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INVESTIGATION OF DIFFERENT CONCENTRATION OF UREA AND $ZNSO_4$ BY SOIL APPLICATION ON SOME QUANTITATIVE AND QUALITATIVE FRUIT CHARACTERISTICS IN GRAPEVINE, YAGHOTI CULTIVAR IN SISTAN REGION

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ABSTRACT

Grape (*Vitis vinifera* L.) is one of the most important commercial fruit crops of temperate to tropical regions. This research had done to investigate the effect of different doses of nitrogen and zinc on some characterization in grapevine (Yaghoti cultivar) on completely randomized design with 16 treatments and 3 replications (each replication with 3 trees). They were used 4 levels of urea (0, 150, 250 and 350 g/tree); 4 levels of zinc sulfate (0, 35, 45 and 55 g/ tree) and interaction of each level of urea to each level of zinc sulfate. The result of this experiments showed the effect of different treatments were significant ($P\leq 0.05$) on all parameters (yield, number of clusters per plant, average weight of clusters per plant, The weight of the biggest cluster in each tree, TSS and pH of grape juice. N_2S_3 treatment had the most yields between others, whiles this treatment didn't have significant differences to N_1S_2 and N_3S_1. The lowest yield was belong to control and N_2S_1 treatments. On the other hands N_1S_2, N_2S_3, N_3S_1 and N_3 treatments had most cluster numbers per tree (31.6 clusters in each tree) whiles control treatment had 24.5 clusters). The biggest cluster was observed in N_2 treatment. Total soluble solid (TSS) were most in N_2S_2, N_3S_1 and control treatments. The maximum and minimum range of pH was observed in N_3S_2 and S_3 treatments. According to the result of this experiments and different

parameters, treatments containing urea had better effect on yield, number and size of clusters in grapevines than Zinc sulfate.

Keywords: Grapevine, zinc, nitrogen, deficiency, yield, weight of cluster

INTRODUCTION

Grapevine [European (*Vitis vinifera* L.) or American (*Vitis labrusca* L.) or Muscadine (*Vitis rotundifolia* L.) is one of the earliest fruit crop grown in the world (Salunkhe & Kadam, 1995). It occupies top position in the world with respect of area (75866 thousand ha) and production (67221 thousands tones) (FAOSAT data, 2010).

Grape is one of the most delicious, refreshing and nourishing subtropical fruits. The berries are a good source of minerals and vitamins (B1, B2 and C). The fruits are consumed in fresh forms as a table fruit and in the processed form as wine, raisin and fresh juice (Yogeeshappa, 2007).

Long, warm and dry summer with cool winter is considered best for production of grapes with higher yields and superior berry quality. Mountainous and sub-mountainous areas up to 2000 m or even more elevation are considered best for its cultivation (Winkler et al., 1974).

Nitrogen is critical for flower differentiation, rapid shoot growth, bud vigor, and fruit set. The complex physiology of nitrogen uptake and utilization has important implication for nitrogen management in vineyards (Seyedbagheri, 2009).

Zinc is an essential micronutrient that plays many important roles in various physiological and metabolic processes in all living organisms. It functions as a cofactor for over 300 enzymes and protein synthesis (Broadly et al., 2007; Kobayashi et al., 1998). It has been demonstrated that Zn deficiency is one of the most widespread mineral nutrition problems affecting normal development in plants (Pinton and Marschner, 1993; Sharma et al., 1987). In grapevines, deficit of Zn results in the development of leaves that are smaller than normal and mottled, and shortened internodes. Another important symptom of Zn deficiency in grapevines is the production of clusters with few berries that also vary in size from normal to very small (Christensen and Jensen, 1978; Vasconcelos et al., 2009). In this way, vineyards commonly correct Zn deficiency with both soil and foliar application of fertilizers (Christensen, 1980; Srinivasan and Mullins, 1981).

Nikkhah et al. (2013) evaluated the effect of foliar application of boron and zinc on

grapevines. Their result showed that using different levels of fertilization significantly increased berry (number, length and weight), cluster (length and weight) and seed (number and size) characteristics and TSS. Foliar application of 0.5 mL L^{-1} mixture of amino acids and seaweed (*Ascophylumnodosum*) extract can be used effectively to improve growth and physic-chemical berry quality of grapevine cv. 'Perlette' (Khan et al., 2012).

Delgado et al. (2006) expressed previous authors had shown that moderate nitrogen application before bloom enhances anthocyanin accumulation. But excessive nitrogen can delay ripening, promote excessive vegetation, and result in reduced polyphenol concentration and color. Also the lower application rate of N significantly increased yield, but the higher rate didn't increase it further. The result of Iqbal et al. (2012) experiment on apple trees showed fruit yield/tree (kg) have been influenced by application of nitrogen treatment T_5 (800 g N/ tree).

Dolati-Baneh and Taheri (2010) expressed that foliar application of N, Zn and B in first year didn't have any effect on qualitative characteristics in fruits, but foliar application of Zn alone or in mixing to Urea (5/1000) caused increasing cluster weight in second year.

Arshad et al. (2007) evaluated the effect of foliar application of Nitrogen and Potassium nutrients on qualitative and quantitative characteristics in bearing of Soltani grape. Their result showed foliar application of nitrogen in beginning of growing period had very effect on quantitative characteristics. Shim et al. (1972) concluded that efficiency of nitrogen application in spray form of Urea is 4 times more than soil application. Nitrogen influenced production and qualitative of berries directly and indirectly. Their result showed pH in fruit juice decrease by increasing the nitrogen level.

MATERIAL AND METHOD

Current study was performed on mature bearing vine trees in institute agricultural research in university of zabol on 2014 on completely randomized design to investigate the application of nitrogen (urea fertilizer) and zinc (zinc sulfate) on some qualitative and quantitative characteristics in grapevine (Yaghoti cultivar in sistan region). In this study were used 4 levels of urea (0, 150, 250 and 350 g/tree); 4 levels of zinc sulfate (0, 35, 45 and 55 g/tree) and interaction of each level of urea to each level of zinc sulfate (16 treatments, each treatment 9 trees). They were used by covering the fertilizer in 2 sides of trees by putting the fertilizer in a depth of

20 cm of soil on February month. It was used during the trial drip irrigation for trees.

At the end of the trial all clusters were removed, counted and weighed in all of 9 trees separately. Some parameters such as yield per tree, the number of clusters, cluster weight, the weight of the heaviest clusters, total soluble solids (TSS) was measured with a portable refract meter and were expressed as °Brix) and pH were measured after harvesting the fruit at the end of the trial on June.

Data were analyzed on general linear models in SPSS. Then mean comparison was performed by Duncan test ($P\leq 0.05$).

RESULT AND DISCUSSION

Yield: According to the result of this experiment the effect of different doses of nitrogen and zinc were significant on grapevine yield ($P\leq 0.05$).

(N1, N2, N3 are 150, 250 and 350 g Urea per each tree respectively and also S1, S2, S3 are 35,45 and 55 g Znso4 per each tree)

Diagram (1) showed between different treatments, N_2S_3 and N_1S_2 treatments had the maximum yield than others that their yields were more than control treatment. Result showed adding the amount of $Znso_4$.6H20 (zinc sulfate) from 45 to 55 g/trees (without nitrogen) decrease yield of trees. It is probably due to trees didn't need more concentration than 45 g/trees and additive concentration wasn't use for fruit set in grapevines. On the other hand, the result of this experiment showed application of nitrogen alone had better effect on grapevine yield than zinc application. Brunetto et al. (2013) reported that the greater yield on the grapevines with the organic compost application may be explained by the greater mean number of berries per cluster. This probably occurred through better plant nutrition, resulting from release of nutrients in a more gradual manner, synchronized with plant needs (Melo et al., 2012). However data analysis in this experiment showed application of nitrogen and zinc together had better effect on grapevine yields.

Swietlik (1995) expressed that the effects of other soil treatments were statistically insignificant. Foliar Zn deficiency symptoms were much more severe in winter than summer months irrespective of treatment. As the trees aged, however, the severity of symptoms decreased in all treatments. Corrective foliar or soil Zn applications were found to increase grapefruit yield when 15% or more of the canopy foliage showed Zn deficiency symptoms in January.

Yogheeshappa (2007) observed the fresh fruit yield of grapes in low and high yielding vineyards ranged from 7.01 to 9.59 and 10.48 to 19.42 tons per acre with an average value

of 7.38 and 13.87 tons per acre, respectively. In Ashoori et al. (2013) the greatest yield achieved in $N_1 \times Zn_2 \times Fe_3$ (N_1=0, Zn_2=1.5 mgl^{-1} and Fe_3= 20 g/tree soil application).

Number of clusters per plant: According to the result of this experiment the effect of different doses of nitrogen and zinc were significant on number of yield in grapevine ($P \leq 0.01$).

Similar to figure 1, diagram 2 shows N_1S_2 and N_2S_3 treatments have the most number of clusters in each tree (31 clusters) that they had about 7 clusters more than control treatment in each tree. There weren't any significant differences between N_1S_2, N_2S_3 to some of the treatments such as N_1, N_2, N_3, S_1, N_1S_1, N_1S_3, N_2S_2 and N_3S_1 in number of clusters, but these treatments had significant differences to other treatments. Addition in amount of zinc sulfate fertilizer from 35 to 45 g/trees has caused decreasing the clusters number from 28 to 25; although there aren't any significant differences between S_2 and S_3, but S_1 treatment had significant differences to S_2 and S_3. It showed probably the range of trees requirement is about 35 g/ trees. On the other hand, addition of zinc sulfate to urea fertilizer had various effects in different concentration of nitrogen. For example N_1S_2 had more yield and number of clusters in each tree than N_1S_1, but N_1S_3 had less yield and clusters number than N_1S_2. But Zn addition to N_2 and N_3 concentration showed difference result in yield and clusters number follow these respectively:

$N_2S_1 \leq N_2S_2 \leq N_2S_3$

$N_3S_1 \geq N_3S_2 \geq N_3S_3$

The foregoing showed adding zinc from 35 to 55 g/trees caused more yield and clusters' number in trees that received Urea fertilizer in concentration of 250 g/trees, whiles the opposite of this process occurred in application of Urea in 350 g/trees. The reduction in yield and clusters number is probably due to reducing in plant tolerance to more levels of Zn and N nutrition.

Yogheeshappa (2007) expressed the average berry weight, bunch weight, number of bunches per vine (Thompson seedless cultivar) were found to be more in the high yielding vineyards. In low and high yielding vineyards, the number of bunches per vine were varied from 73.95 to 96.73 and 95.62 to 137.26 with a mean value of 81.58 and 113.43, respectively. The result of Eman et al. (2008) showed that number of clusters/ plant was not significantly affected by the treatments in both seasons. In their experiments the highest value followed by treatment 3 (50% mineral+ humic acid) and treatment 6 (50% mineral N+ municipal solid waste+ humic acid+ bio fertilizer).

Average weight of clusters per plant: According to the result of this trial the effect of different doses of nitrogen and zinc were significant on Average weight of each cluster in each tree on grapevine ($P \leq 0.05$).

Application of different concentration of Urea and Zinc sulfate showed the most average weight of clusters in each tree were observed in N_2S_3 treatment that it didn't had significant differences to other treatments except S_1 and N_2S_1. According to the result of Yogheeshappa (2007) the bunch weights of low and high yielding vineyards were ranged from 153.52 and 236.7 g with a mean of 202.70 and 236.55 g and 295.32 g with an average of 274.01, respectively.

The weight of the biggest cluster in each tree: According to the result of this trial the effect of different levels of nitrogen and zinc were significant on the weight of the biggest cluster in each tree on grapevine ($P \leq 0.01$).

According to above figure (4) the most weight of maximum cluster was belong to N_2 treatments that it had significant differences to other treatments, whiles there isn't any significant differences between other treatments.

Total soluble solid (TSS) in grape juice: According to the result of this trial the effect of different levels of nitrogen and zinc were significant on total soluble solids of grape berry juice in each tree ($P \leq 0.05$).

According to the result of Yogheeshappa (2007) the total soluble solids (TSS) ranged from 18 to 24°B and 19 to 25°B with an average of 21.33 and 22.00 °Brix of low and high yielding vineyards, respectively. The quality of the fruits (TSS, reducing and non-reducing sugar and total sugar) were found to be slightly less with increase in the yield of the vineyards. The average sugar: acid ratio was found to be more in fruits of high yielding vineyards.

Ighbal et al. (2012) expressed that treatment T_2 containing (500 g N/plant) attained the maximum fruit Total Soluble Solids (TSS) of 12.21% but the treatment T5 was found minimum (10.57%).

pH in grape juice: According to the result of this trial the effect of different levels of nitrogen and zinc were significant on pH of grape berry juice in each tree ($P \leq 0.01$).

Jackson (1986) found that plants with low berry numbers made more leaf area than those with high numbers. Low berry number, high leaf area, growth rate and high berry sugar and pH levels and low acid levels.

The result of Iqbal et al. (2012) showed that higher doses of nitrogen increased the quality of the fruits of apple fruits. The similar results were recorded by Cheng et al. (2002).

While the pH of fruit indicated that treatment T_5 (800 g N/plant) attained the maximum fruit pH of 3.97. The results showed that higher dose of nitrogen did not enhance the pH of the fruits. The similar results were shown by Guak *et al.* (2001).

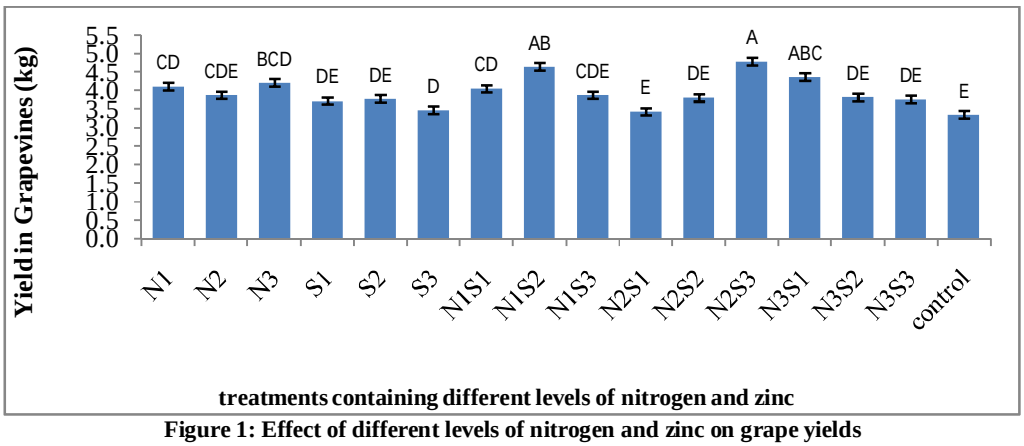

Figure 1: Effect of different levels of nitrogen and zinc on grape yields

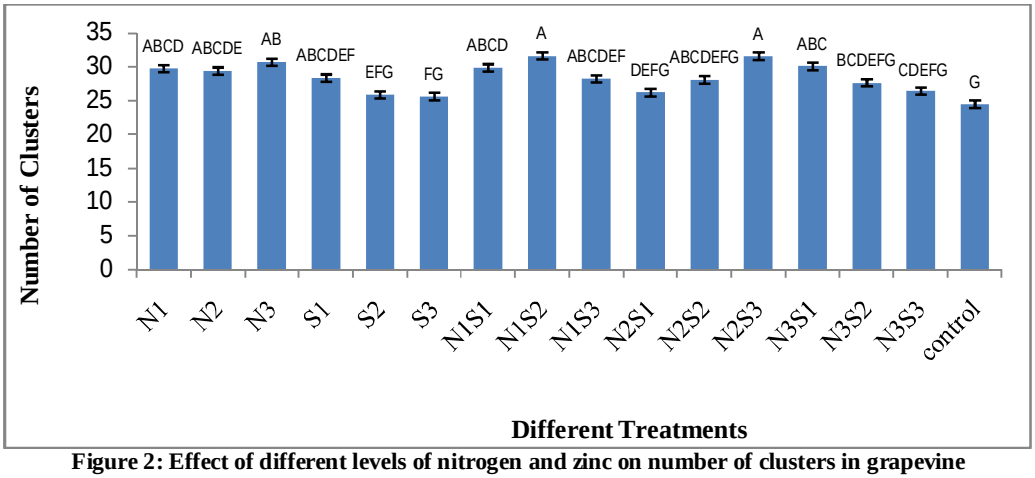

Figure 2: Effect of different levels of nitrogen and zinc on number of clusters in grapevine

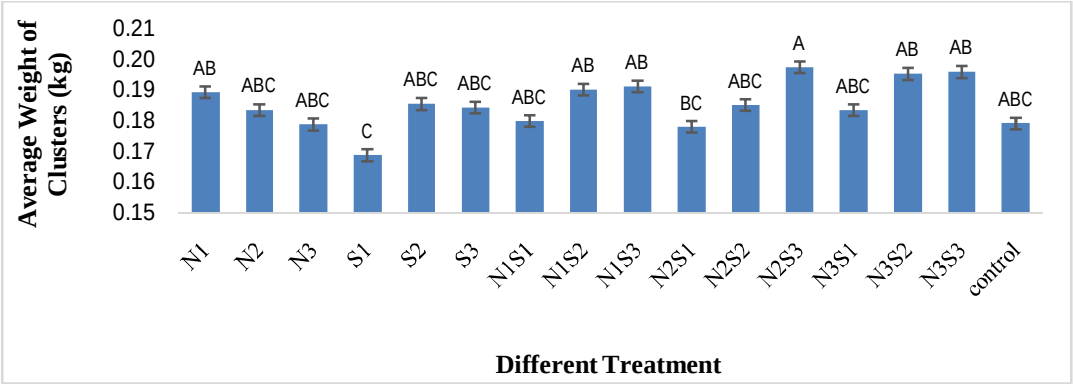

Figure 3: Effect of different levels of nitrogen and zinc on average weight of clusters in grapevine

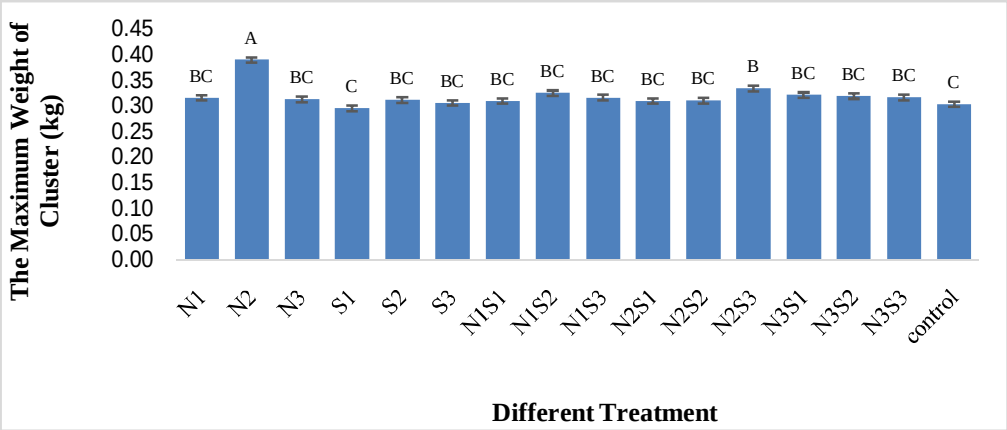

Figure 4: Effect of different levels of nitrogen and zinc on maximum clusters weight in grapevine

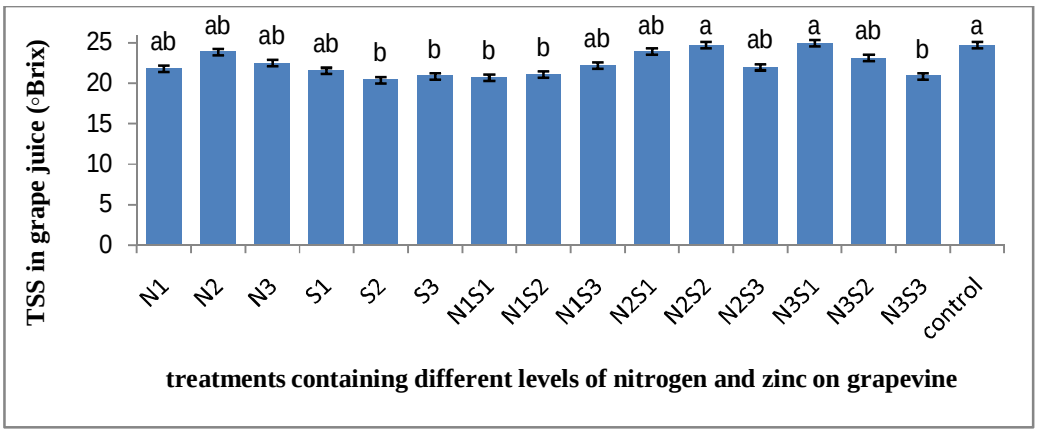

Figure 5: Effect of different levels of nitrogen and zinc on TSS in grape juice

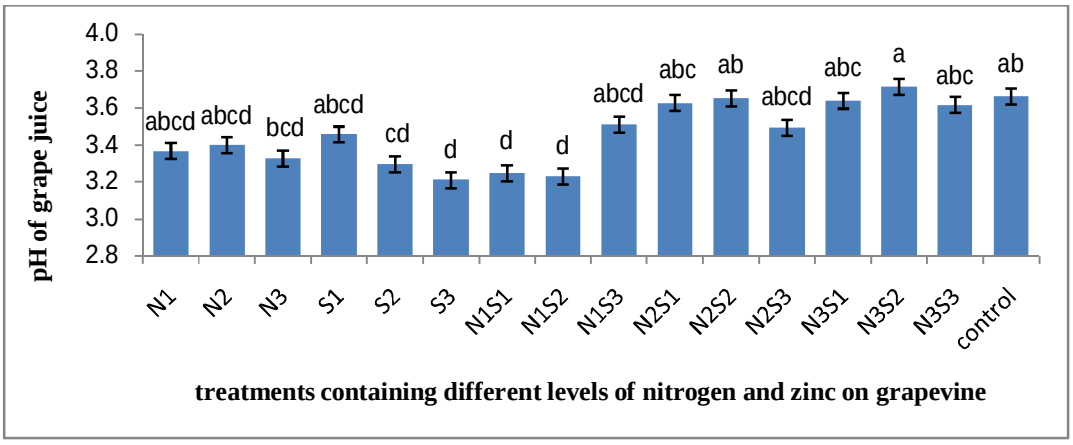

Figure 6: Effect of different levels of nitrogen and zinc on pH in grape juice

Table 1: Mean square of different parameters containing different concentration of nitrogen and zinc

	yield	Number of cluster	Average weight of cluster	The weight of the biggest cluster	TSS	pH
Treatments	0.493**	14.469**	0.00*	0.001**	7.4*	0.09**
error	0.076	3.514	0.00	0.00	3.41	0.033
CV (%)	11.70	9.38	5.85	7.52	9.64	6.51

***, ** are significantly in P≤0.05 and P≤0.01 and ns are non-significantly**

CONCLUSION

According to the result of this experiment, application of different concentration of Urea and Zinc sulfate had different effect on qualitative and quantitative characteristics of Yaghoti cultivar of grapevine. Because of early ripening of this cultivar (at least 2 months before ripening the other cultivar in other provinces) enhancing the yield and other quantitative and qualitative characteristics can lead to increasing the economic efficiency for growers. Especially the lack of water and unsuitable financial situation of farmers, High price of fertilizer in this region caused the farmers don't interest in using of fertilizers for grapevines. So the result of this study can be recommend to farmers for application of urea and zinc sulfate that deposit the lack of water can enhance the number of cluster and yield in Yaghoti grapevines.

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