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FOLIAR FERTILISER INFLUENCES THE YIELD AND QUALITY OF VRANAC VARIETY GRAPES IN A ĆEMOVSKO FIELD

SUMMARY

Earlier research results on the influence of foliar fertilizers on yield and quality of Vranac variety grapes are confirmed. This paper describes the results of 11 preparations of foliar fertilisers and their impact on the yield and quality of the Vranac variety grapes in the plantations of grapes in a Ćemovsko field. The plantation is 30 years old. Planting shape of the vines is a bifurcated horizontal cordon with a 70 cm high trunk. The experimental parcel is 0.13 ha. The planting distance is 2.6 x 0.8m. Vines are staked in rows on five support lines running in an east-west direction.

The following preparations studied: Wuxal boron, Wuksal ferro, Wuxal super, Cvetal bor, Cvetal kalcijum, Cvetal željezo, Vitastemin, Mortonicj plus, Multi K-Mg, Magnisal, Haskon M10 AD. Altogether, there were 12 control group without foliar fertiliser group and 15 vines per treatment with three reiterations of five vines each.

The basic aim of this research was to determine which of the foliar fertilisers would show the most optimal influence on quantity and quality of grape yield, on pheno phases of growth and on other indicators of fertility.

The most positive effect (statistically significant) on grape yield compared to the control was seen for the Wuxal boron, Cvetal bor, Magnisal and Multi K-Mg preparations.

Group with the smallest and the largest grape yield were identified. The smallest grape yield per vine, at 4.62 kg, was group number 5, which was top dressed with Cvetal Ca. The highest yield per vine, at 7.17 kg, was group 1, which was top dressed with Wuxal boron, followed by group 4 at 6.78 kg, top-dressed with Cvetal bor. Group number 10, which was top dressed with Magnisal, had a yield of 6.48 kg.

The preparations that showed the highest (statistically confirmed) economic effect in grapes yield were Wuxal boron, Cvetal bor and Magnisal.

Key words: foliar fertilisers, Vranac variety, grape yield and quality

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INTRODUCTION

In contemporary viniculture production, fertilising is one of the most important agro technical measures. In line with other operations, it needs to provide high and profitable production of quality grapes.

Nutrition through the root is without a doubt of primary importance for the growth and development of plants; that is, their production, which is measured by the quantity of yield.

However, the previous year's nutrition through the leaves has become an interesting topic for scientific workers as well as in practical agriculture.

Nutrition through the leaves is important because it provides the plant with necessary nutrients when some disorder of their nutrition arises from soil solution either because of lack of nutrients or because of immobilisation or antagonism of the nutrients within the soil.

This method of fertilisation provides faster absorption of mineral elements and their immediate influence on movement of material within cells, resulting in harmonious nutrition and maintenance of the necessary balance of ions in the plant cell.

Feeding fertiliser, especially microelements, through the leaves is very important because the effects occur with the use of less mineral matter.

Knowing those facts, the place and role of foliar fertilisers is clear: It completes basic nutrition occurring through the soil, thereby becoming an integral part of the nutritional system of the vines in the intensive agricultural production.

MATERIAL AND METHOD

The experiment was conducted in AD Plantaže 13 Jul in the Ćemovsko field near Podgorica. All testing was done on the Vranac grape variety, which was grafted onto the stock vine Paulsen 1103. Vines were old, but mid lush. The experiment was conducted at the end of April 2010.

The Vranac grape is a premium quality wine variety that is considered a domestic autochthonous variety. It has a leading position in the structure of wine varieties in Montenegro. Important technological and organoleptic characteristics of Vranac grapes are: sugar content 20-24%, total acid content 5-7 gr/l, as well as a mild coloration of the grape must. The skin is rich with coloured matter. This variety gives a high quality premium wine, very coloured, harmonious and with a specific variety taste. High quality Loza brandy is also made from these grapes.

Base Paulsen 1103 is very good vine base that shows good affinity with different varieties. It is especially good in vineyards with long cultivating shapes. It is tolerant of drought and salinized soil, and is quite resistant to nematodes, cryptogam diseases and root phylloxera.

The basic pruning in the experimental year was done in the second half of November. Pruning was mixed, and the burden was 30 buds per vine.

In the testing year, the basic fertilisation was not performed. Top dressing was conducted with Kristalin formulation 5-16-36 through a drip system in the

amount of 90 kg per hectare: the first time in May (50 kg), and the second time in July (40 kg).

Vineyard protection measures during the vegetative growth were taken in order to prevent excoriosis, grape powdery mildew, grape downy mildew, grape moth, grape rot and so on, for a total of 15 sprayings in a year.

From March to July, three circles of inter row cultivation were done, and each row was covered.

Chemical weeds destruction was done from March to August. In addition, mechanical weeds suppression was done, from the half of June until the half of July in the testing year, with a manual scythe.

The experimental vineyard was watered by a drip system, in June, July and August, on average, every 15-17 days for four hours.

The experimental parcel is 0.13 ha. Foliar fertilisers were applied to eleven groups, and the twelfth group – a control received no fertiliser topdressings.
The following fertilisers were used:

1. Wuxal boron (8%N, 8%P and microelements: B, Cu, Fe, Mo, and Zn).
2. Wuksal ferro (5% Fe, l 5% N).
3. Wuxal super (8% P, 6% K, and microelements: B, Cu, Mn, Mo, and Zn).
4. Cvetal bor (15%N, 15% P, 10%K, and microelements: B).
5. Cvetal kalcijum (10% N, 15% Ca, 2% Mg, and microelements: B, Zn, Fe, Cu, Mn, Mo, and vitamin B1).
6. Cvetal željezo (10%N, 20%K, and microelement: Fe).
7. Vitastemin (auxin, cytokinin, gibberellin, free amino acids, organic acids and their derivates, ABA and saturated aliphatic hydrocarbon).
8. Mortonicj plus (19%N, 9%P, 27%K, Mg and microelements: Fe, Mn, Zn, Mn, B, Mo, Co, Cu).
9. Multi K-Mg (12, 5%N, 43%K, 2% Mg).
10. Magnisal (21%N, and 25% Mg).
11. Haskon M10 AD (15%P, 20% K, and microelements: B, Mn, and Mo.
12. Control (no foliar top dressing).

Each group consisted of 15 vines, spread in three repetitions, with 5 vines each.

Top dressing through the leaves was done with a 0.3% dilution of the chosen fertilisers. The first top dressing was done ten days before blooming, the second one approximately 10 days after blooming and the third one in the SARKA phase.

All top dressings were done in the early morning hours in calm and cloudy weather, with no precipitation. All top dressings were done by back hand pump; the control group was sprayed ordinary water.

Experimental measurements consisted of the following indicators: grape yield per vine, and quality indicators: i.e. sugar content and acidity in grape juice.

In addition, the following agrochemical parameters were measured: soil pH (active with H_2O and potential acidity with 1N KCl), total carbonates using

Scheibler's method with a calcium standard, humus per Kotzmann's method and accessible potassium and accessible phosphorus according to Egner-Riehm's method. Content of accessible forms of Fe, Zn, Mn and Cu were determined by atomic absorption spectrophotometry, using a DTPA (diethyl-triaminopentaacetate) method, and boron content, after extraction by boiled water, was measured colorimetrically with cucurmin.

Analyses of variance were used to determine significant differences between the examined factors. Statistical significance between special treatments for the examined factors was determined by the LSD test (Fishers Least Significant Difference), with significance levels of 0.05 and 0.01.

The soil in the study area is a cement-brown Mediterranean soil. Based on its features and general appearance, it lies between ruddle and brown soil on different bases. The soil is formed on quaternary, fluvial, glacial, rocky-gravelly sediments of different content and great power.

Mechanical content as well as basic agro-chemical parameters of the soil in the Tuzi vineyard were determined and their average values are given in Tables 1 and 2.

The soil tested conducted for the Tuzi vineyard showed that it belongs to the group of highly skeletal soils. On average, for the layer up to 60 cm, it consists of about 60% skeletal soil (Perović, N, et al., 2003).

In our experiment, the content of skeletal was not determined, but we focused on studying the mechanical content in small sample of the soil.

Table 1. Mechanical analyses of soil surrounding the experimental vines (%)

Place Tuzi	Depth (cm)	Size of particles in mm				Total	
		2-0,2	0,2-0,02	0,02-0,002	<0,002	Sand	Clay
	0 – 30	18.96	26.05	26.88	28.11	45.01	54.99
	0 – 30	23.21	28.27	24.06	24.46	51.47	48.53
Average		20.96	27.16	25.47	26.28	48.24	51.76
	30 – 60	45.73	25.02	12.75	16.50	70.75	29.25
	30 – 60	55.03	20.83	11.47	12.66	75.86	24.14
Average		50.38	22.92	12.11	14.58	73.30	26.69

Table 1 shows that the soil of the upper layer has an equal content of sand and clay, while the bottom layer is predominantly rough and fine sand. These data agree with analyses conducted by Perović, N. et.al (2001).

The high content of skeletal, soil, as well as particles of sand in the soil of Ćemovsko field, enables good warming of the soil during the day, and especially gradually decreases in temperature during the night. According to the research by Burić, D. and Mijović, S (1996), this has a positive effect on the sap movement within the vine grapes, which causes faster ripening, and at the same time, good quality grapes. According to Perović, N. et.al (2003), the high content of skeletal soil and the modest representation of the so-called active fraction of the soil in

the Ćemovsko field would be expected to lead to faster migrations and bigger losses of nutrition from the soil. The low clay content makes this soil permeable, so there is no problem of water retention. On the other hand, this contributes to the process of nutrition leaching from the soil.

In addition to the mechanical content of the soil, basic agro-chemical parameters were analysed.

Table 2. Basic agro chemical parameters of the soil surrounding the experimental vines

Place	Depth (cm)	pH (H_2O)	pH (1N KCl)	Tot. Carb. (%$CaCO_3$)	Humus (%)	Accessible (mg/100g)	
						P_2O_5	K_2O
Tuzi	0–30	7.79	7.25	35.7	3.58	5.0	21.7
	30–60	8.01	7.65	76.8	1.25	2.6	6.3

Table 2 shows the agro chemical characteristics of the soil at depths of the root system of 0-30 and 30-60 cm.

Agro-chemical analyses were conducted fractions of the soil less than 2mm, by standard methods.

Table 2 indicates that the soil under the experimental vines was alkaline, especially in the lower layer; the pH in KCl was 7.25 for the upper layer and 7.65 for the lower layer, while in water suspensions these values were 7.79 – 8.01.

Such extremely high values for calcium carbonate are hazardous due to the immobilisation of nutrients, which can cause chlorosis (Perović, N. 1991, 2003). According to the research of this author, the content of active carbonates in the soil of Ćemovsko field is relatively low: 4.33%. This parameter was not analysed in this experiment.

The content of humus in the upper layer is at the optimal level, while the lower layer is poorly humic.

The concentration of easily-accessible phosphorus was poor in both soil layers. Topalović, A. et al (2003) determined that phosphorus in Ćemovsko field is negatively correlated with calcium, because it mainly comes from $CaCO_3$. According to the same author, this important negative correlation is probably artificial, and is a consequence of complementarities of the main components of sediment: limestone, clay, organic substances, oxides and hydroxides of metals.

The content of accessible potassium in the soil is of special importance for normal growth and fruiting, as well as for grape quality. In our research, the soil of the upper layer is rich in accessible potassium while the lower one is poor.

This rapid decrease in soil fertility is the result of an imbalance caused by elements being taken up by the vine and reimbursed by fertilising. Perović, N (2001) states that application of potassium fertilisers has consequently increasing the content of all carbonates. Their content increases with increased doses of potassium.

The content of accessible Ca, Mg, sulphur and microelements in the soil before the start of the experiment is also a very important factor, and shortages can eventually be overcome by addition of fertiliser by summer top dressing (Rotim, N. 2009).

Table 3. Agrochemical analyses of the content of some macro and micro elements in the soil before the experiment started

Cu	Zn	Mn	Fe	$S0_4^{2-}$	B	Ca	Mg	Ca/Mg
Ppm						mg/100 gr		mekv.
5.0	1.1	9.4	3.9	20.0	0.22	1410	20.0	44.1 : 1

Table 3 shows that the content of accessible magnesium is high: 20 mg/100 g, but the ratio of Ca:Mg is unfavourable: 44.1 : 1. Perović, N (1996) in her research states that the application of larger doses of potassium fertilisers, aimed at realising high and stable yields of Vranac grapes in the conditions of skeletal carbonated soil, has to be followed by intake of a certain quantity of magnesium. Šaćeragić, B (2009) states that an excessive content of calcium adversely affects the plant supply of potassium, magnesium, iron and microelements, especially boron.

The sulphur content is 20 ppm (parts per million). This is considered adequate.

Accessible iron content is very low: 3.9 ppm. According to Topalović, A. et al (2003), the soil of the "Tuzi" site , where our experiment was conducted, has the lowest content of accessible iron compared to other sites in Ćemovsko field.

Mobile manganese is on the level of a middle supply: 9.4 ppm, as is accessible zinc: 1.1 ppm. The content of accessible boron is also very low: 0.22 ppm. According to Kerin, D (1970), an average of 100-300 g of boron is taken out from 1 ha annually, and about 259 g is leached. Thus, the analysed vineyard, which is 29 years old, should show a considerable lack of this microelement. In connection with this, there is a real danger of the appearance of deficiency symptoms. However, none of the organs of the vines showed any marked symptoms of a lack of boron. According to the research of Perović, N. et al. (2001), between contents of water-dissolved boron on the one hand, and pH and KCl on the other, a significant negative correlation is established, which means that movement of this micro element decreases as total carbonate and pH increase. Trandafilović, V (2009) also states that a lack of boron can be compensated by foliar nutrition at concentrations from 0.2 to 0.5 %, which is especially recommended for lime soils, because lime is known to bind boron and inactivate its uptake in lime soils. Spraying of the leaves is done before and after blooming.

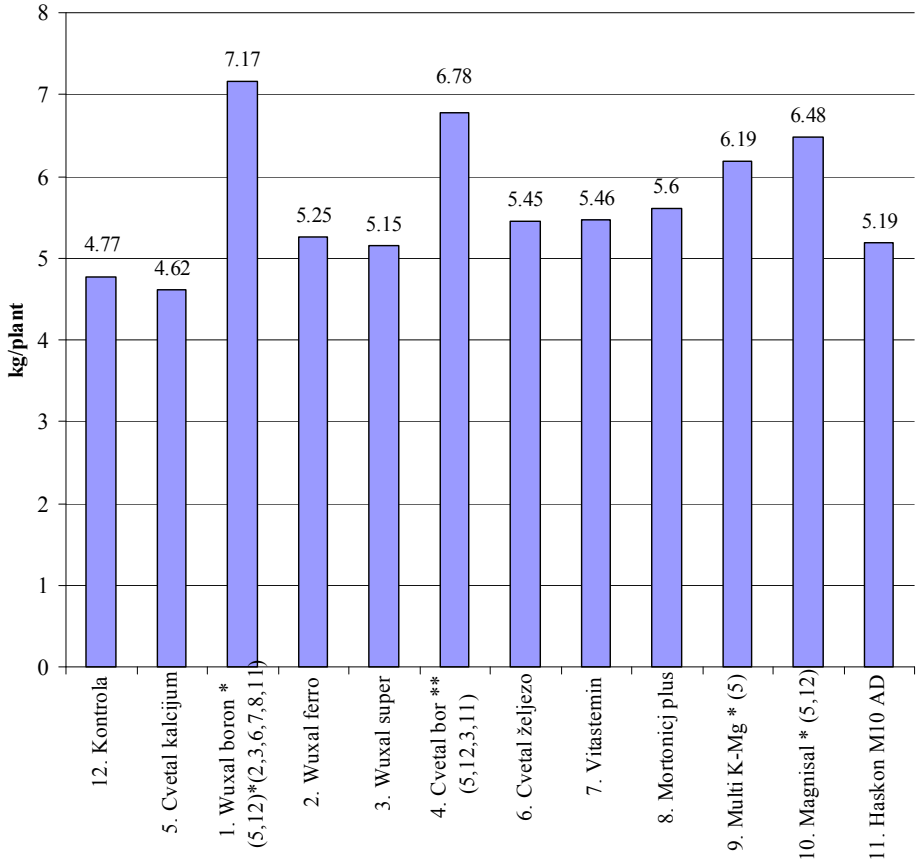
The soil is rich in accessible copper: 5.0 ppm. In his research, Vukadinović (2007) states that the grape yield showed a poorly expressed positive correlation with the copper content.

RESULTS AND DISCUSSION

The influence of liquid foliar fertilisers was analysed in the Vranac variety, through indicators of fertility as well as grape quality.

Grape yield per vine

The effect of foliar fertiliser preparations on the examined factors can be perceived the best through the absolute indicator of fertility – grape yield per vine.



* statistically important difference
** statistically very important difference

Graph 1. Change of grapes yield depending on type of foliar fertiliser

Graph 1 shows that the lowest yield, at 4.62 kg per vine, was obtained for group number 5, which was top-dressed with Cvetal Ca. This foliar fertiliser consists of 15% calcium, 10% nitrogen, 2% magnesium, plus microelements: B, Zn, Fe, Cu, Mn, Mo and vitamin B1. The result can be explained by the fact that

the nutritional complex of the soil of the experimental parcel had a very high content of total carbonate.

Table 2 shows that the calcium level in the soil layer at 0-30 cm is 35.7%, and in lower layer it is even 76.8%. Under these conditions, application of preparations with increased content of calcium has a negative impact on the physiological status of vine and on yield, because calcium antagonistically acts on uptake of other macro (Mg^{2+}, K^{+}, P_2O_5-), as well as micro elements (B, Zn, Fe...). This statement is confirmed by Perović, N (2003) in her experiment conducted under the conditions of Ćemovsko field.

In addition, our experiment shows that addition of calcium through the leaves, under the conditions of high presence of this element in the soil, blocked the uptake of very important macro and microelements into the vine.

A positive effect was assumed following the application of this preparation under the conditions of acid soils. Compared to group number 5, group number 12 – the control group, without foliar top dressing – showed a frugal yield of 4.77 kg per vine. This difference in yields between these groups was not statistically significant.

The biggest yield per vine in the experiment was realised for group number1, which was top dressed with Wuxal boron: 7.17 kg. After that was group number 4 which was top dressed with Cvetal bor. Grape yield per vine for this group was 6.78 kg.

Increase of grapes yield per vine at both groups is statistically important compared to groups 5, 12, 3 and 11.

The positive effect of addition of boron preparations in our experiment corresponded with the results reported by Perović, N (1987, 1988). She determined that under the conditions of the weak supply of accessible boron in the soil of Ćemovsko field, foliar top dressing of vines by preparations based on boron has a very positive impact on yield and grape quality.

Vines are typically characterised by greater needs for boron, and therefore are more sensitive to a lack of this microelement. Boron influences several processes that play central parts in plant metabolism: synthesis of nucleic acids, respiration, and metabolism of phosphorus, carbohydrates, proteins, phenolics, auxin, and so on (Školjnik, M. 1965, 1974, Albert, L. 1965, Hodak, J. 1970; Agarwala, S. et al. 1981).

Groups number 1 and 4 had the largest yields of grapes per vine, followed by group number 10, which was foliar top dressed with Magnisal, and group 9, which was treated with Multi K-Mg. These are preparations that consist of higher percentages of magnesium.

Increases in yield in group 10 (Magnisal) was statistically significant compared to the control group and the group top dressed with Cvetal Ca. Increases in group number 9 were statistically significant only in comparison to the Cvetal Ca group.

In the conditions of highly carbonated soil, like the soil of Ćemovsko field, disorders in magnesium uptake by the vine can be expected, as a consequence of the antagonistic action of calcium on magnesium.

Perović, N (1996) determined a negative influence of a medium level intensity between magnesium and calcium in Vranac leaves under the conditions of Ćemovsko field. This is why foliar top dressing with Magnisal and Multi K-

Mg enables additional uptake of magnesium through leaves, which resulted in increased yield.

The success of foliar preparations arises from their magnesium content, as a consequence of the antagonistic action of calcium in the soil on magnesium uptake. The quantity of accessible magnesium in the soil of experimental parcel is high: 20mg/100 g, but the ratio of Ca : Mg (44.1 : 1) is unfavourable (Table number 2) for magnesium uptake.

Magnesium, also, has a positive role in respiratory processes, translocation of carbohydrates, metabolism of nitrogen, and so on. The vine, according to the data of Konlechner, H (1961), takes up between 30 and 65 kg per hectare of magnesium a year, which indicates the significant need for this macroelement by the vine.

Nutrition with magnesium depends not only on its content, but also on the quantities of other ions present in the soil. Many authors have reported an antagonism between K^+ and Mg^{2+} and NH_4^+ and Mg^{2+} (Levy, J.F. 1965, Gadžijev, D. 1969, Danilov, B. 1972, Loue, A. 1981). Perović, N (1991) determined that the content of magnesium in the Vranac leaf would be reduced with increased doses of potassium. In our experiment, the vine was top dressed with the Kristalin preparation, which also contains potassium. It can be assumed that potassium also had an antagonistic effect on magnesium uptake through the root, and as a consequence, it had a more intense uptake of magnesium through the leaves.

Other foliar preparations used in our experiment did not have statistically important impacts on yield compared to the control group. It has to be emphasised that the period of research was short for making relevant decisions concerning the effectiveness of the preparations used in our experiment. This fact was confirmed by Perović, N (1988) who, based on a four-year-experiment, came to the conclusion that foliar preparations have to be used over a period of several years in order to have any important effect on yield.

The impact of foliar top dressing on grape yield in very skeletal carbonate soils is poorly described in the literature. According to extensive research conducted in different pedo-climate conditions around the world (e.g. Avramov, L (2001), Glintić, M (1967), Lović, R (1973), Mihajlova, M (1961), Milosavljević, M (1998), Mitović, D (1980), Tkačenko, T.V (1981), Ubavić, M (1977), etc.), foliar top dressing of vines shows a positive impact on grape yield. However, the effect of application of some combinations of foliar preparations, were dependent on the agrochemical indicators of soil, the variety characteristic s of the grapes, climate factors and other specific indicators regarding where the experiment was conducted.

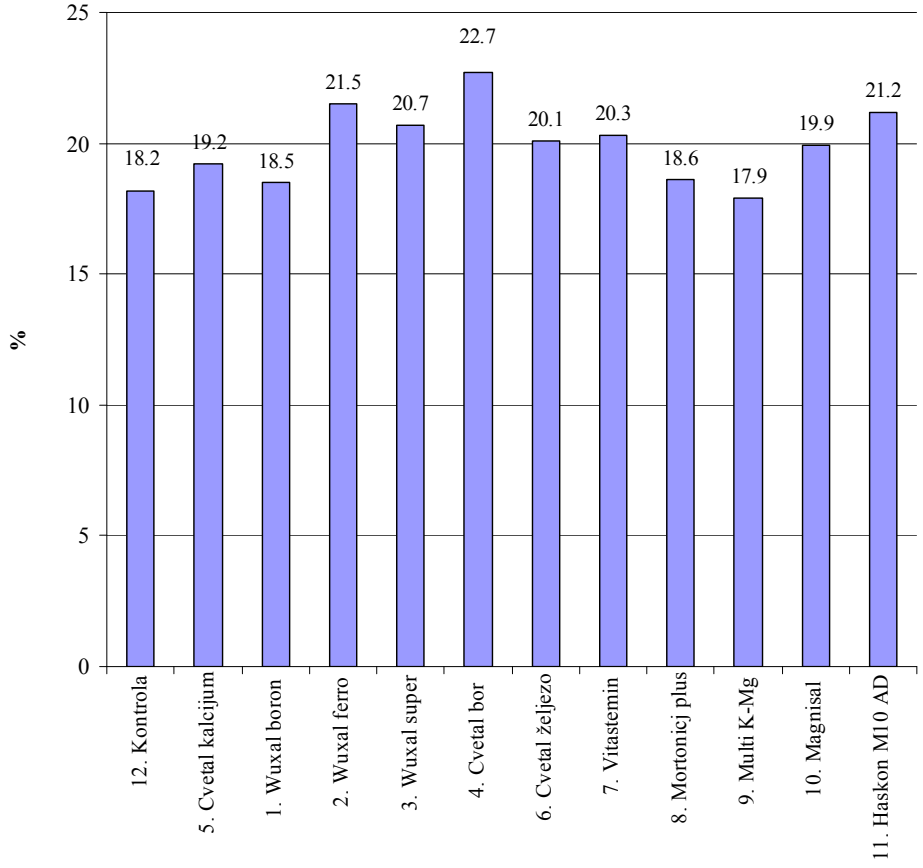
In addition, the fact that the age of the experimental plantation is 29 years should not be neglected. Therefore, it is possible that application of some examined foliar fertilisers in younger plants could consequently have a bigger effect.

Indicators of Grape Quality

Sugar content in grapes juice

Foliar nutrition is another important factor that has a direct impact on achieving higher amounts of sugar in grapes.

Results of this research are shown in graph 2.



Graph 2. changing sugar content in grapes depending on type of foliar fertiliser

No important statistical differences were noted between groups concerning sugar levels. Therefore, only a tendency for foliar preparations to have an effect on this quality indicator can be discussed.

The highest sugar content in grape must was seen in the group 4 (22.7%), which was foliar top dressed by Cvetal boron. It has to be emphasised that this group had the most significant increase in grape yield.

Perović, N (1988) in her research on Ćemovsko field, also noted an increased sugar content in grape must following foliar application of boron.

Experiments by Tkačenko, T.V (1962) on vines also showed that foliar nutrition at full bloom influenced the sugar content increase, the weights of bunches of grapes and the number of seeds.

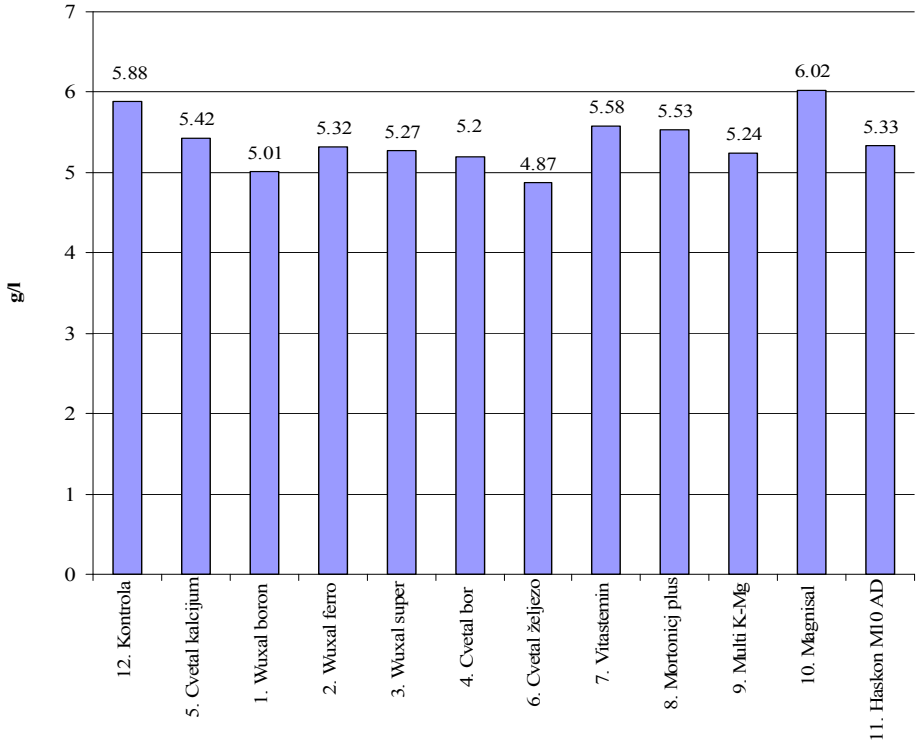
Boron has also been suggested to combine with a zinc and copper influence on increases in sugar in grapes, as reported by Mitović, D (1980). The same

author stated that increases in sugar content in grapes appeared to be a result of increased biochemical processes, increases in fermentation activities and many oxido-reduction processes in the organs of the vine.

The lowest sugar content in grape must was found in group number 9 (17.9%), which had foliar top dressing with Multi K-Mg. The sugar content in grape must of the control group (18.2%), was not late compared to the other groups. The yield in this group was small. Sugar contents in the other groups were around the average value.

Acid content in grape must

The acid content in grape must is also a very important parameter of grape quality. Due to special pedoclimate conditions and specific assortments, grapes produced in the southern part of Montenegro have high sugar content and low acid content. Besides this, a part of the acid from grapes during the processing, storage and other manipulations, is lost and transferred into solid shapes, which are sedimented as tartrate.



Graph 3. Changes in acid content in grapes depending on the type of foliar fertiliser applied

Studying of influence of foliar top dressing on total acid content in grapes is important, because it can influence the quantity of this important component in

grapes and later in wine. This has specific importance in vineyards of the south, because of the relationship between sugar and acid on which wine quality produced in this area depends.

During dry years, the coming of alkali from the soil is relatively poor and so acids in grapes will be in more of a free state. In years with more precipitation, there will be a stronger flow of nutritional compounds from the soil and also alkalinity, and so a greater part will be free, which will influence the value of alkalinity of the ash and the real acidity of the grape must made of these grapes.

The highest acid content was seen in group number 10 (6.02 g/l), which was top dressed with Magnisalom. The lowest acid content was seen in group number 6 (4.87g/l), which was top dressed with Cvetal željezo. Perović, N (1988) determined that a combination of boron, copper and manganese gave the least amount of total acids compared to the control, which is similar to the tendency indicated in our research. Mijović, S (1992), in his three-year-research, stated that foliar top dressing did not influence increases in acid content in grapes compared to the control group.

Microelements, in addition to their positive impact on yield, can be said not to decrease acidity, at least not in those preparations that consist of larger percentages of boron, manganese or iron.

CONCLUSION

- In our experiment with foliar top dressing of vines, we studied 11 foliar fertiliser preparations. The highest yield per vine was realised in the group top dressed with Wuxal boron , at7.17 kg.

- A positive and statistically significant effect was seen for the group top dressed with Cvetal boron (6.78 kg).

- Increasing yields in groups top dressed with boron were statistically significant and higher compared to groups top dressed with preparations Cvetal Ca, Wuxal super and Haskon.

- A positive effect of foliar top dressing was noted with Magnisal (6.48 kg) and Multi K-Mg (6.19kg).

-The lowest yield was noted in the group top dressed with Cvetal Ca, and the control group.

-No statistically significant impact was seen for foliar fertilisers on the quality of Vranac grapes.

-The largest average sugar content in grape juice was found in the group top dressed with Cvetal boron (22.7%).

-The highest acid content was found in the group top dressed with Magnisal (6.02 g/l).

-The effects of applications of these fertiliser preparations should be checked in experiments of longer duration.

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Ilija ČUKIĆ i Natalija PEROVIĆ

UTICAJ FOLIJARNIH ĐUBRIVA NA BIOLOŠKE I TEHNOLOŠKE KARAKTERISTIKE SORTE VRANAC NA ĆEMOVSKOM POLJU

SAŽETAK

Višegodišnja istraživanja uticaja folijarnih đubriva na biološke i tehnološke karakteristike sorte Vranac su potvrđena ogledom koji je obavljen na sorti Vranac u AD Plantaže 13. jul na Ćemovskom polju u okolini Podgorice. Ogled je postavljen metodom slučajnog blok sistema. Ogledna parcela je površine 0.13 ha. Naslon je u vidu špalira sa pet redova žice, a pravac redova je istok-zapad.

U svakoj varijanti je bilo po 15 čokota raspoređenih u tri ponavljanja sa po 5 čokota. Korišćeno je 11 sredstava za folijarnu prihranu: Wuxal boron, Wuksal ferro, Wuxal super, Cvetal bor, Cvetal kalcijum, Cvetal željezo, Vitastemin, Mortonicj plus, Multi K-Mg, Magnisal, Haskon M10 AD, dok je 12. Kontrola (bez folijarne prihrane).

Preparati koji su pokazali najveći (statistički potvrđen) ekonomski efekat u prinosu grožđa su Wuxal boron, Cvetal bor i Magnisal.

Ključne riječi: folijarna đubriva, sorta Vranac, Ćemovsko polje.