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# Correction of Boron Deficiency in Grape Vines of Bez El-Anza Cultivar

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**Abstract:** Deteriorated vineyard of the seedy cv. Bez El-Anza at Nekla region, was investigated. Vines showed symptoms of abnormality in root growth, clusters and berries led to reduction in yield. Leaf boron content (B) was about 14 ppm which considered much lower than that of normal range. The cause of abnormality was expected to be boron deficiency. Therefore, a field experiment was laid out for two successive seasons in order to clarify the effect and number of boric acid sprays (17% B) at conc. of 0.05% up to four times on diseased grapevines. Results showed that spraying deficient vines for 3 times at three weeks intervals as growth start had sufficient boron to insure normal vegetative growth, while vine sprayed 4 times recorded the highest berry set percentages. Leaf mineral and total carbohydrate contents were significantly increased up the 4$^{th}$ spray one, meanwhile leaf B content was nearly doubled by the second spray and reached optimal values in vines received B four times. Ascending improvement in berry dimensions, quality of berry juice and total yield were maximized by the fourth boric acid spray. It can be recommended that using boric acid as foliar spray at 0.05% for 4 times was effective. As it corrected abnormality in vine growth, improved nutrient status, yield and berry quality in vineyards.

**Key words:** Grape vines · Bez El- Anza cultivar · boron · vegetative growth · cluster yield · berry set minerals content

## INTRODUCTION

Growers of grapes have a long list of problems that can possibly subvert their efforts. Boron deficiency have a dramatic effect on vine yard, where its severe effect often diagnosed by visual symptoms on roots tendrils, shoots, leaves, flowers, clusters and development of berries [1], according to its essential role in growth of roots, pollen germination, fruit setting percentages and development of berries & cluster [2].

In grapevines, foliar application is considered emergency treatment as boron deficiency detected, especially in sandy soils [3, 4]. In addition, repeating sprays may be necessary when rates of foliar applications are much lower.

In order to clarify the efficiency of frequent boron sprays leading to optimum dose. A field experiment was laid out in a deteriorated grape vine of Bez El-Anza seedy variety at Nekla region, where visual symptoms was expected to be boron deficiency. Response to correction of this physiological disorder was studied.

## MATERIALS AND METHODS

This study was carried out during two successive seasons on a boron deficient grapevine cultivated with the seedy grape variety Bez El-Anza *(Vitis vinifera)*. Vines were 12 years old grown in sandy loam soil at Nekla region, Giza Governorate under drip irrigation system. Soil analysis indicated sandy texture with 11.3% silt, 12.6% clay and its pH 7.9, $CaCO_3$ 2.86% where extractable boron 0.16%. Leaf samples were analyzed; its boron content recorded 14 ppm, which was more lower than those of normal range (26- 40 ppm) as indicated by Fragoni [5].

Treatments were applied in a Randomized Complete Block Design with 3 replicates (two vines/each). The chosen vines were nearly similar in growth, received the normal practices, planted at 2.5x3 m apart and trained according to the head system.

**The experiment included the following treatments:**

- Boron in the form of boric acid (17 %B) was individually sprayed at conc. 0.05% with Triton B (0.1%) for one time, two times, three times and four times at three weeks intervals started as growth start and ended nearly after berry set. Control sprayed with water only.
- In the second season, the experiment was repeated on another set of injured vines.

**Recorded data:**

**Growth parameters including:** Shoot length, No. of laterals per shoot, number of leaves/ shoot, leaf area, leaf

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fresh and dry weight and percentages of berry set. Leaf samples were analyzed on dry weight basis for determination of N, P, K, Fe, Zn and Mn contents according to the methods described by Cottanie *et al.* [6]. Boron was determined by Azomethine- H colorimetric method [7].

Where, total carbohydrates were analyzed by the methods of Mclory [8].

At harvest (1st week of September), yield was determined as no. of clusters/vine, cluster weight, yield per vine and No. of berries per cluster.

Berry quality in terms of berry weight, berry size and berry dimensions (longitudinal & equatorial, in cm led to shape index) were recorded - where total sugars, total soluble solids (T.S.S), total acidity (as tartaric acid/ 100 ml juice) and T.S.S /acid ratio were also calculated in berry juice.

The obtained data was statistically analyzed according to Snedecor and Cochran [9].

## RESULTS AND DISCUSSION

**Effect of boron sprays on vegetative growth:** Results presented in Table 1 show that shoot length, number of laterals per shoot and number of leaves per shoot were gradually increased as the number of boron sprays increased. This hold true up to the 4th spray for both seasons. Whereas, the different spray frequencies failed to reveal significant improvement for either No. of laterals or No. of leaves per shoot.

Leaf area, leaf fresh and dry weight were linearly increased by increasing number of boron sprays with significant benefits, except slight fluctuations in leaf area related to either 1st or 2nd spray one.

Meanwhile, the fourth spray increased leaf area by 16.6 and 14.8% for the 1st and 2nd seasons, respectively as compared with control.

These results indicated that spraying deficient vines for 3 times at three weeks intervals had sufficient boron to ensure normal growth for shoots and leaves. Where, more than three spray frequencies may be required to correct boron deficiency. The response to boron application regarding vegetative growth is in line with those observed by Ahmed and El-Morsey [10], Azimov [11] and Youssef [12].

Regarding berry set, data showed that different boric acid sprays significantly increased fruit set as compared with injured vines (control), for both seasons.

In general, vines sprayed 4 times recorded the highest berry set percentages followed in descending order by vines sprayed thrice times, twice times and single one. Where the average of berry set for the both seasons were increased more than control by 48.9, 34.2, 21.2 and 9.5%, respectively.

The favorable effect of boron on growth characters and berry set could mainly attributed to its important role in metabolism of N, biosynthesis, translocation of carbohydrates and fruiting processes.

These results are in accordance with those obtained by Sharrocks & Portch [2], Ali [3], Ahmed & Abd-Hameed [4] and Zhang [13].

In conclusion, spraying injured grapevine by boron in the form of boric acid at 0.05% with Triton B (0.1%) for 4 individual doses at three weeks intervals

Table 1: Effect of boron sprays on vegetative growth and fruit set of Bez El-Anza grape cultivar

| No. of boron foliar sprays | Shoot | | Leaves | | | | Berry |
|---|---|---|---|---|---|---|---|
| | Length (cm) | No. of laterals | No./ shoot | Area ($cm^2$) | F.wt. (g) | D.wt. (g) | Set % |
| | | | First season | | | | |
| 0 | 126.00 | 28.3 | 57.2 | 221.00 | 10.53 | 4.18 | 6.36 |
| 1 | 141.00 | 28.7 | 52.6 | 230.00 | 10.97 | 4.45 | 7.21 |
| 2 | 146.00 | 29.2 | 53.1 | 237.00 | 11.43 | 4.47 | 8.05 |
| 3 | 153.00 | 29.8 | 53.7 | 248.00 | 12.00 | 5.04 | 8.94 |
| 4 | 158.00 | 30.1 | 54.4 | 260.00 | 12.62 | 5.36 | 9.91 |
| L.S.D at 5% | 4.41 | N.S | N.S | 7.46 | 0.42 | 0.24 | 0.69 |
| | | | Second season | | | | |
| 0 | 123.00 | 27.7 | 53.6 | 228.00 | 10.33 | 4.11 | 6.92 |
| 1 | 138.00 | 28.2 | 54.9 | 239.00 | 10.73 | 4.36 | 7.74 |
| 2 | 143.00 | 28.6 | 54.3 | 245.00 | 11.15 | 4.63 | 8.51 |
| 3 | 149.00 | 29.1 | 54.8 | 254.00 | 11.73 | 4.92 | 9.93 |
| 4 | 154.00 | 29.5 | 55.0 | 264.00 | 12.34 | 5.24 | 10.33 |
| L.S.D at 5% | 4.26 | N.S | N.S | 6.78 | 0.39 | 0.23 | 0.66 |

Table 2: Effect of boron sprays on leaf mineral and total carbohydrate contents of Bez El-Anza grape variety

| No. of boron foliar sprays | % on dry weight bases | | ppm on dry weight basis | | | | | Total carbohydrate % in center |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | Fe | Zn | Mn | B | |
| | | | | First season | | | | |
| 0 | 1.89 | 0.23 | 1.09 | 88.00 | 30.40 | 26.30 | 14.10 | 14.03 |
| 1 | 2.27 | 0.23 | 1.19 | 102.00 | 36.70 | 35.70 | 20.80 | 16.50 |
| 2 | 2.42 | 0.24 | 1.28 | 115.00 | 46.10 | 45.20 | 28.40 | 18.40 |
| 3 | 2.51 | 0.24 | 1.37 | 167.00 | 60.90 | 57.80 | 36.60 | 19.80 |
| 4 | 2.63 | 0.25 | 1.44 | 174.00 | 63.50 | 66.80 | 46.10 | 21.70 |
| L.S.D at 5% | 0.098 | N.S | 0.064 | 17.20 | 6.22 | 8.14 | 6.40 | 1.26 |
| | | | | Second season | | | | |
| 0 | 1.94 | 0.223 | 1.11 | 96.00 | 33.80 | 29.00 | 13.90 | 14.60 |
| 1 | 2.32 | 0.228 | 1.20 | 104.00 | 41.50 | 38.10 | 20.40 | 17.10 |
| 2 | 2.44 | 0.232 | 1.33 | 128.00 | 50.20 | 48.60 | 27.80 | 18.40 |
| 3 | 2.57 | 0.236 | 1.44 | 177.00 | 67.10 | 60.20 | 36.60 | 20.10 |
| 4 | 2.69 | 0.241 | 1.56 | 186.00 | 69.80 | 71.70 | 45.60 | 22.20 |
| L.S.D at 5% | 0.096 | N.S | 0.084 | 17.90 | 7.02 | 8.54 | 6.34 | 1.32 |

starting as growth start can correct the nutrient balance within the vine, improving growth and consequently cures the physiological disorders resulting from boron deficiency.

**Effect of boron sprays on leaf mineral and total carbohydrate contents:** Results in Table 2 show that leaf mineral contents varied according to number of boric acid sprays, where its values in injured vines approached or below deficient concentrations suggested by Fragoni [5]. This was holding true for both seasons except those of optimal level of phosphorus contents. Leaf N and K contents were linearly increased as number of boron sprays increases up the 4$^{th}$ one, where its optimal levels were revealed with the second spray one.

Obtained data also show a progressive increment in the concentrations of Fe, Zn, Mn and B of leaves by increasing boron spray frequencies up the 4$^{th}$ one, with significant differences. The third spray, nearly doubled levels of Fe, Zn and Mn contents with optimum values comparing with control.

Whereas, average boron content sampled from problem orchard was about B 14 ppm and nearly doubled by the second boron spray to reach its optimal range (40-46 ppm) as the fourth foliar spray applied.

These results indicated that boron treatments corrected the disturbance effect of root growth led to suppress differential translocation without revealing physiological antagonism in tested minerals within plant tissues resulting from spraying boric acid at conc. (0.05%) up to 4 times.

Similar results have been previously discussed by Ali [3], Youssef [12] and Madbouly *et al.* [14].

Concerning total carbohydrate, data indicated that single spray of boric acid failed to reveal any significant increase in its contents. Whereas, its values were gradually increased as number of boric acid sprays increased to reach nearly 40% more than control (in both season) as the fourth spray applied. The role of boron in translocation of carbohydrates and increasing its content may be attributed to the increase in leaf mineral content as well as leaf area and its stimulus effect on the process of photosynthesis [15]. These findings are in accordance with these recorded by Sharrocks and Portch [2].

**Effect of boron sprays on yield and berry characteristics:** Data in Table 3 indicated that yield per vine expressed in cluster weight, berry number per cluster and berry weight was gradually increased by increasing No. of boric acid sprays to record significant differences as twice sprays were applied. This hold true for both seasons, though different boron spray frequencies failed to increase number of clusters per vine. The ascending development in yield per vine was maximized as vines received the 4$^{th}$ boric acid spray. Average yield per vine for both seasons reached 15.3 kg compared with 10.3 kg in boron deficient vines.

Berry size and dimensions were progressively improved by increasing number of boron sprays. Results further indicate that twice sprays revealed significant response in improving berry dimensions,

Table 3: Effect of boron sprays on yield and berry characteristics of Bez El-Anza grape cultivar

| No. of boron foliar sprays | Yield | | | Berry | | | | Juice | |
|---|---|---|---|---|---|---|---|---|---|
| | No. of clusters per vine | Cluster wt. (g) | Per vine (kg) | No/cluster | Weight (g) | Size (ml) | Shape index | TSS/acid | Total sugars % |
| | | | | First season | | | | | |
| 0 | 25.50 | 395.00 | 10.07 | 112.00 | 3.53 | 4.06 | 1.01 | 23.60 | 16.50 |
| 1 | 25.60 | 431.00 | 11.03 | 116.00 | 3.71 | 4.27 | 1.05 | 25.30 | 17.40 |
| 2 | 25.80 | 470.00 | 12.13 | 122.00 | 3.85 | 4.43 | 1.11 | 27.10 | 18.40 |
| 3 | 26.00 | 521.00 | 13.55 | 130.00 | 4.01 | 4.61 | 1.16 | 29.30 | 19.60 |
| 4 | 26.30 | 577.00 | 15.18 | 139.00 | 4.15 | 4.77 | 1.22 | 32.00 | 20.80 |
| L.S.D at 5% | N.S | 36.40 | 1.022 | 5.40 | 0.124 | 0.142 | 0.039 | 1.68 | 0.86 |
| | | | | Second season | | | | | |
| 0 | 26.20 | 402.00 | 10.53 | 121.00 | 3.32 | 3.86 | 1.02 | 24.10 | 16.80 |
| 1 | 26.30 | 440.00 | 11.57 | 126.00 | 3.49 | 4.05 | 1.06 | 26.00 | 17.70 |
| 2 | 26.60 | 487.00 | 12.74 | 133.00 | 3.66 | 4.25 | 1.10 | 28.20 | 18.80 |
| 3 | 26.80 | 540.00 | 13.96 | 142.00 | 3.80 | 4.41 | 1.15 | 30.60 | 20.00 |
| 4 | 27.10 | 603.00 | 15.39 | 152.00 | 3.97 | 4.60 | 1.20 | 33.20 | 21.40 |
| LS.D at 5% | N.S | 40.30 | 1.05 | 6.20 | 0.128 | 0.148 | 0.036 | 1.82 | 0.82 |

where vines sprayed 4 times resulted in the greatest values of berry size and shape index.

Concerning juice contents, it is clear from Table 3 that boric acid treatment progressively increased the percentages of total soluble solids as well as total sugars and decreased total acidity, comparing with unsprayed vines. Significant differences were observed due to varying number of sprays and outstanding promotion in quality of berry juice was peaked by increasing B sprays up to the 4$^{th}$ spray. The positive action of boron on yield and berries quality might be attributed to vine nutritional status, biosynthesis and translocation of carbohydrates (previously mentioned in Table, 2) that led to increasing yield in terms of number and weight of bunches, besides improving physical and chemical quality of berries. These results are in harmony with those obtained by Ali [3], Youssef [12], Elshata *et al.* [16], Singh & Rethy [17] and Shoeib & El-Sayed [18].

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