DIFFERENT LENGTHS OF PRUNING IN VINE CULTIVARS CABERNET SAUVIGNON AND MERLOT IN TIKVESH WINE REGION

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Abstract
Wine grape is cultivar that grows for many years, but every year in the vegetation period creates large number of winter fertile buds from which in the next vegetation new shoots will develop. To keep it's shape, to plan it's yield and growth and also the quality of the wine grape it's necessary to make pruning every year until the start of the vegetation to remove all the unnecessary shoots that developed. Wine grape from the whole assortment in Republic of Macedonia takes place in 70% from the whole grape production.The research is focused on the possibility of using different ways of pruning to have the best results in the yield and quality of the ripped grape and also for introduction of machine pruning and machine harvest. The research is conducted on the wine grape varieties: Cabernet Sauvignon and Merlot. On the two researched grape varieties there are 4 variants on vine training from which one is Control. On the two researched variants and grape varieties, the percentage of developed shoots is calculated, potential fertility, number of clusters per vine and shoot, cluster mass per bud and variant, grape yield per vine and hectare, total sugars and total acids. Results from the research in 2016 for the grape yield per vine and per bud, yield per vine, chemical analysis for sugar content and total acids show that the best variant from the Cabernet Sauvignon is Variant 2, for the Merlot is Variant 3.

Keywords: wine grape, Cabernet Sauvignon, Merlot, vine training, yield.

Introduction

Republic of Macedonia has favorable agrobiological and pedological conditions which can create successful cultivation of different grape varieties such as Cabernet Sauvignon and Merlot used for producing high quality red wine. The grape wine is multi year plant which can be cultivated for 25 - 30 years with good profits. Every year during the vegetation the grape wine produces large number of winter fertile buds from which vine shoots will be developed in the next vegetation. The pruning during the dormant period of the vine is regular ampelotechnical measure which enables yield planning, grape quality and vine shoot growth. Also to keep the vine's shape, removal of all unnecessary shoots that developed the previous season but won't be necessary into the next season should be made. The different ways of pruning gives opportunity to achieve the best results in the yield and quality of the grape whether is short spur, half long (short canes),or cane pruning. The results obtained from the different lengths in pruning will enable us to make a conclusion which variant will be the best to be mechanical (machine) pruned and also machine harvested.

Material and methods

The research is conducted on two wine grape varieties Cabernet Sauvignon and Merlot purposed for production of high quality wines. On the two researched grape varieties there are 4 variants with different vine training from which one is a Standard (Control). The Variants differ each other by the length of the cane. The Standard in the both Merlot and Cabernet Sauvignon is with Double Guyot pruning system with two canes with 10 fertile buds and 2 spurs with 2 fertile buds with total of 24 buds per vine. In both researched vines the Variant 1 is consisted of 8 spurs with 3 buds with total 24

buds per vine. The Variant 2 is consisted of 6 long spurs with 4 buds or total of 24 buds per vine. Variant 3 is consisted of 6 long spurs with 5 buds or total of 30 buds per vine. On all researched variants and both grape varieties, the percentage of developed and fertile shoots is calculated, number of clusters per bud, number of clusters per shoot(relative coefficient of fertility) and number of clusters per fertile shoot (the absolute coefficient of fertility). At every grape variety and variant it's calculated the average mass of grape per bud, average mass of cluster in the researched varieties and average mass of berry for all variants. The yield that is calculated from each variant is showed as grape yield per vine and grape yield per hectare. The chemical composition of the must is showed with the contents of total sugars in g/l and the contents of total acids in g/l for every variant and grape variety. Uvologic researches are conducted by the specifications of prof, d-r Zvonimir Bozinovic (Ampelografija 2010). Total sugars are measured with Oechsle Must meter and read on Saleron - Dijardin table. The total acids are calculated by the method of the neutralisation of all acids and their salts with solution of 0,1 m - NaOH. On the base of the spent solution the quantity of total acids is calculated.

Results and discussion

Several elements for the fertility of the researched grape wine varieties are researched. The results for the percentage of developed shoots for grape variety Cabernet Sauvignon and Merlot are shown in Table 1.

Table 1. Developed shoots in percent

	Variety	Cabernet Sauvignon	Merlot
Variant	bud	Developed shoots in %	
Standard	1	70,00	90,00
	2	95,00	100,00
	3	95,00	95,00
	4	85,00	100,00
	5	90,00	95,00
	6	90,00	95,00
	7	95,00	100,00
	8	90,00	100,00
	9	95,00	95,00
	10	100,00	100,00
Average		*90,50*	*97,00*
Variant 1	1	85,00	90,00
	2	95,00	100,00
	3	95,00	100,00
Average		*91,66*	*96,66*
Variant 2	1	90,00	85,00
	2	80,00	90,00
	3	85,00	100,00
	4	95,00	100,00
Average		*87,50*	*93,75*
Variant 3	1	90,00	85,00
	2	95,00	95,00
	3	85,00	95,00
	4	95,00	95,00
	5	100,00	100,00
Average		*93,00*	*94,00*

The Cabernet Sauvignon has relatively high percentage of developed shoots at all variants and standard with values from 87,50% in Variant 2 to 93,00% in Variant 3. In comparison the Merlot has higher values than the Cabernet per Variants and buds which varying from 93,75% in Variant 2 to

96,66% in Variant 1. The development of sufficient number of shoots per vine is important agrobiological characteristic because during the vegetation period on the shoot will be developed other organs of the vine such as leafs, fertile buds, flowers, clusters and tendrils. The results for the fertile shoots are shown in Table 2.

Table 2. Fertile Shoots in percent

Variant	Variety	Cabernet Sauvignon	Merlot
	bud	Fertile shoots in %	
Standard	1	60,00	65,00
	2	90,00	85,00
	3	85,00	75,00
	4	90,00	50,00
	5	85,00	60,00
	6	80,00	60,00
	7	85,00	60,00
	8	80,00	75,00
	9	90,00	80,00
	10	90,00	95,00
Average		83,50	70,50
Variant 1	1	60,00	55,00
	2	90,00	95,00
	3	85,00	100,00
Average		78,33	83,33
Variant 2	1	80,00	75,00
	2	75,00	80,00
	3	60,00	95,00
	4	80,00	95,00
Average		73,75	86,25
Variant 3	1	80,00	60,00
	2	70,00	75,00
	3	60,00	75,00
	4	85,00	95,00
	5	90,00	100,00
Average		77,00	81,00

The percentage of fertile shoots in the Cabernet Sauvignon grape variety is varying from 60% at the first bud until 85 % at the third, fifth and seventh bud in the Standard, with average of 83,50% or average of 78,33% in Variant 1. Variant 2 has average of 73,75% of fertile shoots and Variant 3 has value of 77,00%. The Merlot has higher percentage of fertile shoots at the upper top buds of the vine. The values are from 81% in Variant 3, 83,33% at Variant 1, until 86,25% in Variant 2. The values in the Standard are from 50-95% or average of 70,50% of fertile shoots. The relative coefficient of fertility (number of clusters per developed shoot) and absolute coefficient of fertility (number of clusters per fertile shoot) are shown in Table 3.

Table 3. Number of clusters per developed shoot and per fertile shoot

Variants	Variety	Cabernet Sauvignon	Merlot	Cabernet Sauvignon	Merlot
	bud	Cluster per developed shoot		Clusters per fertile shoot	
Standard	1	1,18	0,73	1,44	1,07
	2	1,53	1,50	1,64	1,58
	3	1,73	0,81	2,00	1,44
	4	1,30	1,12	1,54	1,58
	5	1,46	1,12	1,69	1,50
	6	1,28	1,17	1,50	1,66
	7	1,35	1,38	1,73	1,66
	8	1,56	1,70	1,78	1,81
	9	1,26	1,70	1,58	1,79
	10	1,50	1,89	1,78	1,89
Average		1,41	1,31	1,66	1,59
Variant 1	1	1,05	1,00	1,38	1,54
	2	1,57	1,50	1,66	1,58
	3	1,73	1,95	1,94	1,95
Average		1,45	1,48	1,66	1,69
Variant 2	1	1,33	1,33	1,50	1,60
	2	1,43	1,31	1,53	1,56
	3	1,47	1,75	1,92	1,84
	4	1,31	1,90	1,56	2,00
Average		1,38	1,57	1,63	1,75
Variant 3	1	1,28	0,83	1,43	1,25
	2	1,14	1,10	1,64	1,40
	3	1,23	1,29	1,61	1,46
	4	1,47	1,42	1,47	1,42
	5	1,65	1,80	1,83	1,80
Average		1,35	1,28	1,59	1,46

The relative coefficient of fertility in the wine grape variety Cabernet Sauvignon in Variant 1 is varying from 1,05 to 1,73 or average of 1,45 clusters per developed shoot. In Variant 2 the average value is 1,38 and in Variant 3 the average number of clusters per developed shoot is 1,35. The relative coefficient of fertility in the Merlot wine cultivar is varying of average value of 1,31 per developed shoot at the Standard, in Variant 1 is 1,48, at the Variant 2 the value is 1,57 and 1,28 clusters per developed shoot in Variant 3. The average number of clusters per fertile shoot in the Cabernet Sauvignon at Variant 1 is 1,66, in Variant 2 the value is 1,63 and at Variant 3 is 1,59 clusters per fertile shoot. The absolute coefficient of fertility is with somewhat higher values at the Merlot variety and varying from 1,69 clusters in Variant 1, with 1,75 clusters per fertile shoot in Variant 2 but with lower values in Variant 3 with 1,46 cluster per fertile shoot. In Table 4 the average mass of grape per fertile bud is shown.

We can mark several differences in the Standard and all the Variants in the Cabernet Sauvignon per buds and the average for the Variants. The values are higher in the higher upper buds on the shoot. There is also similarity in the values of the mass of grape per fertile bud and variant in the Merlot grape variety. The values of the average mass of cluster of the two researched grape varieties are shown in Table 5.

Table 4. Average mass of grape per fertile bud

Variants	Variety	Cabernet Sauvignon	Merlot
	Bud	Average mass of grape per fertile bud	
Standard	1	218	283
	2	196	280
	3	264	290
	4	200	230
	5	268	295
	6	235	275
	7	208	280
	8	250	307
	9	242	225
	10	282	290
Average		236	276
Variant 1	1	246	276
	2	312	292
	3	334	386
Average		297	318
Variant 2	1	248	270
	2	344	300
	3	332	334
	4	316	316
Average		310	305
Variant 3	1	224	236
	2	302	342
	3	346	348
	4	308	342
	5	316	290
Average		299	311

Table 5. Average mass of cluster in g

Variant	Cabernet Sauvignon		Merlot	
	g	index	g	index
Standard	165	100	183	100
Variant 1	152	92	186	102
Variant 2	160	97	179	97
Variant 3	169	102	184	101

The average mass of the grape cluster of Cabernet Sauvignon is varying from 152 g in Variant 1, at 160 g in Variant 2 until 169 g in Variant 3. The Merlo has higher values in all variants and can be from 179 g in Variant 2, 184 g in Variant 3 until 186 g in Variant 1. The values compared with the Standard for both varieties are also shown as indexes. In table 6 the values for the average berry mass are shown.

Table 6. Average berry mass in g

Variant	Cabernet Sauvignon		Merlot	
	g	index	g	index
Standard	1,16	100	1,69	100
Variant 1	1,09	94	1,63	96
Variant 2	1,08	93	1,70	100
Variant 3	1,26	108	1,76	104

In the Cabernet Sauvignon the average mass of berry is from 1,08 g in Variant 2, 1,09 g in Variant 1 until 1,26 g in Variant 3. In the Merlot the average mass of the berry is from 1,63 g in Variant 1,

Variant 2 is 1,70 g and 1,76 g in Variant 3. Also the indexes are shown in comparation with the Standard for both grape varieties. The quantity of the harvested grape is important technological characteristic because for cultivating grape the main target is to have optimal and quality yield Bozinović (2010), Hristov 2010). The results from the quantity of harvested grape from the wine cultivar Cabernet Sauvignon is in Table 7 in kg per vine and per hectare.

Table 7. Harvested grape in kg

Variant	Cabernet Sauvignon		Merlot	
	Kg/vine	Kg/ha	Kg/vine	Kg/ha
Standard	3,040	14.072	3,040	14.072
Variant 1	3,155	14.604	3,410	15.784
Variant 2	2,940	13.609	3,240	14.997
Variant 3	2,955	13.678	3,350	15.507

The yield in the Cabernet is varying from 2,940 kg per vine or 13.609 kg/hectare in Variant 2. Variant 3 has values from 2,955 kg per vine or 13.678 kg/hectare. The highest yield is registered in Variant 1 with value of 3,155 kg per vine or 14.604 kg/hectare. At the Merlot wine grape variety higher values per vine and per hectare are recorded in all Variants in comparison with the Cabernet Sauvignon. The quantity of harvested grape is varying from 3,240 kg per vine in Variant 2 or 14.997 kg/hectare. In Variant 3 the values are 3,350 kg per vine or 15.507 kg/ha. The highest yield per vine is 3,410 kg and 15.784 per hectare measured in Variant 1.
The chemical composition of the grape must is shown in Table 8 with sugar content shown in g/l or total acids shown in g/l.

Table 8. Chemical composition of grape must (g/l)

Variant	Cabernet Sauvignon		Merlot	
	Sugar g/l	Total acids g/l	Sugar g/l	Total acids g/l
Standard	218	5,78	228	4,95
Variant 1	236	4,95	226	4,60
Variant 2	220	5,55	230	4,80
Variant 3	210	5,40	234	4,50

The values for the sugar content in the grape must in the Cabernet grape wine variety is varying between variants. In Variant 3 the sugar content is 210 g/l, Variant 2 is 220 g/l but highest value has Variant 1 with 236 g/l. The results in the Merlot are from 226 g/l in Variant 1, 230 g/l in Variant 2 and 234 g/l in Variant 3. The total acid contents in the Cabernet Sauvignon is in the values from 4,95 in Variant 1, 5,40 g/l in Variant 3 and 5,55 g/l in Variant 2. In the Merlot grape variety lower values are measured for the total acid contents which are from 4,50 g/l for Variant 3, 4,60 g/l for Variant 1 until 4,80 g/l for Variant 2.

Conclusions

Republic of Macedonia has favorable condition for cultivating quality grape wine varieties for making high quality wines. The applications of different Variants gave specific differences in the researched results. In the Cabernet Sauvignon grape variety in Variant 3 are received the highest values with 93% for developed shoots, and in Merlot variety it is the Variant 1 with 96,66%. The highest percentage of fertile shoots is received at Variant 1 with 78,33% in the Cabernet Sauvignon grape variety and in the Merlot grape variety is the Variant 2 with 86,25%. The average mass of grape per bud in grams in the grape wine cultivar Cabernet Sauvignon has lowest values in Variant 1 from 297 g and highest value at Variant 2 with 310 g per bud. In Merlot the lowest value is measured in Variant 2 with 306 g per bud and highest at Variant 1 with 318 g per bud. The highest average mass of cluster in the Cabernet Sauvignon is with lowest value at Variant 3 (169 g) and in Merlot grape wine variety the highest value in Variant 1 with 186 g. The average mass of berry in Cabernet

Sauvignon is with lowest value in Variant 2 with 1,08 g, the highest in Variant 3 with 1,26 g. In the Merlot wine grape variety the highest value of the average mass of berry is measured in Variant 3 with 1,76 g. The quantity of harvested grape in the grape wine Cabernet Sauvignon is with lowest value in Variant 2 with 2,940 kg/vine, but highest value in Variant 1 with 3,155 kg/vine or 14.604 kg/ha. At the Merlot wine grape the lowest value is measured at Variant 2 with 3,240 kg/vine and highest in Variant 1 with 3,410 kg/vine or 15.784 kg/ha. In both of the researched grape varieties the content of sugar in grape must is with higher values and its varying with 210 g/l at Variant 3 to 236 g/l in Variant 1 in the Cabernet Sauvignon. At the Merlot wine grape variety the content of sugar is in limits of 226 g/l in Variant 1 to 234 g/l in Variant 3. Total acids content in Cabernet Sauvignon wine grape variety is measured between 4,95 g/l in Variant 1 to 5,55 g/l in Variant 2. In the Merlot wine grape variety the content of total acids is in limits from 4,50 g/l in Variant 3 to 4,80 g/l in Variant 2.

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