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Enhancing the Bearing Capacity and Quality of Superior Grapes Via Root Pruning, Ethephon and Mepiquat Chloride

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SUPERIOR IS one of the grapevine cultivars already cultivated in the Egypt vineyards to export and/or local market, which is spreading in new areas. The present study investigates additional treatments that may improve productivity and fruit quality of Superior grapevine. In this respect, the vines were subjected to: root pruning (RP), foliar application with either ethephon (ET) or mepequat chloride (MC). The vines were root-pruned along both sides of vine to a depth of 50 cm and 30, 45 or 60 cm from the trunk. Whereas ET and MC were sprayed at the concentration of 100, 200 or 300 ppm and at 100, 150 or 200 ppm, respectively. All treatments were carried out at two weeks before bloom.

The obtained results clearly showed that RP at 30 or 45 cm as well as all MC and ET treatments reduced shoot length, which in turn increased the intensity of light reaching the center of the vine. RP at 30 cm was significantly the highest in this respect followed by MC at 150 and 200 ppm. As a general trend all mepiquat treatments induced increment in the total carbohydrates stored in shoot tissues of treated vines compared with untreated ones. In addition, plant content of N, P and K showed different fluctuations. However, MC treatment seemed to enhance shoot content of N and K. In general, these effects were associated with an enhanced in vine productivity during following treatments season. RP mainly at 30 cm as well as MC application at 150 and 200 ppm resulted in significantly increased fruitfulness, whereas both ET applications (200 and 300 ppm) significantly decreased it. However, all MC treatments produced the heaviest bunch. Therefore MC gave the highest yield / vine while the lowest yield was recorded for ET followed by control treatment.

In conclusion, treating Superior vines with MC at medium (150 ppm) or high (200 ppm) concentrations could be recommended to an increase light density inside vine canopy as well increasing fruitfulness, number of cluster / vine, average berry or brunch weight and in turn vine yield.

Keywords: Grapevine, Superior, Root Pruning, Mepiquat chloride, Ethephon, Productivity, Yield, Fruit quality.

Agricultural trade plays an essential role in the Egyptian economy. Grape is one of the major and most exportable fruit crop in Egypt (El-Sawalhy *et al.,* 2008).

Furthermore, grapes exportation is one of the booming industries. Exported grapes increased from 5478 tons in 2000 to reach 62332 tons in 2011 (FAO STAT, 2014). Superior grapes represent a big portion of the exported grapes. Thus enhancing the bearing capacity of these vines in terms of both quality and quantity is a challenge.

The Superior vines are vigorous and they develop long rapid growing canes. This induces shading causing early natural defoliation and a reduction in reproductive bud differentiation (Jensen *et al.,* 1976). In addition, the impact of vigor and excessive shad on fruitfulness and quality is well known (Hopping, 1977, Perez & Kliewer, 1990, Wheeler *et al.,* 2005 and Creasy & Creasy, 2009).

Thus, effective means to reduce growth vigor should be found. Root pruning has been assessed on several deciduous fruit trees and vines (Schupp & Ferree, 1990, Ferree *et al.,* 1999, Wang *et al.,* 2001 and Asín *et al.*, 2007). In general, it was found to control vegetative growth and its effect varied according to the severity and timing (Ferree *et al.,* 1999, Asín *et al.,* 2007 and Travers, 2013).

Ethephon (ET) has long been used to promote flowering commercially in pineapple (Turnbull *et al.,* 1999), there are also indications that it promotes flowering (Bukovac *et al.,* 2006) and growth control (Jackson, 1999) in apple. The growth regulation using ET can encourage flower bud formation on bearing trees, without significantly affecting production in the same year (Jones *et al.,* 1988). The chemical plant regulators that slow shoot growth, like ET, generally do so by inhibiting the natural gibberellines that promote shoot elongation in tree and vines (Jackson, 1999).The effectiveness of ET on growth inhibition was dependent on the vigor of the vines. ET sprays on topped shoots were suggested for reducing density in vigorous vineyards and allowing the development of a larger number of growing points, with controlled growth increasing the fruiting capacity of the vines (Shulman, 1980).

Mepiquat chloride (MC) was originally registered as Pix by BASF (Casteel, 2004). MC was found to control vegetative and reproductive growth by reducing gibberillic acid (GA) concentrations in the plant, which hinders internodes elongation (Halmann, 1990). Decreased GA concentrations affect solute movement between cells due to a decrease in cell wall relaxation and plasticity, and an increase in cell wall stiffness (Behringer *et al.,* 1990, Potter & Fry, 1993, and Yang *et al.,* 1996). This stiffness increases the friction between cells resulting in hindrance of cell elongation and replication. Clusters on vines treated with MC produced an increased berry set, which resulted in a yield increase (Cahoon *et al.,* 1991). In addition, on ‘Kyoho’ grapes, MC alone and in combination with GA inhibited shoot growth, increased leaf area, chlorophyll content, increased cluster weight, berry enlargement and enhanced the fruit maturity by one week (Lim *et al.,* 2004).

The scope of this investigation is to investigate the impact of root pruning, mepiquat chloride and ethephon on enhancing the productivity and fruit quality of Superior grapes.

Materials and Methods

The present investigation was carried out for three successive seasons, *i.e.* 2011-2013, on six year-old own rooted Superior vines. Thirty vines of uniform vigor and bud load were chosen for this experiment. They were grown in a private orchard located in El-Bostan region in Behera governorate (Egypt). The vineyard was of sandy soil, vines were spaced 1.5×3 m and irrigated by a drip irrigation system (two lateral lines per row and four emitters per vine each at 8 L/h). The vines were cane pruned: each vine bore eight canes that were shorten to 12 buds. Normal management practices recommended by the national Ministry of Agriculture were adopted.

In the first season (2011), the following treatments were applied on three vines (each acting as replicate): root pruning (RP) (along both sides of the row to a depth of 50 cm and at 30, 45 or 60 cm from the trunk), ethephon (ET) spraying (at 100, 200 or 300 ppm) and mepiquat chloride (MC) sprayed (at 100, 150 and 200 ppm). All treatments were carried out at two weeks before bloom. Three untreated vines served as control. The mentioned treatments were repeated in both 2012 and 2013 on the same vines.

After 2 weeks of bloom in 2011 and 2012 seasons, four shoots were tagged and their length was measured. The intensity of light at the center of each considered vine was measured by digital Lux meter (Walklab, U.S.A.) for each vine. In addition, in every year, a sample of shoots of each replicate was collected for total carbohydrates and nutrients content determination. Total carbohydrates content (g/ 100g dry weight) was determined by using a colorimetric method (Cherry, 1973). Nitrogen percentage was estimated according to A.O.A.C. (1995), phosphorus percentage was calorimetrically determined according to Temminghoff and Houba (2004), potassium was determined by using Inductively Coupled Plasma (ICP-AES, model: iCAP 6000 series, Thermo Scientific Corporation, Cambridge, UK).

During 2012 and 2013, the bud yield and fruit parameter were measured to study the effect of previous treatments. The number of burst buds and fruitful shoots were recorded after one month of bursted buds. The percentages of fruitfulness were calculated according to Bessis (1960) as follows:

$$\text{Fruitfulness \%} = (\text{No. of fruitful buds/ No. of bursted buds}) \times 100$$

At around 1-10 June when control berries soluble solids content reached 16 prix, a random representing sample of 3 bunches/replicate was harvested and the following parameters were assessed: mean bunch weight (kg) and yield (kg/vine) (by multiplying the mean bunch’s weight of the vine with the number of bunches per vine). Also, to evaluate quality, the following parameter were measured: average berry weight (g), juice soluble solids content (SCC%) by hand refractometer, acidity percentage expressed as ml tartaric acid/100 ml juice according to the official methods of analysis (A.O.A.C., 1995).

The experiment was arranged in a randomized complete block design. The obtained data were tabulated and subjected to analysis of variance (ANOVA) according to Snedecor and Cochran (1989), using MSTAT software package, and means were compared using LSD at 0.05 level. The percentages were transformed to arc sine to find the binomial data according to Steel and Torrie (1980).

Results and Discussion

Concerning the average shoot length, untreated vines produced the longest shoots during 2011 and 2012 seasons, while all treatments decreased the average shoot length (Tables 1 and 2). RP at 30 or 45 cm, ET and MC treatments caused reductions in shoot length.

In both seasons, the intensity of light reaching the center of the vine's head was not altered due to RP at 60cm compared with control. Whereas, the remaining treatments caused significant increments in this parameter. The effect of RP at 30 cm was significantly the highest in this respect followed with mepiquat at 150 and 200 ppm especially in first season (Tables 1 and 2).

All mepiquat treatments induced increments in the total carbohydrates stored in the shoots as compared to the control, but no significant differences among them were recorded. Whereas, no significant effect was observed in presence of the remaining treatments (Tables 1 and 2).

Only mepiquat treatments led to an increase in N concentrations in the first season. The significant increases in shoot N were attributed to all concentrations and their effects were statistically equal. In the second season, the superiority of all MC concentrations still existed. Comparable results were detected due to the ET 300 ppm treatment (Tables 1and 2).

None of the treatments led to significant alteration in P concentration compared with control (Tables 1 and 2).

With respect to attained effects on K levels, all MC concentrations in the first season and only the 100 ppm in the second, resulted the best treatments (Tables 1 and 2). However, it is worth mentioning that, in general, the considered treatments showed increments with various degrees of significance compared with control in both seasons.

TABLE 1. Effect of root pruning, ethephon and mepiquat chloride on shoot length, canopy light intensity and shoot's carbohydrates, N, P and K content of Superior grapevine during 2011 season.

Treatments	Shoot length (cm)	Light Intensity (100 lux)	Total carbohydrates (g/ 100g dry weight)	N %	P %	K %
	Season 2011					
Control	162.8	29.56	24.53	1.43	1.12	1.46
Root pruning 30 cm	129.8	61.00	25.33	1.30	1.07	1.59
Root pruning 45 cm	145.7	41.00	25.45	1.30	1.08	1.71
Root pruning 60 cm	155.0	29.67	25.25	1.50	1.08	1.51
Ethephon 100 ppm	137.9	39.22	25.35	1.36	1.11	2.14
Ethephon 200 ppm	128.8	41.67	26.22	1.53	1.11	2.18
Ethephon 300 ppm	129.7	45.00	26.16	1.53	1.07	1.83
Mepiquat 100 ppm	144.8	41.33	34.25	1.73	1.13	2.32
Mepiquat 150 ppm	133.6	52.56	34.39	1.70	1.13	2.21
Mepiquat 200 ppm	131.0	54.56	33.66	1.70	1.13	2.30
LSD at 0.05	19.83	7.683	2.293	0.179	n.s	0.121

TABLE 2. Effect of root pruning, ethephon and mepiquat chloride on shoot length, canopy light intensity and shoot's carbohydrates, N, P and K content of Superior grapevine during 2012 season.

Treatments	Shoot length (cm)	Light Intensity (100 lux)	Total carbohydrates (g/ 100g dry weight)	N %	P %	K %
	Season 2012					
Control	160. 0	30.00	25.92	1.40	1.14	1.59
Root pruning 30 cm	135. 0	62.67	26.33	1.50	1.13	1.81
Root pruning 45 cm	151.0	43.00	27.00	1.43	1.16	1.61
Root pruning 60 cm	160.7	34.00	26.22	1.55	1.14	1.60
Ethephon 100 ppm	150.0	42.67	25.92	1.61	1.13	2.08
Ethephon 200 ppm	146.7	50.67	26.82	1.67	1.13	2.22
Ethephon 300 ppm	144.3	50.67	26.70	1.66	1.04	2.05
Mepiquat 100 ppm	143.0	49.00	35.46	1.78	1.14	2.29
Mepiquat 150 ppm	134.7	54.33	34.68	1.81	1.13	2.13
Mepiquat 200 ppm	136.3	55.00	35.28	1.81	1.14	2.14
LSD at 0.05	21.95	7.005	2.991	0.109	n.s	0.143

The untreated vines bore 21 and 22.33 clusters/vine in both considered seasons respectively (Tables 3 and 4). Significant reductions in this parameter were observed because of ET application at 200 or 300 ppm in both seasons. Whereas, enhancing effects were detected due to closest RT in addition to applications of MC at medium or high concentrations, without significant differences among them. With respect to fruitfulness coefficient, it was evident that in general reductions and increases in the number of clusters went in parallel with that of the coefficient of fruitfulness. Both ET applications at 200 and 300 ppm showed significant decreases in this coefficient compared with control. Whereas, RP mainly at 30 cm in both seasons and MC applications at both 150 and 200 ppm resulted in significant increases in the afore mentioned parameter.

The majority of conducted treatments significantly affected average bunch weight, such as ET 300 ppm in the first season and of severity RP (30 cm) in second season. In both seasons however, all mepiquat treatments produced the heaviest bunch (Tables 3 and 4). Furthermore, statistically mepiquat at 150 and 200 ppm gave the highest yield per vine in first season and at100 ppm in second one. While, the lowest yield was recorded by ethephon at 200 or 300 ppm in both seasons.

As for the average berry weight and size, all mepiquat treatments and the root pruning at 45 cm in the second season only, provided the best results compared with control and the remaining treatments (Tables 3 and 4).

As for the juice soluble solids content (SCC %) and acidity percentage, it was not altered by the conducted treatments.

TABLE 3. Effect of root pruning, ethephon and mepiquat chloride on fertility, bunch weight, yield and berry physical and chemical characteristics of Superior grapevine during 2012 season.

Treatments	N. of cluster	Fruitfulness (%)	Bunch weight (g)	Yield per vine (kg)	Berry weight (g)	Berry size (cm^3)	SCC (%)	Acidity ml tartaric acid /100 ml juice
	Season 2012							
Control	21.00	35.00	404.0	8.48	4.99	4.69	16.27	0.56
Root pruning 30 cm	27.33	45.56	354.0	9.63	4.33	4.06	16.61	0.54
Root pruning 45 cm	24.00	45.83	379.1	9.13	4.50	4.23	16.94	0.53
Root pruning 60 cm	20.33	37.17	406.3	8.25	4.80	4.55	16.51	0.53
Ethephon 100 ppm	24.33	40.56	394.1	9.56	4.38	4.00	16.73	0.59
Ethephon 200 ppm	12.67	28.71	270.0	3.36	4.03	3.71	16.28	0.53
Ethephon 300 ppm	11.33	25.80	187.9	2.13	3.93	3.66	16.59	0.56
Mepiquat 100 ppm	23.33	38.89	450.4	10.43	6.03	5.73	16.82	0.53
Mepiquat 150 ppm	29.67	49.44	447.9	13.31	6.36	6.08	16.89	0.54
Mepiquat 200 ppm	27.00	45.00	456.5	12.29	6.08	5.99	16.87	0.55
LSD at 0.05	3.945	7.323	36.76	1.492	0.46	0.423	n.s	n.s

TABLE 4. Effect of root pruning, ethephon and mepiquat chloride on fertility, bunch weight, yield and berry physical and chemical characteristics characteristics of Superior grapevine during 2013 season.

Treatments	N. of cluster	Fruitfulness (%)	Bunch weight (g)	Yield per vine (kg)	Berry weight (g)	Berry size (cm^3)	SCC (%)	Acidity ml tartaric acid /100 ml juice
	Season 2013							
Control	22.33	37.22	363.3	8.103	4.22	4.50	16.27	0.57
Root pruning 30 cm	26.67	44.45	321.3	8.557	4.14	3.95	16.48	0.55
Root pruning 45 cm	23.67	39.45	464.7	10.99	5.15	4.95	16.73	0.56
Root pruning 60 cm	22.00	36.67	476.9	10.51	4.78	4.25	16.74	0.56
Ethephon 100 ppm	24.00	40.00	470.4	11.29	4.39	4.29	16.24	0.60
Ethephon 200 ppm	14.33	23.89	370.0	5.23	4.60	4.54	16.33	0.55
Ethephon 300 ppm	10.33	17.22	379.8	3.90	4.11	3.81	16.49	0.56
Mepiquat 100 ppm	25.67	42.78	502.5	12.90	5.85	5.41	16.79	0.54
Mepiquat 150 ppm	26. 00	43.33	504.0	13.08	5.93	5.50	16.78	0.55
Mepiquat 200 ppm	27. 00	45.00	465.7	12.58	5.26	4.95	16.78	0.57
LSD at 0.05	3.84	6.40	42.06	1.727	0.8101	0.7258	n.s	n.s

In general, reduction in shoot growth, which occurred as a result of root pruning and application of growth retardants, was in agreement with previous reports (Szyjewicz & Kliewer, 1983, Ferree *et al*., 1999, Albuquerque *et al*., 2000, Lim *et al*., 2004, Asín *et al*., 2007 and Travers, 2013). The reduced rates of shoot elongation resulting from root pruning might be explained by short-term water stress (Giesler & Ferree and 1984, Schupp & Ferree, 1990), so that the presumably delivery of solutes normally carried in the xylem sap to developing tissues was reduced (McArtney and Ferree, 1999). While, MC controls vegetative and reproductive growth by reducing gibberillic acid concentrations in the plant, which hinders internodes elongation (Halmann, 1990). Decreased gibberillic acid concentrations affect solute movement between cells due to a decrease in cell wall relaxation and plasticity, and an increase in cell wall stiffness (Behringer *et al*., 1990, Potter & Fry, 1993 and Yang *et al*., 1996).

These reductions in shoot growth correlated with enhanced in vine cluster number and fruitfulness under all treatment except ethephon. Whereas, closest root pruning in addition to applications of mepiquat at medium or high concentrations produced the highest clusters number per vine and fruitfulness. Previous study by Albuquerque *et al.* (2000) on “Thompson Seedless” and “Italia” grapes pointed that, application of MC decreased the shoot growth rate, increased the number of fruiting buds, and generally augmented the concentrations of macronutrients in shoots and petioles of both cultivars. This result may be due the clear inhibition of GA formation as the effect of MC (Rademacher, 2000). Flower bud differentiation in grape varieties needs low concentration of GA3 (Lin *et al.,* 2012). Whereas, grape tendrils and inflorescences have a common origin known as anlage or uncommitted primordia. The fate of the uncommitted primordia depends on the cytokinin-gibberellin balance, with cytokinins promoting transition to flowering and gibberellins inhibiting it (Vasconcelos *et al.,* 2009).

Light intensity was considerably higher as a result especially of closest root pruning and medium or high concentration of mepiquat, which had a positive effect on the vine cluster number and bud fruitfulness in following season. These results point to the important of light in enhancing fruitfulness in following season. Whereas, the flower clusters for the next season initiated near bloom (Lavee *et al.*, 1967, Pratt, 1979) or in bloom (Winkler *et al.*, 1974 and Hellman, 2003) from basal and continuously occurred over time, and in sequence from the bottom of the shoot upwards (Creasy and Creasy, 2009).While in the end, bud fertility along the cane increased from the base to the middle and decreased again toward the tip (Huglin and Schneider, 1998).

Increments in light intensity associated to increased carbohydrates stored in the shoots in vines under pix treatments. Furthermore, light is important as it affects the rate at which photosynthesis can occur and hence photo assimilates’ supply. The carbohydrate supply near bloom is an important factor affecting the number and potential size of the flower clusters being initiated (Sommer *et al.,* 2000), but Bennett *et al.*(2005) have also shown that vine carbohydrate status following fruit set will also affect flower cluster number and size in the following season. Hence, overly vigorous shoots are associated with fewer flower clusters because vigorous vines generally have shadier canopies, and the growing points of a vigorous shoot are much better at drawing carbohydrates away from the developing flower clusters (Creasy and Creasy, 2009). In addition, enhancement of light penetration within the canopy of grapevines by shoot positioning or thinning after berry set significantly reduced the amount of bud necrosis and increased bud fruitfulness of “Thompson Seedless” grapevines (Perez and Kliewer, 1990).

Generally, mepiquat tenements enhanced shoot content of micronutrients P and K. This was in accordance with Albuquerque *et al.* (2000). They reported that on “Thompson Seedless” and “Italia” grapes application of growth retardants (chlormequat, daminozide, uniconazole or MC) decreased the shoot growth rate, increased the number of fruiting buds, and generally increased the concentrations of macronutrients in shoots and petioles(although these results were variable and related to the effect of the growth retardants on shoot growth). In addition, these enhanced of shoot micronutrients, especially K, under MC treatment associated with most supreme berry weight and size as compared to control and the remaining treatments.

The higher N vine content, as over application, decreased the number of inflorescences differentiated but not the number of flowers per inflorescence. In agreement, Keller and Koblet (1995) reported a depression in bud fertility in Müller-Thurgau in response to N deficiency as well as to N excess. Application of N can result in a reduction in fruitfulness, in particular if the vines are already well provided with N. Excessive N application was found to increase vegetative growth and reduce fruit production (Christensen *et al*., 1994). Although it is not explicitly discussed, decreased fruit production was probably the result of the poor light microclimate in the vigorous canopies, depressing inflorescence primordia initiation. Moreover, increased vegetative growth and resulting shading of the canopy was suggested to cause bud necrosis and reduced grape fruitfulness (Perez & Kliewer, 1990 and Smart *et al*., 1990).

Optimum phosphorus (P) nutrition promoted bud fruitfulness (Skinner and Matthews 1989), since phosphate deficiency is detrimental to the maintenance of initiated inflorescence primordia (Skinner and Matthews 1989).Optimum levels of N, P, and K are associated with maximum cytokinin production by grape roots (Srinivasan and Mullins, 1981). Adequate status of K has been emphasized for formation of fruitful buds at initiation and differentiation stages (Bhargava and Sumner, 1987). Application of potassium in K deficient vineyards markedly increased the fruitfulness of latent buds of "Thompson Seedless" grapes (Anonymous, 2001).

In general, MC had a positive effect on average bunch weight, vine yield and berry physical characters. The increase in yield was due to previous increase in cluster number and due to the positive effect of MC in weight of cluster. Clusters on vines treated with MC produced an increased berry set which resulted in a yield increase (Cahoon *et al*., 1991) also reported by (Lim, *et al*., 2004) on "Kyoho" grapes. In particular, MC applied at 5, 7, 10 leaves, respectively increased berry setting rate by 3 to 11% (Kim *et al*., 2008). While RP reduced the number of berries per cluster by 29 % (McArtney and Ferree, 1999). As the severity of RP increased, berry and cluster weight decreased (Ferree *et al*., 1999). Whereas, severe root pruning reduced the size of root system and hence lowered competitive ability for water uptakes (Ma *et al*. 2008), which resulted in no enhanced in bunch and berry weight or especially size. "Superior" vines under sever pruning had highest bud fruitfulness and cluster number.

There was no effect of RP on soluble solids content (SSC), or pH of the juice (Ferree *et al.*, 1999).On “Concord” grape MC produced an increased berry set, which resulted in a yield increase. Berry weight and soluble solids decreased as yield increased (Cahoon *et al.*, 1991). Further, MC plus gibberellines was very effective for berry set and berry size increase, thus fruit quality (Lim *et al.*, 2004).

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تحسين الحمل وجودة الثمار فى صنف عنب االسوبريور باستخدام تقليم الجذور والرش بالاثيفون وميبكوات كلوريد

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صنف عنب السوبريور واحد من أهم الاصناف المنزرعة بمصر بمناطق الاستصلاح بهدف الانتاج للتصدير أو للتسويق محليا. الدراسة الحالية سعت لدارسة تأثير عدد من المعاملات التى من شأنها المساعدة فى تحسين انتاجية وصفات الجودة لعنب السوبريور. فى هذا الشأن قسمت الكروم المختارة للإجراء المعاملات التالية: تقليم الجذور والرش بالاثيفون وميبكوات كلوريد. معاملة تقليم الجذور تمت على جانبى الكروم على عمق ٥٠ سم وعلى بعد من الجزع بمسافة ٣٠ و ٤٥ أو ٦٠ سم، بينما تم رش الاثيفون بتركيز ١٠٠ و ٢٠٠ أو ٣٠٠ جزء فى المليون، فى حين تم الرش بتركيزات ١٠٠ و ١٥٠ و ٢٠٠ جزء فى المليون ميبكوات كلوريد. جميع المعاملات تمت قبل مرحلة التزهير بأسبوعين.

أظهرت النتائج تأثير واضح لكل من تقليم الجذور ٣٠ و ٤٥ سم و الميبكوات والاثيفون على تقليل طول الأفرخ والتى ادت لزادة فى كمية الضوء الواصل لقلب الكروم، وفى هذا السياق فقد حقق تقليم الجذور ٣٠ سم أعلى النتائج تلاه المعاملة بالميبكوات كلوريد بتركيز ١٥٠ و٢٠٠ جزء فى المليون. وبشكل عام فان المعاملة بالميبكوات كلوريد حسنت من كمية الكربوهيدرات بالأفرخ مقارنة بالكنترول، كذللك ادت لتحسن محتوى الأفرخ من عنصر النيتروجين والبوتاسيوم. وبشكل عام فقد ارتبط مع هذة النتائج حدوث تحسن فى انتاجيه الكروم فى الموسم التالى للمعاملات. حيث أدت معاملة تقليم الجذور ٣٠ سم ميبكوات كلوريد ١٥٠ و ٢٠٠ جزء فى المليون لزيادة معنوية فى عدد العناقيد للكرمة وبالتالى نسبة الخصوبة للبراعم، فى حين ان معاملة الاثيفون سواء بتركيز ٢٠٠ أو ٣٠٠ جزء فى المليون قد حققت معنويا أقل النتائج فى هذا السياق، ومن ناحية فقد حققت معاملات الميبكوات أعلى متوسط وزن للعنقود. وبناء على ذللك فقد حقق المعاملة بالميبكوات كلوريد اعلى محصول للكرمة فى حين اقل محصول حقق مع المعاملة بالاثيفون وتلاها الكروم الغير معاملة.

فى النهاية يمكن التوصية باستخدام ميبكوات كلوريد ١٥٠ أو ٢٠٠ جزء فى المليون لتحسين كمية الإضاءة الواصلة لقلب الكروم والكربوهيدرات المخزنة بالأفرخ والتى تؤدى لتحسن خصوبة البراعم وعدد العناقيد للكرمه ومتوسط وزن الثمار والعناقيد وفى النهاية زيادة المحصول.

الكلمات الداله: العنب ، سوبريور ، تقليم الجذور ، ميبكوات كلوريد ، اثيفون ، الإنتاجية ، المحصول ، جودة الثمار.