

INFLUENCE OF POTASSIUM FERTILIZATION ON SHOOT GROWTH AND MATURITY INDICATORS OF CV. SAUVIGNON BLANC (*VITIS VINIFERA* L.)

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ABSTRACT

Research were carried out at vineyard on Experimental station "Radmilovac" on Faculty of Agriculture in Zemun on cv. Sauvignon blanc. In experiment was used potassium fertilization in following treatments: control (without fertilization) and treatments with fertilizer were it used doses of 50, 100 and 150 kg K₂O/ha. During the first research year, the largest shoots growth (99.3 cm) was recorded with application of 150 kg K₂O/ha doses and the lowest in control treatment (74.7 cm). Shoots maturity was more favorable with increasing doses of potassium fertilizer in relation to the control treatment. In the second year, continued the same trend where again the largest increase was recorded in treatments with the highest dose and the lowest increase of 12.2% was recorded in control. In the third year of treatment with 100 and 150 kg K₂O/ha realized the largest increase with differences of 16.5% and 28.3% compared to control. The highest degree of shoots maturity was achieved with a dose of 150 kg K₂O/ha (95.06%), slightly lower in the treatment with 100 kg K₂O/ha (86.07%) and the lowest in control (87.30%).

INTRODUCTION

Potassium play a very important role in grapevine nutrition and metabolism. According to quantity in plant tissues potassium is located just behind nitrogen. It is known that vine needs for potassium is large. Potassium play an important role in osmotic and ionic balance, electrochemical processes in the cell, neutralizing excess of organic acid, synthesis and metabolism of proteins and carbohydrates, cell division, photosynthesis, regulation of osmotic pressure in the cell, opening and closing stomata and play very important role in shoots maturation and adequate preparation of vine for dormancy period (Jackson, 2008). Potassium is assimilated in the form of K⁺ ions and transported to higher plant parts through phloem. Potassium deficiencies is manifest by leaves chlorosis and edges of older internodal leaf parts and can be compensated with adequate application of potassium fertilizers. Potassium influence can also expressed on cluster size, yield and berries coloration (Bavaresco et al., 2010).

Potassium level in soil dependent on numerous factors that interact with each other. The most important is mineral content in soil, fertilization, humus content, pH, soil humidity, temperature, microbiological activity of root system etc. (Ličina, 2009).

Needs for potassium during growing season continuously increase. So, accumulation of potassium in leaves and shoots increased until august but increasing in grapes depends on the variety, is to mid august. Increasing dose of potassium fertilizer influence increasing leaf mass and shoot length, which is reflected in level of mature shoots part (Markovic, 1998, 2012).

MATERIAL AND METHOD

The research was done at experimental vineyard "Radmilovac"-Faculty of Agriculture in Belgrade on Sauvignon blanc which was grafted on rootstock Berlandieri x Riparia Kober 5BB. Experimental vineyard was built on a gentle slope of the southern exposure. The lines extending in the direction of south-west with row spacing of 3 m and spacing between vines in the row of 1 m. Type of soil in the vineyard is eutric cambisol. Training system is double asymmetric cordon. The experimental design was complete

block design where each treatment in the eighteen vines which are arranged in three replications with six vines. In experiment each year was applied potassium fertilizer in following treatments (we used 50% KCl): control (no fertilization) treatments with fertilizer doses of 50, 100 and 150 kg K₂O/ha. Nitrogen was also added in amount of 30 kg N/ha and phosphorus in amount 50 kg P₂O₅/ha. The shoot growing was measured from intensive growth until shoot growth termination at autumn. Proportion of matured shoots was measured from moment of first signs of maturation at the base of the shoots.

RESULTS AND DISCUSSIONS

The shoot growth in the first, second and third year of research occur with different intensity. During the first year of research was the smallest shoot growth. Immediately after grafts planting, their growth was initially developed slower. From beginning of June to end of August was more intensively and after slow down again. Reason for slow growth in period May-June can be weather conditions that prevailed in period from planting to beginning shoots growing. In fact, in this period there are very high temperatures and practically no precipitations. Additionally late start of shoot growth in the first year after planting is caused by fact that it requires some time to establish contact with root system and soil and restoring function roots after planting.

Different doses of potassium expressed differences in shoots growth. The biggest shoot increase (table 1) in the first year of research was at treatment with 150 kg/ha K₂O (99.3 cm) and the lowest at control (74.7 cm).

Table 1.

Dynamics of shoots growth in the first year of research (cm)

Shoot length (cm)				
Date	Control	50 kg/ha K ₂ O	100 kg/ha K ₂ O	150 kg/ha K ₂ O
26.V	8,1	7,4	7,3	9,8
9.VI	12,0	12,3	15,5	15,5
23.VI	14,9	17,6	18,4	21,1
8.VII	29,6	31,7	26,8	35,5
21.VII	44,0	44,6	41,6	47,0
29.VII	50,4	51,0	57,0	59,6
22.VIII	66,0	64,7	72,0	79,4
31.VIII	70,6	72,9	77,4	86,8
12.IX	71,7	73,3	81,5	94,2
22.IX	73,8	78,9	84,6	97,8
31.IX	74,7	81,6	85,4	99,3
Total shoot length (%)	100	109,24	114,32	132,93

It was found that there was no significant difference in shoot growth between treatments. Beginning of shoot maturation in all experiment years was detected in mid August.

Table 2.

Dynamics of shoot maturation in first experimental year (cm)

Parameter	Date	Control	50 kg/ha K ₂ O	100 kg/ha K ₂ O	150 kg/ha K ₂ O
Dynamics of shoot maturation	10.VIII	4,8	7,2	9,0	12,1
	20.VIII	9,6	10,7	12,1	16,3
	1.IX	14,1	12,0	15,3	18,7
	12.IX	16,8	14,2	18,7	20,4
	22.IX	27,4	27,0	31,3	37,0
	1.X	35,6	38,8	50,8	49,3
	15.X	44,0	56,0	67,4	73,6
	2.XI	45,8	60,3	69,3	84,8
Mature	Cm	45,8	60,3	69,3	84,8
Immature	Cm	28,6	15,8	13,6	8,7
Mature	%	37,56	73,8	80,38	89,75
Immature	%	62,44	26,20	19,62	10,25

In tables 2 and 3 it can be seen that there is significant reduction in mature shoots part in control compared with fertilization treatments with 50, 100 and 150 kg/ha K₂O, which is in correlation with the total shoot length. Based on this, we can say that in the control (no fertilizer treatment), maturity shoot was very weak, and that in all fertilizing treatments shoots maturity was very well.

Table 3.

The significance of shoot maturation during the first year of research

Treatment	Mean	Control	50 kg/ha K ₂ O	100 kg/ha K ₂ O
150 kg/ha K ₂ O	84,8	39,0**	24,5**	15,5**
100 kg/ha K ₂ O	69,3	23,5**	9,00**	
50 kg/ha K ₂ O	60,3	14,5**		LSD _{0,05} =4,3286
Control	45,8			LSD _{0,01} =5,8051

During the second year of research were conducted shoot growing was intensively from early may to late august and then slowed down until late september (table 4).

Table 4.

Dynamics of shoots growth in the second experimental year (cm)

Shoot length (cm)				
Date	Control	50 kg/ha K ₂ O	100 kg/ha K ₂ O	150 kg/ha K ₂ O
20.IV	2,6	3,2	4,2	4,7
1.V	7,2	8,4	9,0	9,5
10.V	15,8	17,1	18,2	18,9
20.V	31,5	33,4	35,7	38,9
30.V	59,9	57,8	61,8	64,2
10.VI	88,4	86,9	103,7	117,4
22.VI	122,0	113,7	136,1	151,8
2.VII	147,5	153,1	177,7	188,3
12.VII	179,0	182,2	210,6	221,6
2.VIII	218,4	242,8	241,2	258,2
20.VIII	230,0	246,6	248,7	261,8
2.IX	240,3	252,6	253,6	265,9
12.IX	251,9	265,9	256,0	270,4
22.IX	253,6	269,7	257,1	278,2
3.X	254,0	272,0	259,2	282,5
Total shoot length (%)	100,00	107,08	102,08	112,22

The highest increase in shoot length was recorded in treatment with 150 kg/ha K₂O (282.5 cm) and the lowest in control treatment (254 cm), which was manifested also in the first research year. In relation to shoots length in control treatment, shoots in treatment with 150 kg/ha K₂O achieved bigger length for 12.2%.

When it comes to the length of mature shoots part during the second research year shows a similar situation as in the first year. In the control treatment mature shoot parts was less in comparison to other treatments, which was in correlation with shoots length. Difference in the length of immature shoots part between treatments was from 8-16 cm.

Table 5.

Dynamics of shoot maturation in second experimental year (cm)

Parameter	Date	Control	50 kg/ha K ₂ O	100 kg/ha K ₂ O	150 kg/ha K ₂ O
Dynamics of shoot maturation	20. VII	3,5	5,8	5,0	5,3
	1.VIII	11,6	15,8	14,1	15,0
	15.VIII	27,7	33,3	28,6	31,4
	1. IX	72,8	82,3	76,0	79,9
	15. IX	121,3	142,4	126,5	153,6
	2. X	182,5	200,3	189,1	210,6
	15. X	200,7	230,2	205,6	220,3
	1. XI	226,3	240,8	230,2	238,6
	15. XI	230,8	246,5	238,4	241,3
Mature	cm	230,8	246,5	238,4	241,3
Immature	cm	24,0	23,5	26,3	31,9
Mature	%	89,64	90,47	88,97	86,78
Immature	%	10,36	9,53	11,03	13,22

From data from table 5 can be seen that level of shoots maturity in all treatments was satisfactory. The smallest percent of mature part was in treatment with 150 kg/ha K₂O (86.78%), slightly higher in treatment with 100 kg/ha K₂O and in control (88.97% and 89.64%) and the highest in treatment with 50 kg/ha K₂O (90.47%).

In the third year of research have been more expressed differences in shoots growth and maturation between treatments. Results are shown in table 6. The highest shoots increase was in treatment with 100 kg/ha K₂O and 150 kg/ha K₂O with high statistical significance compared to other treatments (table 7).

Table 6.

Dynamics of shoots growth in the third experimental year (cm)

Shoot lenght (cm)				
Date	Control	50 kg/ha K ₂ O	100 kg/ha K ₂ O	150 kg/ha K ₂ O
18. IV	2,5	3,9	5,1	4,7
27. IV	10,2	12,1	15,2	14,0
5. V	18,6	20,8	28,7	25,6
16. V	28,9	31,0	42,6	39,8
30. V	48,2	54,0	82,5	70,3
13. VI	90,6	100,8	150,0	120,7
28. VI	146,8	153,7	162,4	149,6
13. VII	179,7	194,2	178,4	188,3
30. VII	205,8	236,2	259,0	243,7
15. VIII	248,7	276,4	339,0	286,4
5. IX	290,1	300,4	364,3	342,6
25. IX	295,7	308,6	385,8	352,9
10. X	304,0	313,2	390,1	354,0
5. XI	305,9	315,0	392,4	356,4
Total shoot length (%)	100,00	102,97	128,27	116,50

Differences compared to control range from 16.5 to 28.3%. Intense growth happened from early may to early September and then slowed down to october.

Table 7.

The significance of shoot growing during the third year of research

Treatment	Mean	Control	50 kg/ha K ₂ O	100 kg/ha K ₂ O
150 kg/ha K ₂ O	392,40	86,50**	77,40**	36,00**
100 kg/ha K ₂ O	356,40	50,50**	41,40**	
50 kg/ha K ₂ O	315,00	9,10		LSD _{0,05} =16,9728
Control	305,90			LSD _{0,01} =24,6937

In the third year of research achieved the highest shoots length in comparison to vine age and the maximum length of matured shoots part. Analysis of variance (table 9) showed that control had a significantly smaller part of matured shoots in relation to treatment with 50, 100 and 150 kg/ha K₂O. These values are also in proportion to the total length of shoots.

Table 8.

Dynamics of shoot maturation in third experimental year (cm)

Parameter	Date	Control	50 kg/ha K ₂ O	100 kg/ha K ₂ O	150 kg/ha K ₂ O
Dynamics of shoot maturation	15.VII	2,6	4,2	6,7	5,4
	1. VIII	7,2	9,8	18,6	15,6
	15. VIII	19,0	25,9	44,8	39,0
	1. IX	67,2	74,8	86,3	94,2
	15. IX	110,2	122,6	175,0	180,2
	30. IX	175,0	181,6	208,2	204,3
	15. X	230,1	236,2	268,2	258,3
	5. XI	270,8	287,4	344,4	339,6
Mature	Cm	270,8	287,4	344,4	339,6
Immature	Cm	34,4	27,7	48,0	16,8
Mature	%	87,3	90,37	86,07	95,06
Immature	%	12,7	9,63	13,93	4,94

Observing percentage of shoots maturity can be noticed that it was somewhat lower in the treatment with 100 kg/ha K₂O in the control (below 90%), while in other treatments over 90%. The highest degree of maturity was noticed in treatment with 150 kg/ha K₂O (table 8). The significance for matured shoots part are shown in table 9.

Table 9.

The significance of shoot maturation during the third year of research

Treatment	Mean	Control	50 kg/ha K ₂ O	100 kg/ha K ₂ O
150 kg/ha K ₂ O	344,4	73,6**	57,0**	4,8
100 kg/ha K ₂ O	339,6	68,8**	52,2**	
50 kg/ha K ₂ O	287,4	16,6*		LSD0,05=15,2083
Control	270,8			LSD0,01=20,3957

CONCLUSIONS

After research can be conducted the following conclusions:

- Growth of shoots in the first year was conducted to different intensity. Immediately after planting grafts increase initially developed in slow motion. From the beginning of June to end of August was carried much more intense and then slow down again. This dynamic growth is caused by the weather conditions that prevailed in the period from planting to the end of growing season and thus the grafts after planting;
- In the first year higher growth was achieved in treatment with 150 kg/ha K₂O (99.3 cm) compared to the control (74.7 cm). Percent of matured shoots part was more favorable in treatments with increasing potassium doses compared to control;
- The biggest shoots growth in the second year of study was recorded in treatment with 50 kg/ha K₂O, and the lowest in control. Percent of shoot maturity was very good and varied from 86.78% (treatment with 150 kg/ha K₂O) to 90.4% (treatment with 50 kg/ha K₂O).
- In the third year have been more expressed differences in growth and shoots maturation between treatments. The highest increase was recorded in treatments with 100 and 150 kg/ha K₂O, where differences compared with control range from 16.5 to 28.3%. The highest degree of shoot maturity was achieved in the treatment with 150 kg/ha K₂O (95.06%), and slightly lower in treatment with 100 kg/ha K₂O (86.07%) and control (87.3%).

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