

Effect of different phytosanitary treatment schemes on the yield and quality of some wine grape varieties

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Abstract During 2018-2019 in Dealul Silagiului vineyards was studying the efficiency of different treatment schemes for diseases and pest control (minimum, medium and complex scheme) on the grape quality and yield for three wine grape varieties and two table grapes varieties. The focus of this study was how climate variability over two years influences the efficiency of pest and disease control treatments in the vineyard. The climate was different in both years; 2018 was favourable for grapevine growing while 2019 can be described as improper for grape production. The three treatment schemes had very different financial costs, from 3450 to 5340 lei / ha. The results obtained were greatly influenced by the climate during the growing season. In 2019, the best results in diseases and pest control were obtained with the complex scheme of treatments, which was efficiently significantly higher than the other two schemes of treatment. In the previous year, the same complex scheme was more efficient than the others, but the differences among their efficiency were lower. Future research and management strategies for choosing the best treatment scheme under climate change will be needed.

Key words

phytosanitary treatments, control, production, quality, vines

Grapevine is one of the plants sensitive to the attack of diseases, parasites or pests and greatly influenced by climate variability in the area and during the growing season [3]. GHG emissions in the atmosphere force the increase of global temperature; in last century temperature rise around 0.61°C with heat waves in the summer and precipitation increased in some areas of the world or decrease in others [11,15]. Climate alteration has a direct impact on grapevine plants, insects or microorganisms [5]. High humidity, sunlight blocking, airflow inhibition (sloping ground, trees, vine training system, etc.) promote grape diseases [4]. For these reasons, diseases and pest control is very important in the vineyard management. It is not possible to elaborate an ideal treatment scheme; the treatments must be applied according to the attack extent, the climate favourable for the development of certain diseases or pest, the phytosanitary condition of the vineyard, the vines situation, the cultivated variety, the growing stage, etc. [16]. Diseases and pest control in the vineyard involves cultural practices correlated with pesticides application [6]. Soil type and climate variability in the area of grapevine growing require the permanent adaptation of cultivation technologies [8]. The expenses with the inputs in the viticulture are very high, especially those designated to the chemicals for diseases and pest control, reason for which they have to be managed very well, in accordance with the climate

during the growing season, sensitivity of the cultivated variety to diseases and pests, the yield destination and not least, the technical and financial possibilities of each vineyard and winery [10]. The control of pathogens and pests is very important economically since the harvest can be severely affected concerning the grape yield and quality [2].

Material and Method

The research was carried out during 2018-2019, in a vineyard at the beginning of the full maturity age located on Dealul Silagiului, Timis County. The planting distance is 2.2 m inter-rows rows and 1 m between vines per row. The research focused on four wine grape varieties (Merlot, Cabernet sauvignon, Feteasca neagra and Feteasca regala) and two table grapes varieties (Victoria and Muscat of Hamburg). The selected varieties have different resistance, to can observe the influence and efficiency of treatment schemes for pathogens and pest control. Climate in 2018 was favourable for grapevines growing while 2019 with the excess of precipitation between May-July was unfavourable for grape and wine yield and quality.

The research focused on the influence of three different treatment schemes for pathogens and pest control on grape production and quality. Variant 1 -

complex scheme of treatment, including 14 sprinkles with a 5648 lei cost per hectare; Variant 2 – a medium treatment scheme that includes 10 sprinkles with a 4357 lei cost per hectare and Variant 3 - the minimal treatment scheme that includes 8 sprinkles with a 3455 lei cost per hectare. Observations and determinations were carried out on variants and plots for the grape yield, sugar and acidity in the grape juice. The results were statistically analysed using the analysis of variance (ANOVA) method.

Results and Discussions

In 2018, favourable climate during growing season provide in all varieties high grape yield ranging between 15,370 kg / ha in the Victoria variety V₁ variant and 9380 kg / ha in the Muscat Hamburg in V₃ variant / control. The influence of complex chemical treatment influences positive the grape yield (table 1).

Table 1

Results of phytosanitary treatments influence on grape yield in 2018

Variant	Variety	Grape yield kg/ha	Difference to control (kg/ha)	Statistical significance
V ₁	Merlot	12780	2678	***
	Cabernet Sauvignon	11250	1075	**
	Feteasca neagra	11575	1830	***
	Feteasca regala	14850	1570	**
	Victoria	15370	2590	***
	Muscat Hamburg	13290	3910	***
V ₂	Merlot	11525	1423	**
	Cabernet Sauvignon	10585	410	*
	Feteasca neagra	10230	485	*
	Feteasca regala	13775	495	*
	Victoria	13200	620	**
	Muscat Hamburg	11115	1735	***
V ₃ (MT)	Merlot	10102	-	-
	Cabernet Sauvignon	10175	-	-
	Feteasca neagra	9745	-	-
	Feteasca regala	13280	-	-
	Victoria	12580	-	-
	Muscat Hamburg	9380	-	-

	DL 5%	DL 1%	DL 0.1%
Merlot	423.4	799.2	1502.8
Cabernet Sauvignon	399.1	791.4	1493.2
Feteasca neagra	401.3	752.1	1432.9
Feteasca regala	494.3	893.1	1630.2
Victoria	515.2	930.1	1785.2
Muscat Hamburg	484.1	852.3	1591.4

After the complex treatment scheme application, grape yield increased in all varieties with statistical significance differences compared with the control. Yield increase was higher in varieties sensitive to pathogens and pests and lower in more resistant varieties. Production increases in variant V₁ with 3910 kg/ ha in Muscat Hamburg variety and 1075 kg / ha in the Cabernet Sauvignon variety.

In V₂ variant, the medium treatment scheme increases grape yield, but with smaller quantities compared with the control and V₁ variants. Muscat Hamburg was the variety with the highest yield with additional 1735 kg/ha compared to the control, while in Cabernet Sauvignon and Feteasca neagra varieties was registered the lower additional yield.

In 2019, the less favourable decrease the grape yield significantly in all varieties and variants. Grape yield ranged from 14805 kg / ha in the Victoria variety for the V₁ variant and 7135 kg / ha for the Feteasca neagra variety in the V₃ variant. However, the grape yield increases compared to the control when complex treatment scheme was applied during the growing season; within this variant were obtained grape yield increases between 4670 kg / ha in Merlot variety, respectively 2200 kg / ha in Cabernet Sauvignon variety.

Higher grape yield increases compared to the control in V₂ variant, between 2015 kg / ha in Feteasca neagra variety and 1155 kg / ha in Feteasca regala variety respectively. In 2019 grape yield increases were higher in the sensitive varieties Muscat Hamburg,

Feteasca neagra and Merlot, and smaller increases compared to the control in the varieties more resistant

to pathogens and pests, namely Cabernet Sauvignon and Feteasca regala.

Table 2

Results of phytosanitary treatments influence on grape yield in 2019

Variant	Variety	Grape yield kg/ha	Difference to control (kg/ha)	Statistical significance
V ₁	Merlot	11820	4670	***
	Cabernet Sauvignon	10720	2200	***
	Feteasca neagra	10950	3815	***
	Feteasca regala	13950	2530	***
	Victoria	14805	3635	***
	Muscat Hamburg	12720	4400	
V ₂	Merlot	8950	1800	***
	Cabernet Sauvignon	9870	1350	**
	Feteasca neagra	9150	2015	***
	Feteasca regala	12575	1155	**
	Victoria	12950	1780	***
	Muscat Hamburg	9920	1570	***
V ₃ (MT)	Merlot	7150	-	-
	Cabernet Sauvignon	8520	-	-
	Feteasca neagra	7135	-	-
	Feteasca regala	11420	-	-
	Victoria	11170	-	-
	Muscat Hamburg	8350	-	-

	DL 5%	DL 1%	DL 0.1%
Merlot	401.4	752.6	1411.5
Cabernet Sauvignon	363.3	715.4	1385.1
Feteasca neagra	372.9	725.1	1398.7
Feteasca regala	435.4	815.4	1521.3
Victoria	465.1	867.2	1612.1
Muscat Hamburg	421.5	799.3	1453.2

Table 3

Results of phytosanitary treatments influence on grape yield quality in 2018

Variant	Variety	Sugars (g/l)	Acidity (g/H ₂ SO ₄)	Sugars (difference to control, g/l)	Statistical significance
V ₁	Merlot	211	4.3	22	***
	Cabernet Sauvignon	220	4.2	14	*
	Feteasca neagra	222	4.4	18	**
	Feteasca regala	203	4.5	11	*
	Victoria	155	3.4	12	**
	Muscat de Hamburg	172	4.2	20	***
V ₂	Merlot	197	4.7	12	**
	Cabernet Sauvignon	215	4.4	9	*
	Feteasca neagra	216	4.6	12	*
	Feteasca regala	196	4.7	4	-
	Victoria	152	3.7	9	**
	Muscat de Hamburg	165	4.5	13	**
V ₃ (MT)	Merlot	189	5.1	-	-
	Cabernet Sauvignon	206	4.8	-	-
	Feteasca neagra	204	4.8	-	-
	Feteasca regala	192	5	-	-
	Victoria	143	4.1	-	-
	Muscat de Hamburg	152	4.8	-	-

	DL 5%	DL 1%	DL 0.1%
Merlot	7.01	11.92	19.87
Cabernet Sauvignon	8.12	14.21	20.92
Feteasca neagra	8.23	14.56	21.02
Feteasca regala	6.92	11.41	19.1
Victoria	4.71	8.16	15.91
Muscat Hamburg	5.21	9.02	17.11

The climate in the growing season 2018 favoured grapes quality components increase in all varieties; the sugar concentration was very high in all wine grape varieties which allow the classification of wines as superior quality wines. However, variants V₁ and V₂, on which was applied the medium and complete treatment schemes, registered statistically significant differences in sugars concentration compared to the control.

The highest difference for the sugar concentration was registered in the V₁ variant - Merlot variety (22 g

sugar / litre) and the Muscat Hamburg variety (20 g / 1 sugar/litre) respectively (table 3).

In V₂ variant, the differences registered were smaller compared to V₁, but statistical significance, excepting Feteasca regala variety. The varieties considered more resistant to pathogens and pests (Cabernet sauvignon, Feteasca regala, and Feteasca neagra) registered smaller differences for the sugar concentration compared to the varieties considered more sensitive (Muscat Hamburg, Merlot and Victoria).

Table 4

Results of phytosanitary treatments influence on grape yield quality in 2019

Variant	Variety	Sugars (g/l)	Acidity (g/lH ₂ SO ₄)	Sugars (difference to control (g/l))	Statistical significance
V ₁	Merlot	197	4.8	23	***
	Cabernet Sauvignon	211	4.7	16	**
	Feteasca neagra	209	4.6	23	***
	Feteasca regala	193	4.9	18	**
	Victoria	151	3.7	16	***
	Muscat Hamburg	167	4.4	20	***
V ₂	Merlot	186	5.2	12	**
	Cabernet Sauvignon	202	5	7	-
	Feteasca neagra	195	-	14	**
	Feteasca regala	182	5.2	7	*
	Victoria	146	3.9	11	**
	Muscat Hamburg	160	4.6	13	**
V ₃ (MT)	Merlot	174	5.6	-	-
	Cabernet Sauvignon	195	-	-	-
	Feteasca neagra	186	-	-	-
	Feteasca regala	175	5.9	-	-
	Victoria	135	4.5	-	-
	Muscat Hamburg	147	5.1	-	-

	DL 5%	DL 1%	DL 0.1%
Merlot	6.42	11.82	19.14
Cabernet Sauvignon	7.56	12.34	20.06
Feteasca neagra	7.52	12.26	19.87
Feteasca regala	6.11	11.75	18.87
Victoria	4.11	7.92	14.85
Muscat Hamburg	4.92	8.69	17.93

Abundant precipitation and the temperature variability in the first months from the 2019 growing season were unfavourable for grape yield (table 4). In the second half of the growing season, climate was moderate and sugar concentration increase in grape berries, but with smaller quantities compared to the previous year.

The complex treatment schemes for pathogens and pest control provide the best results and statistically significant differences of experimental variants compared to the control variant.

Rainfall, relative humidity, wind speed during grapevine growing season favoured the pathogens onset [17, 7, 9]. On the other hand, dry climate correlated with low temperatures favour the

development of pathogens on grape berries [3]. The application of synthetic treatments for pathogen control before bunch closure decreased slightly the diseases influence on grape yield according to Molitor et al. (2011) [13].

Even pesticides have beneficial effects against diseases and pests, the researchers [12,14] unanimously believe that grapevine growers need to be aware that most are residual, and measures to prevent fruit contamination are needed [1].

Conclusions

The artificial products for diseases and pest control are the inputs with the greatest impact on the grape and wine production costs, but with the greatest influence on the grape yield and quality. The grapevine is one of the most exposed plants to diseases, pest and environmental influences.

The application of an improper or incomplete treatment scheme significantly decreased the grape yield, but especially the quality of grape berries for winemaking.

Due to the climate variability from year to another, can't be developed an universal treatment scheme; the phytosanitary treatments are applied differently from year to year, depending on the temperature and precipitations, grape variety and the purpose to use the grape product. In both years the results of the research have shown the importance of the phytosanitary treatments in the grapevine growing.

The complex treatment scheme was the best choice for increasing grape yield and quality in all wine grape varieties. The differences compared to the control were higher in the varieties sensitive to the diseases and pests compared to the varieties considered more resistant.

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