

Original Research Article

<https://doi.org/10.20546/ijcmas.2018.702.222>

## Effects of Foliar Fertilizations in the *Vitis vinifera* L. Species

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### ABSTRACT

Nutrition in the grapevine is a specific agrotechnical measure affecting the quantity and quality of grape production and its products. Proper nutrition has a great influence on the many biochemical and physiological processes that happen in various grapevine organs. Among the macro-elements, potassium has a very important role in the development of the vital processes of the vine. This element has the most important influence on maturation processes and increases the resistance of the vine to low winter temperatures. Results achieved in a 2-year (2016-17) study with seven different pleural treatments (along with the control) showed that fertilization with K reduced Mg almost half compared to untreated vineyards, resulting in chlorosis in the basal leaves. High K / Mg Report, determining the low absorption of Mg, did not sit on our test as from leafy fertilization as from irrigation and fertilization both (injection with drop irrigation) with MgSO<sub>4</sub> solution. On the other hand, the application of Mg except Fe supply had the same effect on the absorption of Zn soils and its accumulation in leaves and leaf tails. For more, foliar fertilization with Fe has increased Fe levels on leaves, on berry and on one measure smaller in ripening too.

#### Keywords

Fertilization, Iron, Magnesium, Potassium, *Vitis vinifera* L., Zinc

#### Article Info

##### Accepted:

17 January 2018

##### Available Online:

10 February 2018

### Introduction

All plants need an adequate supply of macro- and micro-elements in order to comply with their normal physiological and biochemical functions. In addition to basic nutritional mineral resources (nitrogen, phosphorus and potassium), some other elements (magnesium, iron, zinc, boron, etc.) are considered essential for the metabolic processes of plants, because they are cofactor and/or activators of many metabolic enzymes, 1992 (Lindsay Allen and

Bruno de Benoist, 2006). Nutrients mentioned above are necessary for life cycle of the vine, from the initiation of bud to leaf fall, and generally restrict production of grape vineyards in the world (Kummer and Vasconcelos, 2001).

The application of nutrients contributes to the manipulation of environmental variables when properly integrated into a land management program (Omar Dary, 1968). It can also be used as a supplement to compensate for the

deficiencies of the earth: to provide sufficient nutrients when nature is not supplying them during critical stages of seasonal growth cycle (George and Rice, 2016).

However, despite the obvious importance of soil composting in the growth and production of plants, knowledge and understanding about the availability of the nutrient, the actual absorption of different fertilizers and how they affect the vineyard physiology and productivity is not well known by farmers (Bergmann, 1992).

## Materials and Methods

### Location, grapevine material and experimental set up

The experiment was conducted in a vineyard plant in Sauk, Tirana; the methodology was applied foliar fertilization on of grapevine Cv. "Shesh i Zi". From meteorological data (Figure 1) that are recorded in a meteorological station located in Petrele, Tirana, near the center of the experiment, the annual precipitation was 917–1197 mm in 2016 and 2017 respectively. In addition, it was noted that large differences in temperature between these two years. During the growth cycle, the temperature range was more or less the same during the summer months, with lower temperatures in April, May and September 2016 compared to next year.

After planting, the grapevines were periodically sprayed with treatments in order to avoid diseases, following a suitable wintering protocol for kleistotecs of fungi, based on integrated rules of pest management. It also created an irrigation system, which uses water to avoid drought conditions in the summer time.

Physical and chemical parameters of the soil are shown in (Table 1) (analysis carried out by

the laboratory; "Another vision, Elbasan, Albania").

In the years 2016- 2017 after short pruning, was held with 4 buds per shoots, some experimental rows of grape, planted on plots, was apply Foliar fertiligation, in the two years, 5 treatments, with 3 repetitions per each 4 plants " Shesh i Zi" (Table 2).

Five variants of foliar fertilization were conducted compared to a row of grape that was not applied deciduous.

The quantities of fertilizers extensions (50 N, 90 P<sub>2</sub>O<sub>5</sub> and 140 K<sub>2</sub>O in kg/ha) was concluded from the terrein object analysis (20 mg kg<sup>-1</sup> amonlaktozës AL; P<sub>2</sub>O<sub>5</sub> soluble and 100 mg kg<sup>-1</sup> AL-K<sub>2</sub>O, as results of consultation of "Other Vision Laboratory Elbasan) and recommendations of the annual cover (E. Kukali). Fertigation was used as ammonium sulphate (20.6% N) in two years in the spring, while phosphorus as phosphate (26% P<sub>2</sub>O<sub>5</sub>) and potassium as potassium sulphate (50% K<sub>2</sub>O) was applied only in 2016 (Diaz *et al.*, 2010). Fertilizers containing: Mg Bittersalz "(MgSO<sub>4</sub> x 7 H<sub>2</sub>O, 16% MgO, Germany), Fe (Fe comprising aminacide, 5% (w/v) Fe), are added before flowering in May, individually or combinationed (Edlira Kukali, 2009). Application of Mg or Fe is calculated based on the recommendations. In order to understand the efficacy of Mg and Fe in the soil application was combined with foliar fertilizations and was compared with untreated variant (control) (George and Rice, 2016).

### Analysis of minerals in leaves and measurements

The leaf analysis is done by selecting eight to twelve leaves of recurrence (2-3 x vine leaves on each plant). After sampling, leaf surfaces are separated from the leaf stems, which are washed with tap water running initially and

then with deionizer water in order to remove dust and other waste in the leaf surface; then leaves/stems are dried in the oven at 105°C for three days. After homogenization and grinding (28 Hz s<sup>-1</sup>, 2.30 min; emulsifier MM 400) of the leaf surface (0.5 g) and the stalk (0.3 g) are dissolved in HNO<sub>3</sub> (covered with lids) and H<sub>2</sub>O<sub>2</sub> (65% and 30%, respectively) in PTFE furnace in a sand bath (Edlira Kukali, 2009).

The dry residue was re-dissolved in 0.5 ml of HNO<sub>3</sub> 1-2 min heating and filling a final volume of 25 ml with deionizer water. Mineral concentrations were determined by spectrophotometer (SPECTRAA-55), in "Another Vision Laboratory, Elbasan" Standards in the following wavelength: nm, 766.5 (C), 285.2 (Mg), 248.3 (Fe) and 213.9 square Zn). For each set of measurements were carried out appropriate quality controls (standard reference materials (SRMs) from the National Institute of Standards and Technology - NIST- Italy (Parsons *et al.*, 1983).

### **Statistical analysis**

All experimental data were analyzed by ANOVA using SPSS statistical package. Where changes in the ANOVA were significant for (p < 0:05) (Ruben Geert van den Berg, 2017)

### **Results and Discussion**

#### **K and Mg concentration in leaves of the vine**

The grapevines which are newly initiated berries, the K concentration in the untreated grapevines was 1.0 ± 0.1 versus 1.2 ± 0.3% in the leaf surface and 2.6 ± 0.3 versus 2.7 ± 0.5% in the shoots in 2016 and 2017 respectively (Figure 2). The measured concentration of K was quite similar in the ripening process, being 1.0 ± 1.3 vs. 0:04 ±

0.2% in the leaf surfaces and 2.4 ± 0.3 versus 2.9 ± 0.5% at the shoots, in the same years respectively. Treatments (2-8) with the addition of K showed higher concentrations of K compared to the untreated grapevines both in times of sampling and in both years. In general average, the K concentration was increased by 1-6 fold in all samples treated compared with untreated those of grapevines. In contrast, the Mg concentration was significantly higher (Figure 2) in samples of untreated grape leaves in two years and both times the sampling. In the initiation phase of berry, measuring the concentration of Mg it was 0:08 ± 0:02 vs. 0:10 ± 0.01% sip. gjethore and 0:19 ± 0:02 vs. 0:14 ± 0.01% spring in 2016 and 2017, respectively.

Furthermore, Mg content in two stages, the leaves of untreated grape averaged almost twice (1.9-fold) higher than the additional treatments with K (average value against 0.0780.101% in 0063-0073 leaf surface and 0:11 to 00:15% in shoots 2016 to 2017 respectively) In the control grapevines, the Mg concentration was increased by 1.6-fold (average of two years) from the collected berries for ripening in two stages on leaf surfaces (0:14 ± 0:01 vs. 0:14 ± 0.02% in 2016 and 2017 respectively) and shoots (0:26 ± 0:02 0:27 Against ± 0.02%, respectively). A comparable improvement was also seen in the shoots treated with Mg and Fe fertilizers (4, 6-8) in 2017 (Table 3).

#### **Effects of different fertilizer treatments on the concentration of Fe and Zn in the leaves of grape**

In initiating of berries 2016, the content of Fe was much higher than the ripening time of the same year and both times the sampling in later (average values ranging between 201 and 264 mg kg<sup>-1</sup> in treatments 5 and 6 even > 300 mg kg<sup>-1</sup> in the leaf surface, and 41-63 mg kg<sup>-1</sup> in shoots (Figure 3).

**Table.1** The average physical and chemical characteristics of the soil (Taulant Mitrushi)

Parameters	Average value
pH (in water) 1:1.25)	8.0
EC (dS m <sup>-1</sup> )	0.80
OM (%)	1.9
CEC (cmol kg <sup>-1</sup> )	24.9
Total CaCO <sub>3</sub>	33.0
Active Lym (%)	9.0
Total N (mg kg <sup>-1</sup> )	1039
Available P (mg kg <sup>-1</sup> )	8
K available (mg kg <sup>-1</sup> )	174
S available (mg kg <sup>-1</sup> )	4
Available Ca (mg kg <sup>-1</sup> )	4793
Available Mg (mg kg <sup>-1</sup> )	43
B Available (mg kg <sup>-1</sup> )	1:34
Available Cu (mg kg <sup>-1</sup> )	17.5
available Fe (mg kg <sup>-1</sup> )	143
Available Mn (mg kg <sup>-1</sup> )	104
Mo available (mg kg <sup>-1</sup> )	12:05
Available Zn (mg kg <sup>-1</sup> )	3.9
Clay (%)	32.7
Lym (%)	47.2
Sand (%)	20.1
texture	sandy clay

**Table.2** Description of treatments applied in the roots of experimental vineyards "Sheshi i Zi, Sauk, Tirana"

No	Treatment	Concentration/quantity of foliar fertilization
1	Control (without treatment)	Didn't treat with supplement feed
2	NPK	10 g N.18 g P <sub>2</sub> O <sub>5</sub> and 28 g K <sub>2</sub> O per root
3	NPK+Mg L	3% (2w/v) "Bittersalz" (foliar fertilization)
4	NPK+ Mg S	3%(w/v) "Bittersalz" (fertigation)
5	NPK+ Fe L	0.15%(w/v) "Foliacon Fe" (foliar fertilization)
6	NPK+Fe S	0.15%(w/v) "Foliacion Fe" (fertigation)

**Table.3** K% measured in the phase of the color change in ripening

Treatments	2016		2017	
	Leaf area	shoots	Leaf area	shoots
<b>1 control</b>	0:04	0.3	0.2	0.5
<b>2 - NPK</b>	1	2.4	1.3	2.9
<b>3- NPK + Mg L</b>	1.1	2.3	1.2	2.8
<b>4- NPK + Mg S</b>	1.4	2.9	1.4	2.6
<b>5- NPK + Fe L</b>	1.2	2.7	1.5	2.3
<b>6- NPK + Fe S</b>	1.6	2.6	1.7	2.6

**Table.4** Percentage (%) of Mg, measured in the phase of berries initiating and in the phase of the color change (Ripening) 2016-2017

Treatments	2016				2017			
	Leaf area		Shoots		Leaf area		Shoots	
	initiation of berry	Verasion	initiation of berry	Verasion	initiation of berry	Verasion	initiation of berry	Verasion
<b>1 Control</b>	0.03	0.14	0.2	2.6	0.10	0.15	0.16	0.27
<b>2 - NPK</b>	0.08	0.15	0.03	0.16	0.02	0.19	0.03	0.28
<b>3- NPK + Mg L</b>	0.07	0.18	0.02	0.01	0.01	0.01	0.01	0.01
<b>4- NPK + Mg S</b>	0.06	0.01	0.19	0.02	0.02	0.02	0.02	0.02
<b>5- NPK + Fe L</b>	0.04	0.19	0.01	0.02	0.01	0.18	0.18	0.29
<b>6- NPK + Fe S</b>	0.05	0.02	0.02	0.03	0.01	0.03	0.03	0.02

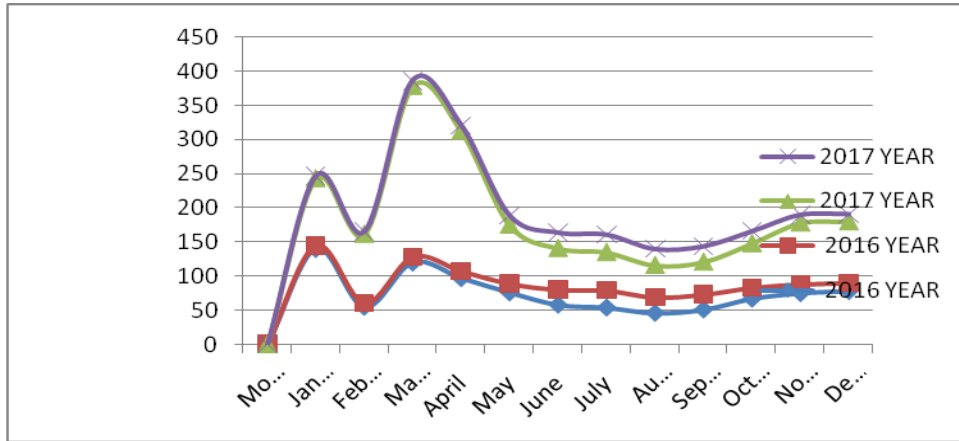
**Table.5** Effects of different fertilizer treatments on the concentration of Fe and Zn in the leaves of grape

Treatments	2016				2017			
	Leaf area		Shoots		Leaf area		Shoots	
	initiation of berry	of ripening	initiation of berry	ripening	initiation of berry	of ripening	initiation of berry	ripening
<b>1 control</b>	87	78	81	83	56	59	24	23
<b>2 - NPK</b>	201	167	163	167	68	69	33	27
<b>3- NPK + Mg L</b>	264	160	177	166	87	110	107	116
<b>4- NPK + Mg S</b>	280	169	168	169	106	112	123	125
<b>5- NPK + Fe L</b>	271	209	204	209	120	127	156	179
<b>6- NPK + Fe S</b>	279	213	209	213	279	213	139	144

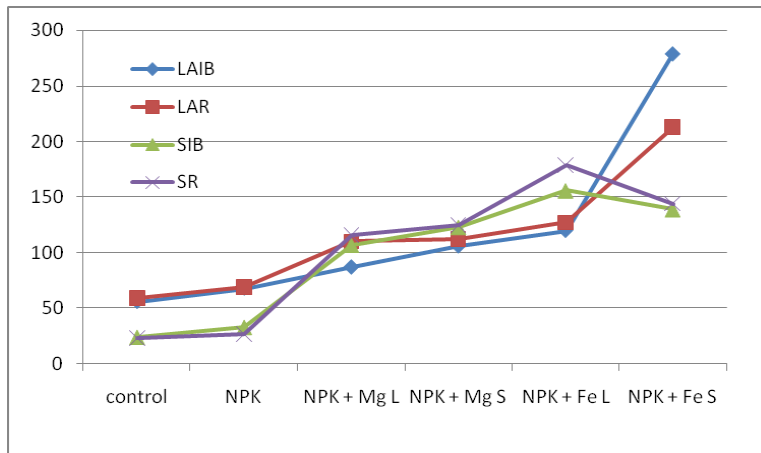
**Table.6** % Zn data in the phase of berries and initiating the phase of the color change in Ripening

Treatments	2016				2017			
	Leaf area		Shoots		Leaf area		Shoots	
	initiation of berry	of ripening	initiation of berry	ripening	initiation of berry	of ripening	initiation of berry	ripening
<b>1 control</b>	17	14	27	52	19	22	25	32
<b>2 - NPK</b>	18	15	29	54	21	23	26	34
<b>3- NPK + Mg L</b>	19	15	30	54	21	26	29	37
<b>4- NPK + Mg S</b>	19	15	31	56	23	24	27	36
<b>5- NPK + Fe L</b>	19	16	32	55	24	25	30	35
<b>6- NPK + Fe S</b>	23	18	32	58	23	26	25	36

**Fig.1** Distribution of monthly precipitation and average temperatures in 2016 and 2017, meteorological station, Tirana

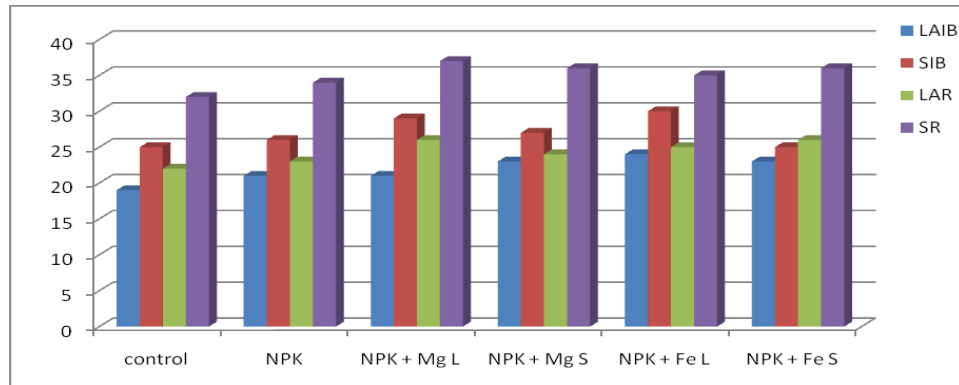


**Fig.2** Effects of fertilizer Mg and Fe in the leaves of Cv. Shesh i Zi, grapevine 2016



LAIB-Leaf area/Init berry; SIB-Shoots Initiat berry; LAR-Leaf area ripening; SR-Shots Ripening

**Fig.3** Effects of fertilizer Mg and Fe in the leaves of Cv. Shesh i Zi, grapevine 2017



LAIB-Leaf area/Init berry; SIB-Shoots Initiat berry; LAR-Leaf area ripening; SR-Shots Ripening

Furthermore, the Fe concentration was reduced by 60% on both leaf surfaces and



shoots (respectively 76-105 and 18-22 mg kg<sup>-1</sup>). In 2017, the Fe concentration of leaf surface was significantly increased by all fertilization treatments (average value of 76-96 mg kg<sup>-1</sup>) compared to controls (56 ± 8 mg kg<sup>-1</sup>). In the first phase of the survey, a significant amount of the higher of the Fe were observed in the surface of the leaf and shoots when the same element was added leaf fertilization (treatment 5; 120 ± 7 and 124 ± 2 mg kg<sup>-1</sup> respectively) or in combination with Mg (Treatment 4: 106 ± 6 and 23 ± 2 mg kg<sup>-1</sup>, respectively) (Table 4).

In both seasons, the Zn concentration in almost all cases was lower leaf surface (17 ± 1 vs. 14 ± 1 mg kg<sup>-1</sup> in the berry phase and 19 ± 2 vs. 22 ± 4 mg kg<sup>-1</sup> ripening times 2016 and 2017 respectively) and the shoots (27 - 3 versus ± 4 25 mg kg<sup>-1</sup> in the berry phase and 52 ± 2 versus 32 ± 5 mg kg<sup>-1</sup> in the ripening time, respectively) at vineyards untreated and differences were also statistically confirmed (Table 5).

The concentration of Zn increased in time from the formation of berries to ripening all samples leaves. Furthermore, the content of Zn was increased to handle degein the vine or Mg or Fe alone or in combination (from 2.2 to 2.9 times versus 1.6-2.2 in 2016 and 2017, respectively) compared with the control vines (1.9 compared to 1.3 in 2016 and 2017) or in pots which are only adding N, P and K (2.2 versus 1.4 times in 2016 and 2017 respectively). During the ripening, Zn (zinc concentrations were statistically significantly higher in treatments T 3-8 (66-89 versus 64-77 mg kg<sup>-1</sup> 2016 and 2017 respectively) compared to untreated control.

The results of the study carried out in Grori Sauk vineyards, showed that K element is an important and critical factor for a report that has with Mg element, reducing Mg concentration in the leaves of grape caused chlorosis.

Due to the high ratio between K and Mg and antagonistic relations, application of leaf fertilization with 3% MgSO<sub>4</sub> solution, has avoided this problematic.

Seeing variability in experimental conditions studied treatments in lidhje of Mg fertilizer resulted in the increase of Zn concentration in leaf surfaces and shoots.

Application of Fe and Mg stimulates absorption, so that the relationship between Mg, Fe and Zn should be studied in more detail in order to determine the relative importance of both aspects.

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**How to cite this article:**

Amelot Grori, Ariola Bici, Renata Kongoli and Edlira Kukali. 2018. Effects of Foliar Fertilizations in the *Vitis vinifera* L. Species. *Int.J.Curr.Microbiol.App.Sci.* 7(02): 1849-1856. doi: <https://doi.org/10.20546/ijcmas.2018.702.222>