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Effect of Foliar Potassium, Boron Treatments and Girdling on Growth, Productivity and Leaves Chemical Composition of Table Grape "Superior cv." Covering with Plastic Sheets

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ABSTRACT

The present study was conducted during the two seasons of 2013 and 2014 in a private vineyard of "Superior" grape cultivar, El-Noubarya city, Behaira Governorate, Egypt. Vines were covered by white plastic sheets. The experiment included 3X3X3 treatments of the three girdling times (no girdling, girdling after fruit set when the berry diameter 6-8mm and girdling at veraison stage), the three foliar potassium times (no foliar potassium, foliar potassium after fruit set when the berry diameter 6-8mm and foliar potassium at veraison stage) and the three foliar boron time treatments (no foliar boron, foliar boron after fruit set when the berry diameter 6-8mm and foliar boron at veraison stage. Their effects on air temperature monitoring, vegetative growth, productivity and leaves chemical composition were studied. Results revealed that, mulching increased mean of maximum air temperatures by 5°C, also mulching increased mean of minimum temperatures by 1.2°C. The highest leaf area was obtained (G1K1B2) and (G1K2B0) treatments compared with all treatments. Moreover, the highest shoot length was observed with (G1K1B1) treatments at April 30th and May 30th in both seasons. The (G2K2B1) and (G2K2B2) treatments gave the highest leaves nitrogen %, phosphorus % and potassium % compared with control treatment. Also the (G1K2B2) treatment gave the highest value of leaf boron during the two seasons compared with all treatments. Furthermore, the (G1K1B1) treatment gave the highest leaf total chlorophyll content in both seasons compared by all treatments. Generally the highest number of clusters was recorder by (G1K1B1) treatment which gave the lowest value of cluster compactness compared with all treatments. Moreover, the (G1K2B2) treatment gave the highest cluster weight and yield per vine compared with control treatment.

Key words: Foliar boron, Potassium, Growth, Productivity, Grape

Introduction

It is well known that most of the new reclaimed area in Egypt are planted with fruit trees especially grapes which considered the first fruit crop in the world and the second fruit crop in Egypt. The area of the vineyards has increased rapidly through the last few years. Grape (*Vitis vinifera* L.) is considered as one of the most important commercial fruit crops of temperate to tropical regions (Gowda *et al*., 2008). The grape is gaining popularity for its high nutritive value, excellent in taste, multipurpose use and better returns (Ghosh *et al*., 2008). A constant and steady improvement is observed in worldwide table grape consumption (Celik *et al*., 2005).

Plasticulture techniques use wavelength selective polyethylene mulch and clear polyethylene to trap solar energy, raise soil and air temperatures, and thereby advance the harvest season of row crops (Wells and loy, 1985; Bonnano and Lamont, 1987; Maurer and Frey, 1987; Gerber *et al*., 1988; Motsenbocher and Bonano, 1989; Gaye *et al*., 1992; Alexander and Clough, 1998; Bowen, 1998; and Jenni *et al*., 1998). Row covers also shield plants from wind which can disturb leaf display (Bowen and Frey, 2002) and reduce stomatal conductance (Caldwell, 1970). Although enclosing whole vineyard blocks or rows in polyethylene film has been used successfully to advance table grape harvest (Novello *et al*., 1999 and 2000). Timing of phonological stages and rates of growth and development in grapevines are strongly dependent on temperature exposure (Guitarez *et al*., 1985 and Williams *et al*., 1985). Covering a vineyard will modify the solar radiation characteristics (Carbonneau, 1984; Smart, 1985 and Reynolds *et al*., 1996) and, consequently, creates changes in the microclimate (photosynthetically active radiation, air temperature, humidity and wind speed) at the cluster level.

Girdling which consists of removing a small section of phloem (about 4 mm in width) from around the trunk, has been practiced for years to produce large berries of grapes intended for table use, or to enhance fruit maturity by enhancing berry coloration or accumulation of sugar (Williams and Ayars, 2005, Roper and Williams, 1989). The operation, however, is expensive and occasionally results in the death of the girdled cane (Weaver and Winkler, 1951). Root carbohydrate concentrations were less for the girdled vines when compared to the control vines (Roper and Williams, 1989). Girdling grapevines resulted in both an increase in carbohydrate concentration above girdle and an increase in weight per unit leaf area (During, 1978). Interruption

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of phloem translocation of photosynthates to the root system is known to improve carbohydrate availability to bunches, thereby enhancing sugar accumulation of seeded grapes and berry size of seedless grapes (Winkler *et al*., 1974). To achieve this, girdling has to be performed at the onset of berry ripening, veraison, when rates of sugar accumulation in berries are highest (Weaver and Mccune, 1959, Peacock *et al.,* 1977, Roper and Williams, 1989).

Potassium is essential for grapevine growth and yield and serves an important purpose in several different plant functions. Potassium is readily translocated throughout the grapevine and may be involved in carbohydrate transport and metabolism. Potassium, a cation, is used as an osmotic agent in the opening and closing of stomata, an important mechanism of vine water relations. Potassium also neutralizes organic acids and plays a role in controlling acidity and pH of the fruit's juice (Mullins *et al.,* 1992). Very little is known about the exact functions of potassium in grape berries, however it is known that potassium is vital for berry growth (Mpelasoka *et al,* 2003). The role of potassium in crop yield formation and product quality, and the dependence of crop stress resistance on potassium nutrition. Average soil reserves of potassium are generally large, but most of it is not plant-available. Therefore, crops need to be supplied with soluble potassium fertilizers, the demand of which is expected to increase significantly, particularly in developing regions of the world.In potassium -deficient crops, the supply of sink organs with photosynthates is impaired, and sugars accumulate in source leaves. This not only affects yield formation, but also quality parameters, for example in wheat, potato and grape (Zorb *et al*., 2014).Potassium is essential for vine growth and yield. Grape berries are a strong sink for potassium, particularly during ripening. Excess potassium levels in grape berries may have a negative impact on wine quality, mainly because it decreases free tartaric acid resulting in an increase in the pH of grape juice, must and wine (Mpelasoka *et al*. 2003).

Boron is a vital element in the development and growth of new cells, in the fertilization of flowers, in the carbohydrate metabolism, and in the translocation of starch and sugars. It is indispensable in the nitrogen and phosphorus metabolism, in the synthesis of amino acids and proteins. It has a role in the RNA and DNA synthesis, in the embrionary development, and in the hormonal regulation (Bergmann 1979, Keller 2005). Boron uptake is the most intensive in the beginning of the vegetation period. Demand on boron is significant at the time of the development of flowers, adosculation and the cell division of fruit. Boron shows very low mobility within the plant. Boron is an essential element for the growth of optimum plant (Marschner, 1995). Excessive amounts of boron just as in the case of its deficiency can have negative effects and stop the growth of plant (Marschner, 1986). Boron positively affects fruit growth (Faust, 1989). Lack of Boron is the most serious illnesses in vine cultivation. Fruit growth gets weaker and the yield decreases by 80% compared to the plants nourished with boron. This is a result of the need for high amount of boron for pollen tube growth and vividness (Mengel and Kirkby, 2001).

The objectives of this study were to investigate the effect of foliar potassium, boron treatments and girdling treatments on:

1-Some vegetative parameters.

2-Yield components of table grape " cv. Superior " covering with plastic sheets.

3-Some leaves chemical composition

Materials and Methods

The present study was conducted during the two seasons of 2013 and 2014 in a private vineyard of "Superior" grape cultivar, El-Noubarya city, Behaira Governorate, Egypt. This study was conducted in a split split-plot design with four replicates in the two seasons. The vineyard was established in 2002, with vine spacing of 2 m within rows and 3 m between rows. The vines are grown in sandy soil under drip irrigation system and trained to cane pruning under baron trellis system.

Experimental treatments:

Air white plastic mulch application (Polyethylene, color clear, thickness 0.120 mm) was applied 25 days after pruning time in all treatments in both seasons. Removal mulching was either all-at-once or in two stages to allow for vine acclimation (Bowen et al., 2004a). All removal was done 15 days before harvest, in the all treatments. All air sleeves covered vegetative growth; the sleeve enclosures were supported at the top by trellis catch wires and closed at the bottom around the vine cane.The main factor was the three girdling times (girdling of main trunk of vines was done by removing 4 mm wide ring of bark (no girdling (G0), after fruit set when the berry diameter 6-8mm (G1) and girdling at veraison stage (G2)), while the sub main factor was the three foliar potassium times (potassium 25% (W/V) with concentrate 2 cm/liter of water)) treatments (no foliar potassium (K0), foliar potassium after fruit set when the berry diameter 6-8mm (K1) and foliar potassium at veraison stage (K2), while the sub sub main factor was the three foliar boron times treatments (boron 7% (W/V) with concentrate 0.5 cm/liter of water (no foliar boron (B0), foliar boron after fruit set when the berry diameter 6-8mm (B1) and foliar boron at veraison stage (B2).

The vines were pruned 20th December and it was carried during dormant season to ten canes per vine with 12 buds per cane. Four renewal spurs (2 nodes) were retained per vine. The vines were treated with 4% hydrogen cyanamide (Dormex) after pruning 12 days. The control is the field (no girdled, no foliar potassium and no foliar boron). The experiment included 3X3X3 treatments of the three girdling times, the three foliar potassium times and the three foliar boron time treatments, which were applied in a split split-plot design, replicated in four blocks.

The following treatments were applied:

1- No girdling + no foliar potassium + no foliar boron (G0K0B0) (control).
2- No girdling + no foliar potassium + foliar boron after fruit set when the berry diameter 6-8mm (G0K0B1).
3- No girdling + no foliar potassium + foliar boron at veraison stage (G0K0B2).
4- No girdling + foliar potassium after fruit set when the berry diameter 6-8mm + no foliar boron (G0K1B0).
5- No girdling + foliar potassium after fruit set when the berry diameter 6-8mm + foliar boron after fruit set when the berry diameter 6-8mm (G0K1B1).
6- No girdling + foliar potassium after fruit set when the berry diameter 6-8mm + foliar boron at veraison stage (G0K1B2).
7- No girdling + foliar potassium at veraison stage + no foliar boron (G0K2B0).
8- No girdling + foliar potassium at veraison stage + foliar boron after fruit set when the berry diameter 6-8mm (G0K2B1).
9- No girdling + foliar potassium at veraison stage + foliar boron at veraison stage (G0K2B2).
10- Girdling after fruit set when the berry diameter 6-8mm + no foliar potassium + no foliar boron (G1K0B0).
11- Girdling after fruit set when the berry diameter 6-8mm + no foliar potassium + foliar boron after fruit set the berry diameter 6-8mm (G1K0B1).
12- Girdling after fruit set when the berry diameter 6-8mm + no foliar potassium + foliar boron at veraison stage (G1K0B2).
13- Girdling after fruit set when the berry diameter 6-8mm + foliar potassium after fruit set when the berry diameter 6-8mm + no foliar boron (G1K1B0).
14- Girdling after fruit set when the berry diameter 6-8mm + foliar potassium after fruit set when the berry diameter 6-8mm + foliar boron after fruit set when the berry diameter 6-8mm (G1K1B1).
15- Girdling after fruit set when the berry diameter 6-8mm + foliar potassium after fruit set when the berry diameter 6-8mm + foliar boron at veraison stage (G1K1B2).
16- Girdling after fruit set when the berry diameter 6-8mm + foliar potassium at veraison stage + no foliar boron (G1K2B0).
17- Girdling after fruit set when the berry diameter 6-8mm + foliar potassium at veraison stage + foliar boron after fruit set when the berry diameter 6-8mm (G1K2B1).
18- Girdling after fruit set when the berry diameter 6-8mm + foliar potassium at veraison stage + foliar boron at veraison stage (G1K2B2).
19- Girdling at veraison stage + no foliar potassium + no foliar boron (G2K0B0).
20- Girdling at veraison stage + no foliar potassium + foliar boron after fruit set when the berry diameter 6-8mm (G2K0B0).
21- Girdling at veraison stage + no foliar potassium + foliar boron at veraison stage (G2K0B2).
22- Girdling at veraison stage + foliar potassium after fruit set when the berry diameter 6-8mm + no foliar boron (G2K1B0).
23- Girdling at veraison stage + foliar potassium after fruit set when the berry diameter 6-8mm + foliar boron after fruit set when the berry diameter 6-8mm (G2K1B1).
24- Girdling at veraison stage + foliar potassium after fruit set when the berry diameter 6-8mm + foliar boron at veraison stage (G2K1B2).
25- Girdling at veraison stage + foliar potassium at veraison stage + no foliar boron (G2K2B0).
26- Girdling at veraison stage + foliar potassium at veraison stage + foliar boron after fruit set when the berry diameter 6-8mm (G2K2B1).
27- Girdling at veraison stage + foliar potassium at veraison stage + foliar boron at veraison stage (G2K2B2).

Temperature Monitoring:

Air temperatures was monitored every five days through the growing season (from late December to late April) using thermisters (model 107B, Campbell Scientific, Edmonton, AB) attached to data loggers.

The following parameters were determined to evaluate the effect of different girdling times, different foliar potassium times and foliar boron time treatments:

Vegetative growth:

Leaf area (cm^2 / leaf): Leaf area was examined during the second half of May on fully developed mature leaves (leaves in the middle third of the shoots just above the raceme) by portable area meter LI-COR model LI-

3000A No. PAM 1671. The chosen leaves were located on the nodes 7, 8 and 9 from the base of the main shoot according to the suggestion of Bioletti (1938).

Shoot length: Average length of 20 shoots made in the middle third of the shoot was measured after the growth had ceased.

Yield: Average yield per vine (kg) were recorded by counting the clusters on vine and mean weight of cluster, then multiply the number of clusters and mean weight of cluster (Kg). At harvest time representative sample per each replicate were harvested and taken to laboratory to determine the physical properties:

Cluster weight (g): The clusters were counted per vine and weighed, and then average weight of cluster/treatment was calculated.

Number of cluster/ vine: The clusters were counted per vine and then average number of cluster/ treatment was calculated.

Clusters compactness: Number of berries per cluster was counted to determine clusters compactness using the following equation according to Winkler *et al*. (1974) and Ali *et al*. (2000).

$$\text{Clusters compactness ratio} = \frac{\text{No. of berries / cluster}}{\text{Cluster length (cm)}}$$

Leaf chemical contents: Leaf nutrient content (NPK) was determined in the oven dried leaf samples (6 leaves from the base) that collected at version stage. Nitrogen (%) was determined by the modified micro-kejldahl method as described by Wilde *et al*., (1985). Phosphorus (%) was determined by using Olsen method as reported by Chapman and Pratt (1965). Potassium (%) was flame photometrically determined using the method outlined by Chapman and Pratt (1965).

Chlorophyll contents: Chlorophyll content in leaves was extracted in 15 ml acetone and acid washed sand, filtered and absorption values of the filtrate was read using spectrophotometer, then total chlorophyll in leaves in both experimental seasons (mg/g fresh) were determined using the method proposed by (Bonner and Varner, 1965).

Statistical analysis: All the data collected were subjected to statistical analysis of variance as described by Gomez and Gomez (1984). The treatment means were compared using L.S.D. test at 0.05 level of probability.

Results and Discussion

Temperature Monitoring:

Air temperatures:

The effect of white plastic sheet coverings on mean of air temperature during 2013 and 2014 seasons are presented in Table (1). Data indicated that mulching increased mean of maximum temperatures in the first season by 4.98°C and 5.01°C in the second season as compared with control. Also results showed that mulching increased mean of minimum temperatures in the first season by 1.25°C and 1.13°C in the second season compared with control. Mulching caused an increase in the mean of mean temperatures by 3.11°C in the first season and 3.07°C in the second season. These results are in agreement with Benismail and Ejnaoui (2004) working in grape cv. Cardinal who found that, the use of plastic increased the temperature around the plants. Also results seemed to be in line with those obtained by Bowen *et al*. (2004a).

Vegetative growth:

Leaf area (cm^2):

Table (2) showed the interaction effect of different girdling, potassium, and boron time on leaf area (cm^2) in table grape "cv Superior" which grown under air cover sleeves at 2013 and 2014 seasons. It can be noticed that, (G1K1B2) and (G1K2B0) gave a highly significant increase compared with all treatments during 2013 experimental season, but the (G1K1B1), (G1K1B0), (G1K2B1), (G1K1B2), (G1K2B0), (G1K2B2), (G1K0B1), (G1K0B0) and (G1K0B2) caused a high significant increase in leaf area compared with all treatment in during 2014 season. No differences were found between the (G0K0B1), (G0K0B2), (G0K1B0), (G0K1B1), (G0K1B2), (G0K2B1), (G0K2B2) and control treatment which gave the lowest leaf area during 2013 season. Moreover, the differences not are big to be significant between the control treatment and the (G0K0B1), (G0K0B2), (G0K1B0), (G0K2B0) and (G0K2B1) treatments which gave the lowest leaf area during 2014 season.

Shoot length:

The interaction effect of different girdling, potassium, and boron time on average shoot length (cm) in table grape "cv Superior" which grown under air cover sleeves at 2013 and 2014 seasons are illustrated in Table (2). Data showed that, the (G1K1B1) treatment gave a highly significant increase of the average of shoot length of the study measured on April 30th and May30th compared with all treatments during 2013 and 2014 seasons. No significant differences were found between (G0K0B1), (G0K0B2), (G0K2B0) and control treatment which gave the lowest value of the study measured on April 30th in the first season, but in the second season no differences were noticed between the (G0KOB1), (G0K0B2), (G0K1BO), (G0K1B1), (G0K1B2), (G0K2B0), (G0K2B1), (G0K2B2), (G2K0B0), (G2K0B2), (G2K2B2) and control treatments. The study measured on May30th, the treatment (G0K0B1), (G0K0B2) and control, no noticed significantly differences were found between it, also it gave the lowest value compared all the treatments during both seasons. It can be concluded that, the girdling after fruit set when the berry diameter 6-8mm with foliar potassium after fruit set when the berry diameter 6-8mm with foliar boron after fruit set when the berry diameter 6-8mm gave the best results.

It can be concluded that, girdling after fruit set when the berry diameter 6-8 mm and at veraison stage gave the best results. Such result may be caused by accumulation of temperature and girdling. Our data are agreed with Novello *et al.* (1999) who studied canes of table grape cv. Matilde which grown with or without plastic covers in Apulia, Italy, they girdled at veraison. They showed that, covering and cane girdling stimulated vegetative growth and increased leaf area per vine

Table 1: Effect of white plastic sheet coverings on mean of air temperature during 2013 and 2014 seasons.

Treatments	2013			2014		
	Max.	Min.	Mean	Max.	Min.	Mean
Mulching	34.11	11.08	22.59	34.70	10.08	22.39
Control	29.13	9.83	19.48	29.69	8.95	19.32

Table 2: Interaction effect of different girdling, potassium, and boron time on average shoot length (cm) and leaf area (cm^2) in table grape "cv Superior" which grown under air cover sleeves at 2013 2014 seasons.

Treatments			2013			2014		
Girdling	Potassium	Boron	30th April	30th May	Leaf area (cm^2)	30th April	30th May	Leaf area (cm^2)
G0	K0	B0	118.0	143.8	110.6	120.6	145.5	115.5
		B1	120.5	144.0	111.3	121.6	145.8	115.5
		B2	119.5	144.5	112.4	121.3	145.8	115.3
	K1	B0	122.3	148.5	111.6	121.3	148.3	116.5
		B1	123.0	149.5	112.5	121.3	150.3	118.0
		B2	123.0	148.3	111.3	122.0	150.0	118.5
	K2	B0	120.8	147.8	113.1	122.0	151.0	117.4
		B1	122.3	150.8	111.0	122.0	151.0	117.5
		B2	121.3	151.3	111.8	121.8	153.0	117.9
G1	K0	B0	134.3	186.8	140.0	136.3	189.8	149.5
		B1	136.3	188.3	141.9	135.5	191.0	149.8
		B2	135.0	188.3	141.3	136.5	191.0	149.4
	K1	B0	142.0	192.8	142.8	140.0	191.8	151.0
		B1	148.3	195.3	144.6	147.5	198.5	151.3
		B2	139.5	190.0	145.6	139.8	192.8	150.8
	K2	B0	135.5	187.0	144.8	140.5	192.3	150.8
		B1	138.0	191.5	142.9	140.8	188.0	151.0
		B2	136.0	189.5	142.7	139.0	190.3	150.0
G2	K0	B0	123.5	179.3	137.1	122.5	181.3	141.5
		B1	123.3	179.5	136.1	124.3	181.0	141.0
		B2	122.5	180.3	136.7	122.8	181.8	141.8
	K1	B0	124.5	181.5	135.8	123.8	181.8	139.8
		B1	126.8	184.0	136.3	124.8	182.5	142.5
		B2	124.5	180.8	135.1	125.3	182.3	140.5
	K2	B0	125.0	181.0	133.6	124.3	181.5	139.3
		B1	124.3	179.3	133.8	124.8	183.8	139.5
		B2	123.8	179.8	133.3	122.3	182.0	139.9
L.S.D at 0.05 %			2.542	2.253	1.671	1.885	2.157	2.005

Yield / vine (kg)

Data of 2013 and 2014 seasons represented the interaction effect of different girdling, potassium, and boron time on Yield / vine (kg) in table grape "cv Superior" which grown under air cover sleeves at 2013 and 2014 seasons are listed in Tables (3 and 4). Results indicated that, all treatments increased significantly compared with control treatment which no differences were founded between (G0K0B1), (G0K0B2) and it (control) during 2013 and 2014 seasons. The (G1K1B1) and (G1K2B1) cause a highly significant of yield in both seasons compared with control treatment, also (G1K2B2) treatment in the first season. Such result may be caused by number of cluster per vine, weight of cluster, girdling, potassium and boron. Dhillon *et al.* (1999) showed that, the bunch number and fruit yield increased with the increase of K doses. Also, bunch and berry weight increased with each level of K applied.

Cluster weight (g)

The interaction effect of different girdling, potassium, and boron time on Cluster weight (gm) in table grape "cv Superior" which grown under air cover sleeves at 2013 and 2014 seasons is illustrated in Tables (3 and 4). Data showed that, the differences are not enough to be significant among the (G0K0B1), (G0K0B2) and control treatment which gave the value of cluster weight compared by all treatments in both seasons. All treatments increased significantly compared with control in both seasons. The (G1K2B1) and (G1K2B2) gave the highest significant compared with control during 2013 and 2014 seasons, also (G0K2B0) and (G1K2B0) in the first season. It can be concluded that, the treatments girdling after fruit set when the berry diameter 6-8 mm and potassium foliar application at veraison and boron foliar application at veraison stage gave the best results. Such result may be caused by number of berries per cluster, weight of berries, girdling, potassium and boron. Our results agreed with Dhillon and Bindra (1999) who showed that, cluster weight increased significantly with girdling done at fruit set as well as 10 days later.

Number of cluster / vine

Data presented in Tables (3 and 4) revealed the interaction effect of different girdling, potassium, and boron time on Number of cluster / vine in table grape "cv Superior" which grown under air cover sleeves at 2013 and 2014 seasons. Data showed that, the (G1K1B1) treatment gave the highest significant compared with control treatment during the two studied seasons. No significant differences were found among (G0K0B1), (G0K0B2), (G0K1B0), (G0K1B1), (G0K1B2), (G0K2B0), (G0K2B1), (G0K2B2), (G1K0B0), (G1K1B0), (G1K2B0), (G2K0B0), (G2K0B1), (G2K1B0), (G2K2B0) and control treatments during the first season. Also, no significant differences were found between the (G0K0B1), (G0K0B2), (G0K1B0), (G0K2B0), (G0K2B1), (G0K2B2), (G2K0B2), (G2K2B0), (G2K2B2) and control treatments during the second season.

Cluster compactness

Data illustrated in Table (3 and 4) show the interaction effect of different girdling, potassium, and boron time on cluster compactness in table grape "cv Superior" which grown under air cover sleeves at 2013 and 2014 seasons. Results showed that, the (G0K2B1), (G1K1B1) and (G1K1B2) treatments gave the lowest significant differences during the first season, also the (G1K1B1) treatment gave the lowest significant differences during the second season compared with all treatments which gave the highest significant of cluster compactness. Such result may be caused by number of berries per cluster, cluster length, girdling, potassium and boron.

Leaf chemical contents:

Nitrogen %

Data illustrated in Tables (5 and 6) show the interaction effect of different girdling, potassium, and boron time on leaf nitrogen % in table grape "cv Superior" which grown under air cover sleeves at 2013 and 2014 seasons. Results indicated that, the (G2K2B1), (G2K2B0), (G2K2B2), (G2K1B1) and (G2K1B2) treatments gave the highest significant differences during the first season compared with all treatments. Furthermore, the (G2K2B1), (G2K2B0) and (G2K2B2) treatments gave the highest significant differences during the second season. No significant differences were found among (G0K0B1), (G0K0B2), (G0K1B0), (G0K1B1), (G0K1B2), (G0K2B0), (G0K2B1) and control treatment during 2013 season. Also, no significant differences were found between the (G0K0B1) and control treatment during 2014 season.

Phosphorus %

The interaction effect of different girdling, potassium, and boron time on leaf phosphorus % in table grape "cv Superior" which grown under air cover sleeves at 2013 and 2014 seasons is illustrated in Tables (5 and 6). Data showed that, the differences are not enough to be significant between all treatments in the first season. No significant differences were found among (G0K0B1), (G0K0B2), (G0K1B0), (G0K1B1), (G0K1B2), (G0K2B0), (G0K2B1), (G0K2B2), (G1K0B0) and control treatment which gave the lowest value of leaf phosphorus % during the second season. Furthermore, treatments increased significantly compared with control in the second season. The treatments of girdling at veraison stage gave the highest significant compared with all treatments during 2014 season.

Potassium %

Results of interaction effect of different girdling, potassium, and boron time on leaf potassium in table grape "cv Superior" which grown under air cover sleeves at 2013 and 2014 seasons is shown in Tables (5 and 6). Results showed that, all treatments caused a significant increase of leaf potassium compared with control treatment which noticed that no differences significant were founded among (G0KB1) and control treatment in the first season, but in the second season the differences are not enough to be significant between (G0K0B1),

Table 3: Interaction effect of different girdling, potassium, and boron time on some physical fruit characters in table grape "cv Superior" which grown under air cover sleeves at 2013 season.

Treatments			2013			
Girdling	Potassium	Boron	Cluster compactness	Cluster weight (gm)	Number of cluster / vine	Yield / vine (kg)
G0	K0	B0	7.264	376.8	16.25	6.124
		B1	7.313	395.7	16.75	6.627
		B2	7.140	391.0	17.00	6.647
	K1	B0	7.135	445.5	16.25	7.245
		B1	7.292	470.7	17.00	8.002
		B2	7.085	460.2	17.00	7.823
	K2	B0	7.036	469.9	17.00	7.988
		B1	6.839	487.0	17.00	8.294
		B2	6.994	472.9	17.00	8.038
G1	K0	B0	7.035	573.9	16.75	9.624
		B1	7.061	576.6	18.00	10.37
		B2	6.990	575.7	18.00	10.36
	K1	B0	6.975	637.9	17.25	10.99
		B1	6.748	666.2	19.00	12.66
		B2	6.705	662.2	18.00	11.93
	K2	B0	6.987	687.3	17.00	11.68
		B1	7.062	712.8	18.00	12.83
		B2	6.994	726.0	18.00	13.07
G2	K0	B0	7.028	491.0	17.00	8.346
		B1	7.126	510.3	17.75	9.058
		B2	7.097	511.2	18.00	9.201
	K1	B0	7.280	537.3	17.00	9.141
		B1	7.126	549.2	18.00	9.896
		B2	7.005	541.3	18.00	9.762
	K2	B0	7.128	551.0	17.00	9.380
		B1	7.159	562.1	18.00	10.13
		B2	7.177	581.6	18.00	10.01
L.S.D at 0.05 %			0.3233	36.51	1.282	0.9781

Table 4: Interaction effect of different girdling, potassium, and boron time on some physical fruit characters in table grape "cv Superior" which grown under air cover sleeves at 2014 season.

2014						
Treatments			Cluster compactness	Cluster weight (g)	Number of cluster / vine	Yield / vine (kg)
Girdling	Potassium	Boron				
G0	K0	B0	7.250	391.6	17.25	6.567
		B1	7.197	407.0	18.00	7.319
		B2	7.128	399.3	17.50	6.986
	K1	B0	7.024	452.8	17.75	8.035
		B1	7.163	469.7	18.50	8.690
		B2	7.042	453.7	18.50	8.392
	K2	B0	6.948	494.3	18.00	8.905
		B1	7.074	517.1	18.00	9.308
		B2	6.968	506.9	18.00	9.123
G1	K0	B0	6.875	618.6	19.00	11.74
		B1	6.877	631.8	19.50	12.32
		B2	6.869	626.1	19.00	11.90
	K1	B0	6.759	685.4	19.50	13.37
		B1	6.189	698.3	20.75	14.49
		B2	6.739	683.8	19.50	13.84
	K2	B0	6.556	752.4	19.00	14.30
		B1	6.538	767.3	19.50	14.97
		B2	6.451	761.0	18.50	14.08
G2	K0	B0	6.990	525.1	18.25	9.589
		B1	7.063	542.9	18.50	10.04
		B2	7.025	537.2	18.00	9.674
	K1	B0	6.934	556.6	18.25	10.16
		B1	7.024	556.6	18.75	10.43
		B2	6.976	561.6	18.28	10.25
	K2	B0	6.980	596.5	18.00	10.29
		B1	7.081	582.0	18.50	10.77
		B2	6.969	572.1	18.00	10.29
L.S.D at 0.05 %			0.8966	23.18	0.8181	0.6372

(G0KOB2) and control treatment which gave the lowest value of leaf potassium compared by all treatments. Moreover, the treatments (G2K2B2) and (G2K2B1) gave the highest significant during the two seasons compared with control treatment.

It can be concluded that, the treatments girdling at veraison stage and potassium foliar application at veraison stage gave the best results. Such result may be caused by girdling and potassium. Our data are agreed with Ali *et al*. (2006) who studied the efficacy of both ethephon and potassium thiosulfate sprays in improving berry colouration. They observed that, a significant increase in leaf potassium content was achieved by potassium applications, especially at the highest concentration (2.1%). Our results are agreed with the finding of Saleh *et al.* (2007) who carried an experiment out to improve yield and fruit quality of Thompson seedless grape which grown under sandy soil condition through foliar sprays of potassium dihydrogen phosphate at 1 and 1.5% concentrations which sprayed at different periods (every 10, 20 or 30 days). They indicated that, using potassium dihydrogen phosphate as foliar sprays had a positive effect on leaf mineral content of Thompson seedless grapevines.

Boron

Results of interaction effect of different girdling, potassium, and boron time on leaf boron in table grape "cv Superior" which grown under air cover sleeves at 2013 and 2014 seasons is shown in Tables (5 and 6). Results showed that, all treatments caused a significant increase of leaf boron compared with control treatment which noticed that no differences significant were founded among (G0K1B0), (G0K2B0) and control treatment in both seasons. The (G1K2B2) treatment gave the highest significant of leaf boron compared by all treatments during the first season. Also, the treatments (G1K2B2), (G1K2B1), (G1K1B2) and (G2K2B2) gave the highest significant during the second season compared with control treatment.

Table 5: Interaction effect of different girdling, potassium, and boron time on some leaves chemical composition in table grape "cv Superior" which grown under air cover sleeves at 2013 season.

Treatments			2013				
Girdling	Potassium	Boron	N %	P %	K %	Boron ppm	Total chlorophyll (mg/gm)
G0	K0	B0	1.40	0.18	1.60	24.00	1.286
		B1	1.40	0.18	1.60	26.25	1.519
		B2	1.40	0.19	1.69	29.75	1.418
	K1	B0	1.40	0.19	1.70	24.25	1.609
		B1	1.40	0.19	1.79	30.00	1.633
		B2	1.41	0.18	1.80	31.00	1.608
	K2	B0	1.40	0.20	1.80	25.00	1.600
		B1	1.41	0.20	1.80	30.50	1.729
		B2	1.50	0.19	1.80	31.75	1.688
G1	K0	B0	1.50	0.18	1.90	29.75	1.959
		B1	1.50	0.19	1.90	31.50	2.147
		B2	1.50	0.21	1.90	33.00	2.087
	K1	B0	1.60	0.23	1.90	30.25	2.152
		B1	1.60	0.24	1.91	31.50	2.307
		B2	1.60	0.23	1.91	33.75	2.216
	K2	B0	1.60	0.23	2.00	30.50	2.207
		B1	1.60	0.24	2.00	33.00	2.265
		B2	1.60	0.25	2.00	35.00	2.231
G2	K0	B0	1.70	0.25	2.00	30.25	1.850
		B1	1.70	0.25	2.00	32.25	1.898
		B2	1.70	0.26	2.00	33.25	1.833
	K1	B0	1.71	0.26	2.00	30.75	1.916
		B1	1.78	0.26	2.10	32.25	2.106
		B2	1.80	0.27	2.10	33.75	2.115
	K2	B0	1.80	0.28	2.17	31.00	1.967
		B1	1.80	0.28	2.24	32.75	2.146
		B2	1.80	0.28	2.24	34.00	2.044
L.S.D at 0.05 %			0.06340	0.1186	0.06340	0.9521	0.04483

It can be concluded that, the treatments girdling after fruit set when the berry diameter 6-8 mm and potassium foliar application at veraison and boron foliar application at veraison stage gave the best results. Such result may be caused by girdling, potassium and boron.

Our results are agreed with the finding of Ratoi and Croitoru (2008) who evaluated the effects of boron natural compounds applied in vineyard, in different vegetative stages, on some biochemical indexes. They showed that, the chlorophyll content, in stage of intense increasing of offshoots, registered the best results in variant which was applied with Bor complex (2,23 mg/l g fresh substance after 2 treatments and 3,09 mg/l g s.p.

after 4 treatments). Furthermore, the content of NPK from leaves was relatively influenced by treatments with boron.

Total chlorophyll

Data illustrated in Tables (5 and 6) show the interaction effect of different girdling, potassium, and boron time on leaf total chlorophyll in table grape "cv Superior" which grown under air cover sleeves at 2013 and 2014 seasons. Results showed that during both experimental studied seasons a significant increase was obtained by all treatments compared with control which gave the lowest value. The (G1K1B1) treatment gave a highly significant increase of leaf total chlorophyll compared with all treatments during 2013 and 2014 seasons.

Table 6: Interaction effect of different girdling, potassium, and boron time on some leaves chemical composition in table grape "cv Superior" which grown under air cover sleeves at 2014 season.

Treatments			2014				
Girdling	Potassium	Boron	N %	P %	K %	Boron ppm	Total chlorophyll (mg/gm)
G0	K0	B0	1.41	0.18	1.70	25.00	1.307
		B1	1.42	0.19	1.70	27.25	1.487
		B2	1.50	0.19	1.71	29.00	1.418
	K1	B0	1.50	019	1.80	25.50	1.680
		B1	1.50	0.19	1.80	27.25	1.850
		B2	1.50	0.20	1.80	29.25	1.801
	K2	B0	1.50	0.20	1.81	26.25	1.704
		B1	1.50	0.19	1.81	27.75	1.792
		B2	1.50	0.18	1.81	29.75	1.770
G1	K0	B0	1.60	0.22	1.90	32.00	2.103
		B1	1.60	0.23	1.90	33.00	2.201
		B2	1.60	0.23	1.90	34.00	2.143
	K1	B0	1.61	0.24	1.90	32.25	2.306
		B1	1.70	0.24	1.92	33.25	2.466
		B2	1.70	0.24	1.99	35.25	2.356
	K2	B0	1.70	0.24	2.00	32.75	2.402
		B1	1.70	0.25	2.00	35.00	2.421
		B2	1.70	0.26	2.00	36.00	2.411
G2	K0	B0	1.80	0.27	2.00	32.25	2.055
		B1	1.80	0.27	2.00	33.00	2.159
		B2	1.80	0.27	2.01	33.75	2.108
	K1	B0	1.80	0.27	2.10	32.75	2.210
		B1	1.81	0.28	2.10	33.25	2.296
		B2	1.81	0.28	2.10	34.75	2.280
	K2	B0	1.90	0.29	2.19	32.75	2.180
		B1	1.92	0.29	2.20	34.00	2.239
		B2	1.89	0.31	2.20	36.25	2.203
L.S.D at 0.05 %			0.07765	0.04483	0.07765	1.287	0.01418

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