2020)

Depth, cm	Iasi vineyard											
	IV		V		VI		VII		VIII		IX	
	mm	%	mm	%	mm	%	mm	%	mm	%	mm	%
2016												
0 - 20	30.18	63	31.73	67	13.44	28	4.21	9	6.69	14	4.31	9
20 - 50	48.19	65	65.77	89	38.16	52	5.96	8	12.06	16	19.22	26
50 -100	103.11	96	102.52	96	64.02	60	27.64	26	31.39	29	23.97	22
100 - 150	58.26	90	74.52	115	54.73	85	27.99	43	30.33	47	26.80	42
2017												
0 - 20	29.61	62	15.11	32	18.60	39	14.27	30	7.99	17	3.58	8
20 - 50	52.31	71	44.28	60	33.11	45	25.38	34	23.63	32	17.25	23
50 -100	87.76	82	84.81	79	58.80	55	34.66	32	38.49	36	24.18	23
100 - 150	78.42	122	86.35	134	52.86	82	45.83	71	35.16	55	28.83	45
2018												
0 - 20	12.80	27	11.05	23	31.71	67	18.59	39	11.57	24	8.28	17
20 - 50	45.02	61	26.73	36	54.19	73	40.88	55	26.00	35	28.08	38
50 -100	107.47	100	74.65	70	84.45	79	77.74	73	62.58	58	39.89	37
100 - 150	100.79	156	66.81	104	55.90	87	59.96	93	62.59	97	36.22	56
2019												
0 - 20	24.02	51	34.25	72	29.17	61	14.61	31	15.08	32	0.60	1
20 - 50	46.87	63	49.49	67	51.44	70	33.88	46	16.07	22	4.88	7
50 -100	94.17	88	91.65	86	94.91	89	73.40	68	44.39	41	28.10	26
100 - 150	76.84	119	80.21	124	97.68	152	78.43	122	52.72	82	23.95	37
2020												
0 - 20	19.13	40	28.08	59	27.28	57	9.92	21	5.71	12	-8.77	-18
20 - 50	20.60	28	18.07	24	25.74	35	25.44	34	16.41	22	19.47	26
50 -100	30.79	29	33.77	32	39.83	37	34.15	32	18.95	18	30.60	29
100 - 150	18.15	28	29.59	46	24.85	39	27.55	43	24.45	38	22.62	35

The year 2018, being a rainy year, presented a relatively uniform distribution of water supply in the soil, throughout the vegetation period, lower values of accessible humidity were recorded only in the first layer (0 - 20 cm).

In 2019, the atmospheric drought started starting with June and continued until the end of the year, when every month there was a deficit of precipitation. Under these conditions, at the end of the vegetation period, the accessible humidity decreased to values between 1 – 7 % on the depth of 0 - 50 cm, values close to the wilting coefficient, and the deficit was between 93 - 99%.

Also, the lack of precipitation in the first months of 2020 and in July, August, September, led to the increase of the water deficit from the soil to the deep layers of up to 59 - 74%. It was noted that in 2020, in all months of the vegetation period, the values of moisture accessible from the deep layers (50 - 100 cm, 100 - 150 cm), were very low between 28 – 29 % in April, 32 - 46 % in May, 37 – 39 % in June, 32 – 43 % in July, 18 – 38 % in August and 29 – 35 % in September, well below the optimal ones for the vine. In the layer 0 - 20 cm humidity values accessible were below the level of wilting coefficient (WC).

Table 3

Soil water deficit during the vegetation period (2016 - 2020)

Depth, cm	Iasi vineyard											
	IV		V		VI		VII		VIII		IX	
	mc/ha	%	mc/ha	%	mc/ha	%	mc/ha	%	mc/ha	%	mc/ha	%
2016												
0 - 20	174	37	158	33	341	72	433	91	408	86	432	91
20 - 50	258	35	82	11	358	48	680	92	619	84	548	74
50 -100	41	4	47	4	432	40	795	74	758	71	832	78
100 - 150	62	10	-	-	97	15	365	57	341	53	377	58
2017												
0 - 20	179	38	324	68	289	61	333	70	395	83	440	92
20 - 50	217	29	297	40	409	55	486	66	504	68	567	77
50 -100	194	18	224	21	484	45	725	68	687	64	830	77
100 - 150	-	-	-	-	116	18	186	29	293	45	356	55
2018												
0 - 20	347	73	365	77	158	33	290	61	360	76	393	83
20 - 50	290	39	473	64	198	27	331	45	480	65	459	62
50 -100	-	-	325	30	227	21	294	27	446	42	673	63
100 - 150	-	-	-	-	86	13	45	7	19	3	282	44
2019												
0 - 20	235	49	133	28	184	39	329	69	325	68	469	99
20 - 50	271	37	245	33	226	30	401	54	579	78	691	93
50 -100	130	12	155	14	123	11	338	32	628	59	791	74
100 - 150	-	-	-	-	-	-	-	-	117	18	405	63
2020												
0 - 20	284	60	195	41	203	43	376	79	418	88	563	118
20 - 50	534	72	559	76	482	65	485	66	576	78	545	74
50 -100	764	71	734	68	673	63	730	68	882	82	748	70
100 - 150	463	72	349	54	396	61	369	57	400	62	377	59

We further estimate, given the evolution of climatic conditions in the northeastern part of the country, by the lack of rainfall, a sharp increase in soil water deficit.

Drought periods lasting 2-3 years are those with serious consequences for vineyards, because the disastrous effects of drought are recorded in the second or third year of the drought period, and the restoration of plantations takes another 2-3 years, which means that for a period of about six years it is not possible to obtain grape production to cover the expenses incurred.

Among the most viable, long-term measures to prevent and reduce the effects of drought in vineyards we recommend the use of drought-resistant varieties *Vinifera* and rootstocks, as well as the generalization/expansion of the irrigation system at the national level. Also, technological solutions and recommendations for preventing and mitigating the harmful effects of drought, must include a complex of agrophytotechnical measures, differentiated during the period of rest and vegetation (Zaldea *et.al*, 2019).

CONCLUSIONS

From the analysis of the precipitation regime, from the five years studied, it is found that two years were characterized as dry (2017 and 2020), two years were less dry (2016 and 2019) and one rainy year (2018). In the dry years, the rainfall deficit started in the autumn of the previous year, and the quantities recorded in the spring failed to restore the water supply from the soil to the deep layers.

In 2019, the atmospheric drought started with June and continued until the end of the year, when every month there was a deficit of precipitation. Under these conditions, at the end of the vegetation period, the accessible humidity decreased to values between 1 – 7 % on the depth of 0 - 50 cm, values close to the wilting coefficient, and the deficit was between 93 – 99 %.

The lack of precipitation in the first months of 2020 (January, March, April), in the summer months (July, August) and in September, led to the registration of very low values of accessible humidity, well below the optimal ones for vines. alive, to a depth of 150 cm.

The distribution over time of excess / deficit periods in precipitation has a certain regularity. Periods of the opposite direction are always close to each other, so that after a rainy period does not follow a normal period, but a few months or years of drought.

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