

THE EFFECT OF DIFFERENT ZINC APPLICATION METHODS AND LEVELS ON YIELD AND QUALITY OF HESAPALI (*Vitis vinifera* L.) GRAPE*

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Abstract

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This study has been done to determine the effects of zinc, applied at different doses and in different ways in the fields where NPK was used and also not used as a base fertilizer on the yield and quality of the grape type of Hesapali grown widely in the environs of Aladag, Hadim, and Konya. The test has been applied to the vine grapevine at the doses of 0, 10, 20, 40g Zn/grapevine for both the ones to which NPK was not applied ($N_0P_0K_0$) and to which NPK was applied (150-50-50 g/grapevine $N_1P_1K_1$) in the form of $ZnSO_4 \cdot 7H_2O$. Zn application has been performed in two different forms: I. By mixing all the zinc with the soil (20-30 cm depth) in the projection of the grapevine 15 days before blossom and II. By spraying j of all the zinc over the leaves with a fifteen-day interval at 4 times, which starts 15 days before blossom.

According to results of the study: Wet grape yield obtained from each grapevine, which was exposed to the average of two different applications ($N_0P_0K_0$ and $N_1P_1K_1$) forms of zinc has statistically increased in an important proportion by increasing the dose of zinc applied to the grapevine. Comparing with the controls, the highest yield of wet grape with the proportion of 212% and 206% has been obtained in $N_0P_0K_0$ and $N_1P_1K_1$ applications by applying 10 and 40gram of zinc to each grapevine. Beside as an average of NPK and zinc levels, application of zinc over leaves has increased the yield of the wet grape more than the one applied to the soil (7.00 b and 8.4 a kg grape/grapevine). Moreover water soluble dry matter (%), and titratable acidity (g/100 cc) of grape with rising zinc doses, has increased as an average of NPK and zinc application and, the most water soluble dry matter (18.91%) and titratable acidity (2.74g/100cc) has been obtained by application of 20g Zn/grapevine.

Key words: zinc application, soil analysis, *Vitis vinifera* L., quality, grape

Introduction

The area of viticulture in Konya is 37.926 ha and harvest reaped from this area is 117.132 tons. This

area and yield have constituted 6.7% and 3.2% of the area of viticulture and the whole yield of Turkey respectively. The average wet grape yield in Turkey is 600kg/da and although it is 308.8kg/da in Konya, it

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is 239.4kg/da in Hadim-Aladag environs, which is the subject of study (Anonymous, 2000). 32% (12.230da) of all the vineyards in Konya is in Hadim-Aladag environs and 25% (29.280 ton) of whole yield has been done here.

Hadim-Aladag environ is located quite suitably for viniculture not only from the side of climatic specialties but also productive soil. Despite these positive conditions, the yield and quality has been decreasing gradually and so the number of farmers who is interested in viticulture has been lessening recently, and vineyard areas have been reduced.

Since vine is a long lasting plant, it is difficult to determine the effects of the fertilizer and the amount and timing of the fertilizing on the yield and quality. Climate, soil, specialties of the plant and economic factors must be taken into consideration while fertilizing the vineyards (Winkler et al., 1974). It will be possible to improve viticulture if we use resistant mature improved against the diseases, and true watering and fighting techniques and take true cultural measures, and make a true and balanced fertilization (Brohi, 1984).

High quality and yield to obtain from vines like other plants will be possible if they can take sufficient amount of all the vegetal nutrient elements as soon as they need them in addition to the other measures. It is needed to feed the plant with true techniques by fertilizing them sufficiently and in a balanced way with nutrient elements, which don't exist in the soil, or the plant cannot get from soil sufficiently. As a matter fact, a quite many researchers have determined the lack of zinc in the sample of both soil and plant in their study on the condition of nutrition of vine (Kovanci and Atalay, 1977; Danisman et al., 1983; Brohi and Aydeniz, 1987).

Furthermore Gezgin and Er (1996) have determined the lack of zinc nutrition in nearly all of the vines in a research, which was performed by studying 13 different samples of soils and leaves in the fruiting period in testing vineyards of Aladap. They have also determined that 15 % of the vines are lack of nitrogen but the nutrition level of P, K, Ca, Fe, Mn and Cu are sufficient.

Zinc, an element of micro-nutrition, is inevitable for the draught of the vegetal metabolism. Zinc has a considerable function in carrying carbohydrates and enables sugar to be used regularly in the plant. In addition, zinc has a considerable role in synthesis of enlarging hormone named oxcin and on increasing activity of usage of the other nutrient elements vegetal enlargement, roots maturing, and grain and fruit formation. As a matter of fact it has also been determined by many researchers that zinc application on vine has an effect to increase yield (El-Shamy and Haggag, 1987; Ahmedullah et al., 1987; Strakhov, 1988; Ravi-Kumar et al., 1988).

This research has been done to determine the effect of NPK and zinc fertilizing on yield of type of Hesapali grape and pH acidity (g/100cc) and qualifications such as water soluble dry matter (%).

Material and Methods

Location of testing area: A valley among Taurus Mountains in South of middle Anatolia and altitude is 700 m. The river Goksu flows in the middle of the valley. Test has been performed on an 8-10 year-old Hesapali grape in the of Cavus Area in Gaziler Village in Environs of Aladag in Hadim Konya in 1999-2000. The physical and chemical properties of soil belonging to the testing vineyard are given in Table 1.

There are two grapevines per each plot in test formatted in 3 repetitions according to factorial design in random plots. In test nitrogen, urea, phosphorus, Triple super phosphate and potassium with zinc in form of K_2SO_4 fertilizer at the level of 150-50-50g/grapevine (N, P_2O_5 , K_2O) respectively are applied to the soil.

As for zinc, it is applied to the grapevine in the form of $ZnSO_4 \cdot 7H_2O$ at doses of 0, 10, 20, 40 g Zn/grapevine. Zinc application is performed in two different ways, from soil and leaf. The initial application is performed with pouring all the zinc into the soil (20-30 cm depth) in the projection of the grapevine 15 days before blossom and as for latter, by spraying 1/4 of all the zinc over the leaves with a fifteen-day interval at 4 times, which starts 15 days before blossom.

Table 1
Some properties of experimental soil at different depths

Soil properties	Soil depth, cm	
	0-30	30-60
Sand, %	56.3	64.9
Silt, %	25.3	19.1
Clay, %	18.4	16
pH, 1:2 W/v	7.78	7.81
CaCO ₃ , %	15.6	16.4
Organic matter, %	1.21	1.5
Ca ²⁺	16.58	19.45
K meq/100g	1.33	0.96
Mg ²⁺	2.18	1.17
Available P ppm (Olsen, 1954)	9.29	9.92
Fe - Mn ppm	5.55-15.2	11.1-15.88
Zn - Cu ppm	0.36-2.16	0.10-1.20
B ppm	2	1.12

Water soluble dry matter (%) unfermented grape juice, titratable acidity (g/100cc) and pH in the samples taken from both wet yield and grapevine have been determined according to Celik (1991). The data was statistically analyzed using the Minitab 8.2 statistical software program.

Results and Discussion

The effect of zinc applied in different ways and levels on the grapevine being given NPK and also not given, and the LSD test and its control showing the difference between averages and values of wet grape in Hadim-Aladag environs and its quality have been given at Table 2.

The Grapevine Yield (kg/grapevine)

According to the results of researches, as an average of both zinc dose and its ways of application and treatments unapplied with zinc (Zn₀), any difference of the yield of wet grape in the application of N₀P₀K₀ and N₁P₁K₁ (7.77-7.62 and 3.70-3.77 kg/grapevine

in order) have not been found statistically. Why an important increase of grape yield was not obtained by is related to the amount of organic components of the soil, in which test was performed, was at medium level whereas phosphorous and potassium suitable for the plant were at high level.

However as an average of the application ways of NPK and zinc, the yield has been increased at the rate of between 35.1%-203.8% in respect of the control. The highest yield (11.33 kg/grapevine) with an increase of 202.8% in respect of the control has been obtained by applying 40g of zinc to the grapevine. In addition to this, any important statistical difference between applications of 40gram of zinc (Zn₃) and 20 gram of zinc (Zn₂) has not been determined (p<0.05).

Moreover zinc application has not considerably changed the effect on yield as to NPK application. As a matter of fact, as an average of zinc application ways, the highest grape yield (11.53 kg/grapevine) has been obtained by applying 20 gram of zinc (Zn₂) to the grapevine in N₀P₀K₀ applications and by applying 40 gram of zinc (Zn₃) to the grapevine in N₁P₁K₁ applications. Loneragan and Webb (1993) have stated that this situation has showed that the more NPK we apply to the plant means the more zinc the plant needs.

As a matter of fact the increase in yield has differed from 27.6%-212 to 42.4%-206 respectively by increasing zinc applied to the plant in both N₀P₀K₀ and N₁P₁K₁ applications in the comparison with the controls (3.70-3.77 kg/grapevine respectively) and the average has been determined as 146.7% and 136.1%.

Similarly many researchers (Ahmetullah et al., 1987; El Shamy and Haggah, 1987; Strakhov, 1988; Ravi-Kumar et al., 1988) have stated that zinc application has enabled the grape yield to increase considerably.

One more thing, as an average of NPK and zinc level, zinc applied to the leaves has enhanced the yield more than one applied to the soil (7.00 and 8.38 kg/grapevine respectively). According to the LSD test, the difference between the zinc application to the leaf and soil is considerably at important level from the point view of the wet grape yield (p<0.05). As Gezgin

Table 2
The effect of zinc application on Hesapali grape yield and quality *

Doses	Grapevine yield, kg/grapevine			Water soluble dry matter, %			Titratable acidity, g/100cc				
	Application	N ₀ P ₀ K ₀	N ₁ P ₁ K ₁	Average	% Incre.	N ₀ P ₀ K ₀	N ₁ P ₁ K ₁	Average	N ₀ P ₀ K ₀	N ₁ P ₁ K ₁	Average
Zn ₀	U1	3	4	3.5	-	20.3	19.5	19.9	2.89	2.57	2.73
	U2	4.4	3.5	3.95	-	16.3	16.8	16.5	2.33	2.82	2.57
	Average	3.70b	3.77d	3.73c	-	18.3	18.1	18.2b	2.61	2.69	2.66ab
Zn ₁	U1	2.9	4.7	3.8	8.6	19.4	17.7	18.5	2.72	2.54	2.63
	U2	6.5	6	6.25	58.2	16.7	17.7	17.2	2.5	1.93	2.21
	Average	4.72b	5.37c	5.0b	35.1	18	17.7	17.9c	2.61	2.23	2.42c
Zn ₂	U1	8.5	10.5	9.5	171.4	19.3	21.2	20.2	3.7	2.06	2.88
	U2	14.5	9.1	11.8	198.7	16.1	19	17.5	2.61	2.53	2.6
	Average	11.53a	9.80b	10.67a	186.1	17.7	20.1	18.9a	3.15	2.32	2.74a
Zn ₃	U1	10.5	11.8	11.15	218.6	18.5	20.1	19.3	2.45	2.74	5.59
	U2	11.7	11.2	11.45	189.8	16.7	16.9	16.8	2.75	2.39	2.57
	Average	11.12a	11.53a	11.33a	203.8	17.6	18.5	18.0bc	2.6	2.56	2.58b
Average NPK		7.77	7.62			17.9b	18.6a		2.75a	2.46b	
		6.23b	7.77a	7.00b	132.9	19.4	19.6	19.5a	2.94	2.48	2.71a
		9.30a	7.47a	8.38a	148.9	16.5	17.6	17.0b	2.55	2.43	2.49b

U1: One applied soil U2: One applied leaves

*The average of 3 replicates

** Values for a particular column followed by the same letter are not significantly different (p<0.01)

and Sumbul (1992) stated that this may be related to that zinc applied to the leaf is more effective because of the fixation of the zinc applied to the vine soil whose lime clay and suitable P of content are high.

Furthermore, the difference between $N_0P_0K_0$ and $N_1P_1K_1$ treatments is not statistically important but that the zinc applied to the soil supplies statistically more yield than the one applied to the leaf in $N_1P_1K_1$ treatment and at same time the one applied to the soil in $N_0P_0K_0$ treatment may result from urea nitrogen increasing the positive effect of zinc.

In return of this, similar to general average the zinc applied to the leaf has supplied statistically more yield of wet grape than the one applied to the soil in $N_0P_0K_0$ treatments ($p < 0.05$). According to multiregation analysis, important statistical relations ($p < 0.01$) have been determined between NPK, zinc (Zn) doses, and zinc application ways and wet grape Yield (Y):

$$Y = -1.226 - 0.15 \text{ NPK} + 2.84 \text{ Zn Dose} + 1.38 \text{ Zn Appl.}, R^2 = 0.754^{**}$$

$$\text{and } Y = -1.48 + 2.84 \text{ Zn Dose} + 1.38 \text{ Zn Appl.}, \text{ and } R^2 = 0.753^{**}$$

As it is understood from the determined coefficients related to equations, 75.3% of variations in the grape yield arise from the different doses of the zinc and the applications connected with the treatments. As defined above, according to the results of multiregation analysis, the effect of NPK on the wet grape yield in the vineyard where the test has been done has been at unimportant levels.

The pH of Grape Juice

As an average of zinc dose and application way, the pH of grape juice has been determined as 3.87 and 4.03 in $N_0P_0K_0$ and $N_1P_1K_1$ treatments respectively. According to LSD test the difference between average values has been considered to be important ($p < 0.05$). In the pH of grape juice obtained in increasing levels of zinc application as an average of $N_0P_0K_0$ and $N_1P_1K_1$ treatments has changed more irregularly than the pH (3.98) obtained from Control

Application (Zn_0). The highest pH value (4.03) of grape juice has been obtained in the application of the grapevine at the dose of 10 gram of zinc (Zn_3), which has a less increase than control (Zn_0) has. The lowest pH value (3.87) of grape juice has been obtained in the application of 40g of zinc (Zn_3).

Besides, the pH of grape juice obtained in the treatments of zinc applied on the leaf has usually been lower than the one obtained in the treatments of zinc applied into the soil. Furthermore, while the zinc applied on the leaf is increasing, the pH of grape juice has usually decreased when the control is in question. Statistically ($r = 0.551^{**}$, $p < 0.01$) important positive relations have been determined between the Ph of grape juice and NPK application, and zinc doses ($r = -0.370^{**}$, $p < 0.01$).

Water Soluble Dry Matter (%)

As an average of zinc dose and its application way, the Water soluble dry matter (%) of the grape juice has been 17.9% and 18.6% in $N_0P_0K_0$ and $N_1P_1K_1$ treatments respectively, and a statistically important difference between values has been determined.

Although a regular increase or decrease in proportion to the control (Zn_0) in the ratio of Water soluble dry matter (%) has not occurred as an average of NPK and zinc applications with an increase of zinc amount (18.2 %), the highest percentage of Water soluble dry matter (%) has been obtained with the application of 20 g zinc to the grapevine. Moreover according to the LSD test, even though the differences between the zinc application of 20 g/grapevine (Zn_2), which causes the highest percentage of Water soluble dry matter (%), and other zinc doses have been at statistically important levels ($p < 0.05$), the differences between zinc doses have not been at important levels.

Besides, as an average of NPK and zinc dose, the application of zinc into the soil has supplied more Water soluble dry matter (%) than the one on the leaf (19.5 % and 17.0 % respectively). To LSD test, the difference between both averages of the ratio of Water soluble dry matter (%) has been considered to be sta-

tistically important ($p < 0.05$).

The Titratable Acidity of Grape Juice (g/100cc)

According to the results of researches as an average of zinc dose and two different ways of application, the average acidity level of grape juice has been higher in $N_0P_0K_0$ treatments than in $N_1P_1K_1$ treatments (2.75 g/100cc and 2.46g/100cc respectively) and these average values have had a statistical importance ($p < 0.05$).

As an average of NPK and zinc application way, the highest acidity (2.74 g/100cc) has been obtained in the application of 20g/grapevine (Zn_2) in proportion to the one obtained in the control application (Zn_0) (2.66g/100cc). However statistically important difference between the application of 20 gram zinc (Zn_2) and the control (Zn_0) has not been determined from the viewpoint of acidity level of grape juice. Besides, as an average of NPK and zinc dose, the zinc applied into the soil has caused more acidity than the one on the leaf (2.71g/100cc and 2.49g/100cc respectively). According to LSD test, the difference between both average of acidity level has been at statistically important level ($p < 0.05$). Important negative relations between NPK application and pH specialty and the acidity level of grape juice have been found ($r = -0.358^{**}$ and $r = -0.594^{**}$ $p < 0.01$).

Conclusion

It is possible to enumerate, in entries as below, the results determined in the research held in Hadim-Aladag Environs:

With the increases of 212% and 206%, the highest yield of Hesapali vine has been obtained in $N_0P_0K_0$ and $N_1P_1K_1$ treatments with the application of 20g/grapevine and 40g/grapevine in proportion to the controls. Besides, as an average of NPK and zinc levels, the zinc applied on the leaf has supplied more yield than the one into the soil.

Furthermore, the average of NPK and zinc application way together with increasing zinc doses have caused the percentage of Water soluble dry matter (%) and titratable acidity (g/100cc) of grape juice to

increase at important levels; the highest level of Water soluble dry matter (18.9%) and acidity (2.74g/100cc) has determined with application of 20 g zinc.

No effect of NPK application on the augmentation of the yield has been determined. However NPK application has caused the plant to need more zinc.

Similar researches in the vineyards in the environs must be kept going according to the results obtained. Besides, the farmers should be suggested and enabled to make zinc applications to the vines by taking the results of soil and plant analysis into consideration.

References

- Anonymous**, 2000. Turkiye istatistik yilligi T.C. Basbakanlik D.I.E. Ankara
- Brohi, A. R.**, 1984. Bagcilikta Gubrelemenin Onemi Tokat Bagciligi Sempozyumu C.U. Zir.Fak. Tokat
- Brohi, A. R. and A. Aydeniz**, 1987. Tokat ilinde yetistirilen Narince ve cavus uzumlerinin bitki besin kapsam durumu. *C.U. Zir.Fak.Der. Cilt:* 3, **1**: 27-58.
- Celik, H.**, 1991. Kastamonu ili bagciligi ve burada yetistirilen bazi uzum cesitlerinin ampelografik ozellikleri uzerine bir arastirma 19 May. *Uni. Zir.Fak.Der. Cilt.* **6**:1-2.
- Danisman, S., C. Genc and I. Uslu**, 1983. Iznik ve Geyve ilcelerinde yetistirilen muskule uzum cesidinin beslenme sorunlar. *Doga Bilim Dergisi*, No: **7**: 9-10.
- El-Shamy, H. A. and M. N. Haggag**, 1987. Respanse of Thompson seedleec grapes to nitrogen manganese and zinc foliar sprays. *Alexandria- J. of Agricultural-Research*, **32**: 2.267-276.
- Gezgin, S. and F. Er**, 1996. Konya Hadim-Aladag yoresi baglarinin beslenme durumunun toprak ve bitki analizleri ile belirlenmesi. *S.U. Zir.Fak.Der.* **9**(11): 91-135.
- Gezgin, S. and S. Sumbul**, 1992. Kirecli topraklarda cinko Adsorpsiyonu uzerine bir arastirma. *S.U. Ziraat Fakultesi Der.* **2**(3):143-153.
- Ahmedullah, M., S. Roberts and A. Kawakami**, 1987. Effect of soil applied macro and micro-nutrients on the yield and quality of concord grapes. *Vitis*

, Vol. 1.26 No.4.

Kovanci, I. and I. Z. Atalay, 1977. Alasehir Baglarinin Yaprak analizleri yontemi ile incelenmesi. E.U. Zir.Fak.Der. Cilt: **14**, sayi: 1.

Loneragan, J. F. and M. J. Webb, 1993. Interactions between zine and other nutrients affecting the growth of plants. In. Zinc in Soils and Plants. P.O. Box 17,3300 Dordrecht, The Netherlands.

Olsen, R. V., C. V. Cole, F. S. Watanable and L. A. Dean, 1954. Estimation of available phosphorus in sail by extraction with sodium bicarbonate, 989. Wash-

ington.

Ravi-Kumar, K. S. Chauhan., Sunell-Sharma, R. Kumar and S. Sharma, 1988. Anote on the effect of zinc sulphate on berry set, panicle drying and quality of grapes cv. Gold. Haryana. *Journal of Horticultural Sciences*, **17** (3-4): 213-215.

Strakhov, V. G., 1988. Trace element fertilizer application in vineyards. Vliyanie L'dabrenii na Obmen Veshchestu; Produktivnost' Rastanii. 153-160. Kinhinev. Moldovian. SSR.

Winkler, A. J., J. A. Cook, W. W. Kleiwer and L. A. Lider, 1974. General Viticulture (Book). Univ. Of Calif. Prees. Berkeley, U.S.A

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