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A STUDY ON THE POSSIBILITY OF IMPROVING COLOURATION OF CRIMSON SEEDLESS GRAPES UNDER DESERT CONDITIONS VIA THE APPLICATION OF SOME TREATMENTS
A- SPRAYING WITH POTASSIUM AND ETHEPHON

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ABSTRACT

The current study was conducted on crimson seedless grape for two successive seasons; 2004 and 2005. The main goal was to explore the efficacy of both ethephon and potassium thiosulphate sprays to overcome the problem of lack of berry colouration. Ethephon was applied at 300 ppm at 5% colouration; meanwhile potassium (as potassium thiosulphate) was tested at 0.7%, 1.4% or 2.1% each at three dates:
1) Beginning of bloom or flowering, then at berry set and veriason stage, T_1 2) Full bloom then every week until harvest, T_2 and 3) After berry set then every week until harvest, T_3. Irrespective of the applied concentration of potassium (K)an obvious increase and improvement in berry properties took place by delaying the date of application. Nevertheless, the higher the used concentration, the better was its efficacy. Thus, the most effective treatment was potassium at 2.1% when sprayed every week after berry set till harvest as pronounced increases were attained in berry length, diameter, cluster weight, yield, berry adherence and firmness. Moreover, K applications increased TSS, total sugars, TSS/acid but reduced total acidity. Also, a significant increase in leaf potassium content was achieved by K applications, especially at the highest concentration (2.1%) which had a significant increase in anthocyanin content in berry skin. Such increase was proportional to K percentage in

each treatment. Moreover, relationship between sugar and anthocyanin content in the berry skin was evident. Ethephon treatment improved berry colour compared to all K treatments. However, it reduced cluster weight, berry adherence and firmness while it had no effect on berry weight and berry chemical properties. Spraying the clusters with ethephon at 300 ppm at 5% colouration, stage beside K foliar application at 2.1% at berry set and till harvest at weekly intervals are recommended for improving berry colour.

Key words: *ethephon, grapes, potassium colouration, yield.*

1. INTRODUCTION

Crimson seedless grape is newly introduced in Egypt. It is the latest in ripening table grape so the chances are widely available to be successfully exported to European and Arab countries because of its excellent eating quality. Yet, the main problem associated with its production under the Egyptian desert conditions is the lack of inadequate colouration. Many approaches has been adopted to overcome this problem elsewhere.

Ethephon (2-chloroethyl phosphonic acid) has been shown to accelerate the ripening of many fruits. It releases ethylene and is considred as a ripening hormone (Burg and Burg, 1965). Ethephon was applied to improve the colour of berry grape (Weaver, 1976 a & b), Abd El Kawi, *et al.*, 1984b; Dokoozlian *et al.*, 1995 and Omar and Girgis, 2005). Potassium is one of the essential elements in plant nutrition, as it plays many important regulatory roles in the development of tissues. The absorption of potassium by plants has two peaks, the first at fruit setting and the second during berry maturation (Yu *et al.*, 1994). During the four weeks before veraison, there is a little or no uptake of nitrogen and phosphorus, while potassium uptake continues throughout veraison (Lohnertz, 1988).

Many investigators emphasized on the pronouncing benefits of potassium addition at any dose on increasing anthocyanin and improved color of grape berries (Scienza *et al.*, 1981; Morris and Cowthan, 1982; Chris *et al.*, 1984). Potassium intensifies the synthesis of carbohydrates, catalizes the activity of some enzymes, promotes the synthesis and accumulation of thiamine and riboflavin and is essential for the activity of guard cells (Yagodin, 1984). Potassium foliar application is one of the pre-harvest treatments,

which has been widely used to increase cluster weight, yield and improve fruit quality Kamel, 1976; Omar, 2000; Ibrahim, 2002). On the contrary, vines severely deficient in (K tended to have fewer and smaller tight clusters with unevenly coloured small berries (Peacock, 1997).

The main object of the present work was to assess the effects of both ethephon and potassium thiosulphate on improving berry colour of the late maturing Crimson Seedless grape variety. Furthermore, their effects on fruit quality were also studied.

2. MATERIALS AND METHODS

This investigation was conducted in a private vineyard located at the 76 Km of Cairo-Alexandria desert road for two seasons (2004 and 2005). Ninty nine uniform Crimson Seedless grapevines of 5-year-old grown in sandy soil were chosen. The vines were trained to cane system supported by Spanish parron trellis. Spaces between vines were 2 m and 3 m between rows. Each vine was pruned to eight canes each of 10 buds. Number of clusters were adjusted to 32/vine. The selected vines were subjected to the same horticultural practices except for the tested treatments. Treatments were as follows:

Spraying with ethephon at 300 ppm was carried out on clusters when it reached 5% colouration, while potassium thiosulphate (K38, S38) was applied at three concentrations [0.7% (KC_1), 1.4% (KC_2) and 2.1% (KC_3)], each concentration was applied according to the following times:

1) Beginning of bloom or flowering, then at berry set and veriason stage, T_1.
2) Full bloom then every week until harvest, T_2.
3) After berry set (70%) then every week until harvest, T_3

Triton B as a wetting agent was added at 0.1% to all potassium thiosulphate solutions and spraying was done till runoff. Thereafter the present investigation contained 11 treatments [KC_1T_1, KC_1T_2, KC_1T_3, KC_2T_1, KC_2T_2, KC_2T_3, KC_3T_1, KC_3T_2, KC_3T_3, Ethephon and control].

The experimental design was a randomized complete block replicated three times with the vine in each replicate.

When the Brix value reached 17-18 for the control clusters the treated vines were investigated for the following characteristics : cluster weight (g), yield/vine (Kg), weight of 100 berries (g), size of

100 berries (ml), berry length and diameter, adherence strength (g), firmness (g/cm^2), percentage of full coloured berries (by dividing weight of full-coloured berries by total weight of berries). TSS, total sugars and total acidity were determined (cm) (according to A.O.A.C, 1985). TSS/acid ratio and anthocynain content in berry skin were determined according to Yilidz and Dikmen (1990. Potassium was estimated in leaf petioles opposite to the cluster at full bloom, fruit set and veraison times. The gradual changes of the TSS and total sugars in berry juice, total anthocynain in the berry skin and potassium in the leaf petioles were estimated at five day intervals beginning from veraison till harvest.

Mean separations were determined using Duncan's test (Snedecor and Cochran, 1980).

The vineyard soil texture is sandy and data of soil analysis according to Wilde *et al.* (1985) are shown in Table (1).

Table (1) : Analysis of vineyard soil .

Sand %	Silt %	Clay %	Texture	O.M	pH	E.C (d^*m^{-1})	Total $CaCO_3$	Total N %	Available P (ppm)	Available K (%)
84.0	9.0	7.0	Sandy	0.43	7.88	1.38	2.37	0.12	2.23	0.1 4

3. RESULTS AND DISCUSSION

3.1. Cluster weight and yield per vine

Table (2) shows that foliar application of potassium at all tested concentrations and dates significantly increased cluster weight and yield per vine in both seasons of the experiment. The most effective treatment was KC_3T_3 which recorded the highest averages for cluster weight (546g and 558g. in both seasons respectively) season as well as the highest average yield/vine (17.47 and 17.86kg,). Since the number of clusters were adjusted to 32 clusters per vine; it is supposed that any increase in cluster weight should be parallel with the increase in yield by weight. However, the application of ethephon at 300 ppm reduced cluster weight and yield/vine. These results agree with those of Dhillon *et al.* (1999); Omar (2000) and Ibrahim (2002).

Table (2) : **Influence of ethephon and potassium thiosulphate on the yield and physical fruit properties of Crimson Seedless grape**

Treatments	Yield Kg/vine		Cluster wt (g)		Weight of 100 berries (g)		Berry length (cm)		Berry diameter (cm)		Adherence strength (g)		Firmness (g/cm²)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Control	12.96 j	13.34 j	405 i	417 j	258.89 k	265.52 k	2.00 g	2.06 h	1.37 h	1.40 h	435 j	450 j	480 j	550 j
E	13.08 j	13.44 j	408.6 i	420 j	271.57 j	278.60 j	2.06 fg	2.08 h	1.49 g	1.52 g	416 k	431 k	462 k	532 k
KC_1T_1	13.70 i	14.02 i	428 h	438 i	280.02 i	287.93 i	2.14 ef	2.20 g	1.52 g	1.56 f	450 i	465 i	526 i	596 i
KC_1T_2	14.24 h	14.46 h	415 g	452 h	301.85 h	308.89 h	2.18 de	2.24 f	1.56 f	1.59 f	457 h	473 h	540 h	610 h
KC_1T_3	14.70 g	14.88 g	463 f	465 g	319.41 g	328.58 g	2.23 c-e	2.29 e	1.60 e	1.63 e	481 g	495 g	557 g	625 g
KC_2T_1	14.88 f	15.23 f	465.33 f	472 f	332.41 f	339.32 f	2.25 cd	2.31 de	1.62 de	1.65 de	494 f	510 f	568 f	638 f
KC_2T_2	15.36 e	15.71 e	480 e	491 e	351.91 e	359.82 e	2.27 b-d	2.33 d	1.64 d	1.67 d	509 e	525 e	578 e	647 e
KC_2T_3	16.17 d	16.32 d	506 d	510 d	377.68 d	383.53 d	2.30 a-c	2.36 c	1.68 c	1.71 c	52.2 d	538 d	591 d	661 d
KC_3T_1	16.37 c	16.73 c	511.67 c	523 c	392.78 c	399.81 c	2.33 a-c	2.38 c	1.70 bc	1.73 bc	534 c	549 c	603 c	673 c
KC_3T_2	16.90 b	17.25 b	527.00 b	539 b	399.47 b	407.33 b	2.36 ab	2.42 b	1.72 b	1.75 b	538 b	553 b	611 b	681 b
KC_3T_3	17.47 a	17.86 a	546.00 a	558 a	405.75 a	416.70 a	2.39 a	2.46 a	1.76 a	1.79 a	552 a	567 a	625 a	695 a

Values with the same letter (s) at the same column do not differ significantly at $p \leq 0.05$.

E : Ethephon

K : Potassium thiosulphate

C : Concentration

T : Time

3.2. Berry weight, length and diameter

The results of berry weight are shown in Table (2). Generally, they show that all treatments significantly increased berry weight.The best effect was recorded with KC_3T_3. The promotion on berry weight in response to the foliar application of the (K) might be attributed to their positive action on providing the vines with their requirements from K during first development . Ethephon application had no effect on weight of berries. Such results are in line with those of Winkler *et al.* (1974); Weaver (1976 a &b); Abdel-Kawi *et al.* (1984); Abdel-All (1991) and Abbas and Mohamed (2000).

Regarding the response of berry length and diameter, the data given in Table (2) show that, irrespective of the concentration and/or timing of K^+ application, there were significant increases in length and diameter of berries in response to all potassium treatments. However, the effects of treatments KC_2T_3, KC_3T_1, KC_3T_2 and KC_3T_3 were not significant on berry length in the first season only. In addition, treatment of KC_1T_1 as well as spraying ethephon had significant effect on berry length or diameter in the first season 2004, while it appeared ... nificant in the second one. These results are in harmony with those obtained by Winkler *et al.* (1974); Weaver (1976 a &b); El-Dawwey and Ahmed (1992); Ibrahim (2002) and Omar and Girgis (2005).

3.3. Adherence strength and firmness

Foliar application of K significantly increased adherence strength of Crimson seedless berries. This increment is accentuated by increasing the applied concentration. The highest value was recorded with KC_3T_3 treatment. Berry firmness followed the same trend of adherence strength (Table 2). These results are in line with those of Abd El-Mohsen (2003) who reported that the higher rate of K was effective and acceptable in improving berry firmness and adherence which in turn produce cluster with better quality.

Conversely, ethephon at 300 ppm resulted in a significant reduction in berry adherence and firmness. The results are in harmony with those reported by Abdel-Kawi *et al.* (1984a), Dokoozlian *et al.* (1995) and Omar and Girgis (2005).

3.4. TSS, acidity, TSS/acid ratio and sugar

It can be stated from the data in Table (3) that the applications of K at three concentrations at different times were very effective in improving chemical quality of the berries in terms of increasing the percentages of total soluble solids, total sugars, TSS/acid as well as reducing total acidity. The increments in TSS, total sugars and TSS/acid ratio were in parallel with the increment of K level in foliar solution in both seasons. Also, it is noticeable that the KC_3T_3 treatment had a very promising effect on increasing TSS and total sugars. These findings are in agreement with those obtained by Huang *et al.* (1994); Shin and Lee (1993); Omar (2000); Abbas and Mohamed (2000) and Abd El-Mohsen (2003).

This result was confirmed earlier by Weaver (1976 a &b) who recorded the benefits of K through its effect on enhancing the formation and translocation of carbohydrates in plant tissues. Lowering of berry acidity compared to the control could be due to the formation of potassium salts of tartaric acid which are relatively insoluble (Ranson, 1965). These results agree with El-Sese *et al.* (1988), Christensen *et al.* (1991), Omar (2000) and Ibrahim (2002).

The results dealing with the effect of ethephon (Table 3) showed that spraying ethephon at 300 ppm did not affect berry juice quality (T.S.S., acidity, TSS/acid ratio and sugar). These results go in line with those found by Weaver and Pool (1971); Agaoglu and Eris (1983); Hwang *et al.* (1986); Fitzgerald (1995); Omar and Girgis (2005).

3.5. Anthocyanin content

It is clear from the obtained data (Table 3) that foliar application of potassium at three concentrations and in the three tested dates had positive influence on the accumulation of anthocyanin in Crimson seedless berries skin. However, when the effect of application dates was considered, the obtained data indicated that the increase in anthocyanin was proportional to delaying of time application. Moreover, maximum anthocyanin content was gained by ethephon treatment and from KC_3T_3 in both seasons. This fact may reflect the positive effect of K in increasing the accumulation of sugar in the berries as previously mentioned in the present results. Subsequently, there is a direct correlation between potassium uptake and sugar

Table (3) : Influence of ethephon and potassium thiosulphate on chemical fruit properties and full coloured berries % (F.C.B.) of Crimson Seedless grape.

Treatments	F.C.B. (%)		Total sugars (%)		TSS (%)		Acidity (%)		TSS/Acid ratio		Anthocyanin (mg/100g)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Control	43.00 j	51.0 j	13.7 j	13.8 h	16.6 i	16.7 i	0.66 a	0.66 a	25.15 i	25.30 j	42.40 k	46.71 k
E	95.00 a	97.0 a	13.8 j	14.9 g	17.8 h	17.8 h	0.64 a	0.65 a	27.81 h	27.38 i	94.81 a	95.75 a
KC_1T_1	55.00 j	57.0 i	15.00 i	15.12 g	18.2 g	18.4 g	0.55 b	0.52 b	33.12 g	35.37 h	50.71 j	53.68 j
KC_1T_2	58 hi	60 hi	15.6 h	15.3 g	18.5 f	18.7 f	0.53 bc	0.50 c	34.95 fg	37.41 g	55.61 i	58.65 i
KC_1T_3	61 gh	63 gh	15.8 g	17.1 f	18.8 e	19.0 e	0.51 cd	0.49 c	36.89 ef	38.78 g	60.57 h	64.24 h
KC_2T_1	64 g	66 fg	17.2 f	17.5 ef	19.1 d	19.3 d	0.49 de	0.47 d	38.98 e	41.06 f	64.52 g	67.11 g
KC_2T_2	68 f	69 f	17.7 e	18.0 de	19.6 c	19.8 c	0.47 ef	0.45 e	41.70 d	44.12 e	69.75 f	71.52 f
KC_2T_3	73 e	75 e	18.8 d	18.3 cd	19.8 c	20.0 c	0.45 fg	0.43 f	43.68 d	46.53 d	72.41 e	76.37 e
KC_3T_1	79 d	81 d	18.1 c	18.7 bc	20.5 b	20.7 b	0.43 gh	0.41 g	47.67 c	50.49 c	76.85 d	79.60 d
KC_3T_2	85 c	87 c	18.6 b	19.2 b	20.7 b	20.8 b	0.41 hi	0.39 h	50.86 b	53.33 b	79.86 c	82.73 c
KC_3T_3	91 b	93 b	18.9 a	19.8 a	21.1 a	21.3 a	0.39 i	0.37 i	54.12 a	57.57 a	83.67 b	86.91 b

Values with the same letter (s) at the same column do not differ significantly at $p \leq 0.05$

E : Ethephor

K : Potassium thiosulphate

C : Concentration

T : Time

content and hence anthocyanin synthesis in the skin of berries (Scienza *et al.*, 1981; Morris *et al.*, 1983; Chris *et al.*, 1984 and Abd El-Mohsen, 2003). Ethephon application improved berry colour better than all K treatments. These results agree with those mentioned by Weaver (1976 a&b); Abdel-Kawi (1984b); Dokoozlian *et al.* (1995) and Omar and Girgis (2005).

3.6. Leaf potassium content

It is obvious from Fig. (1) that the percentage of K^+ in the leaf petioles was more pronounced when potassium thiosulphate at 2.1% was applied during the period from veraison until harvest. In addition, the treatment KC_3T_3 also induced a significant increase in K percentage in the leaf petioles than other potassium treatments in the three stages of analysis (bloom, fruit set and veraison), in both seasons. The obtained data highlight the importance of foliar potassium with suitable concentration in the right time. It is obvious from Fig. (1), that petiole K content decreased at veraison stage than that at bloom or fruit set stages. These results are in accordance with Christensen (1984) and Omar (2000) who observed that the petiole levels of potassium tended to decrease between bloom and veraison. The increase in petioles K content may be due to the translocation of K^+ to the fruits. The present results were previously confirmed by the findings of Soyer *et al.*, (1992) Omar (2000); Abbas and Mohamed (2000) and Abd El-Mohsen (2003).

3.7. Percentage of full coloured berries (F.C.B.)

It is clear from Table (3) that ethephon and K treatments enhanced colouring and induced a fair percentage of full coloured berries. The more increase of K concentration and delaying time, the more increase of F.C.B. %. The significant highest F.C.B. % was recorded from the treatment of the ethephon followed by KC_3T_3. Weaver, 1976a &b; Abdel-Kawi *et al.*, 1984b; Dokoozlian *et al.*, 1995; Kim *et al.*, 1998; Omar and Girgis, 2005 reported that ethephon tended to increase the fruit anthocyanin content.

The correlation between K and berry colour was clear. Data of the present work indicated that the increase in anthocyanin was proportional to the increase in K percentage in each treatment. These results are in agreement with those of Arutyunyan (1978); Scienza *et al.* (1981). On the other hand, Morris and Cowthan (1982) on grapevine stated that, K fertilization significantly improved color of

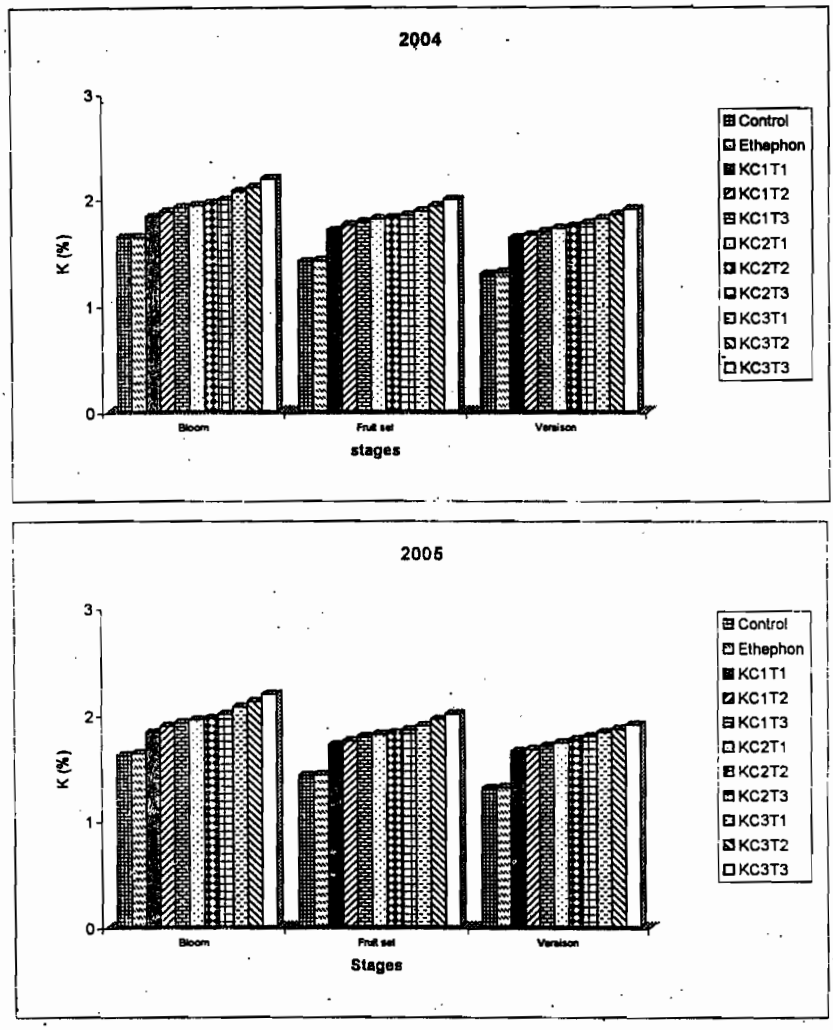

Fig. (1) : Potassium content determined at bloom, fruit set and veraison as affected by ethephon and potassium thiosulphate treatments during seasons of 2004 and 2005.

K : Potassium thiosulphate, C : Concentration, T : Time

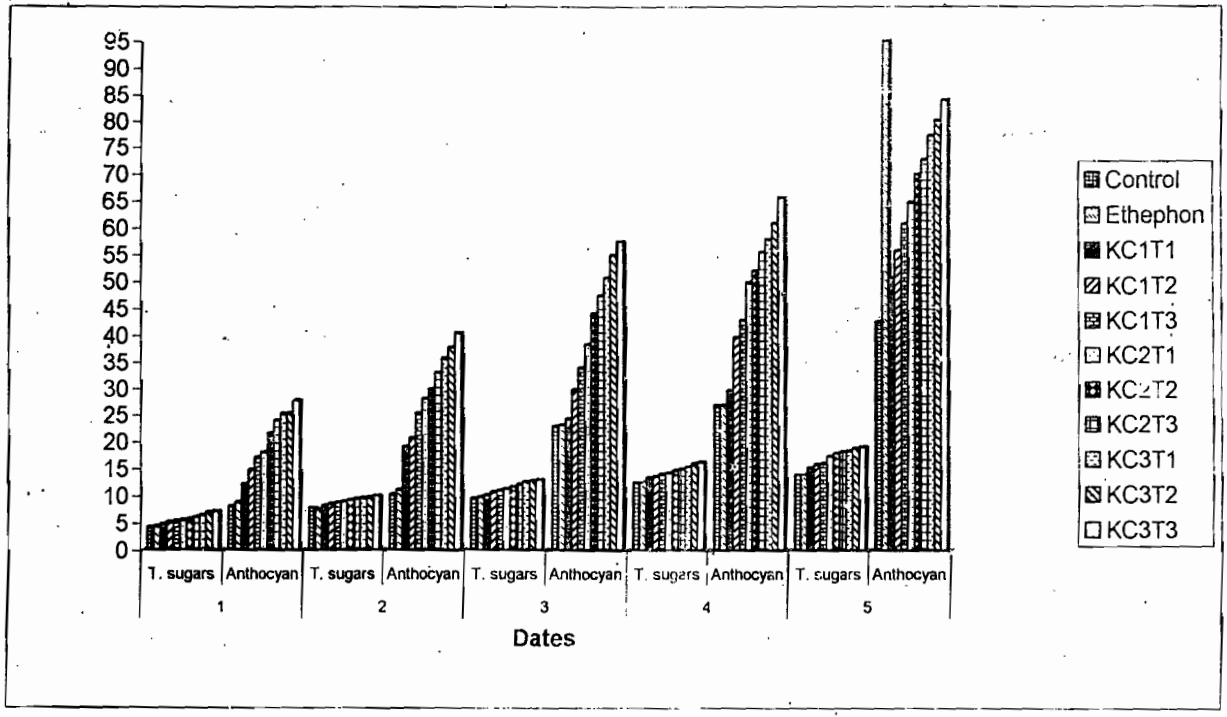

Fig. (2) : Developmental changes in anthocyanin and total sugars as affected by ethephon and potassium thiosulphate (season 2004)

Dates : 1: 29/7, 2: 4/8, 3: 11/8, 4: 18/8, 5: 25/8

K : Potassium thiosulphate, C : Concentration, T : Time

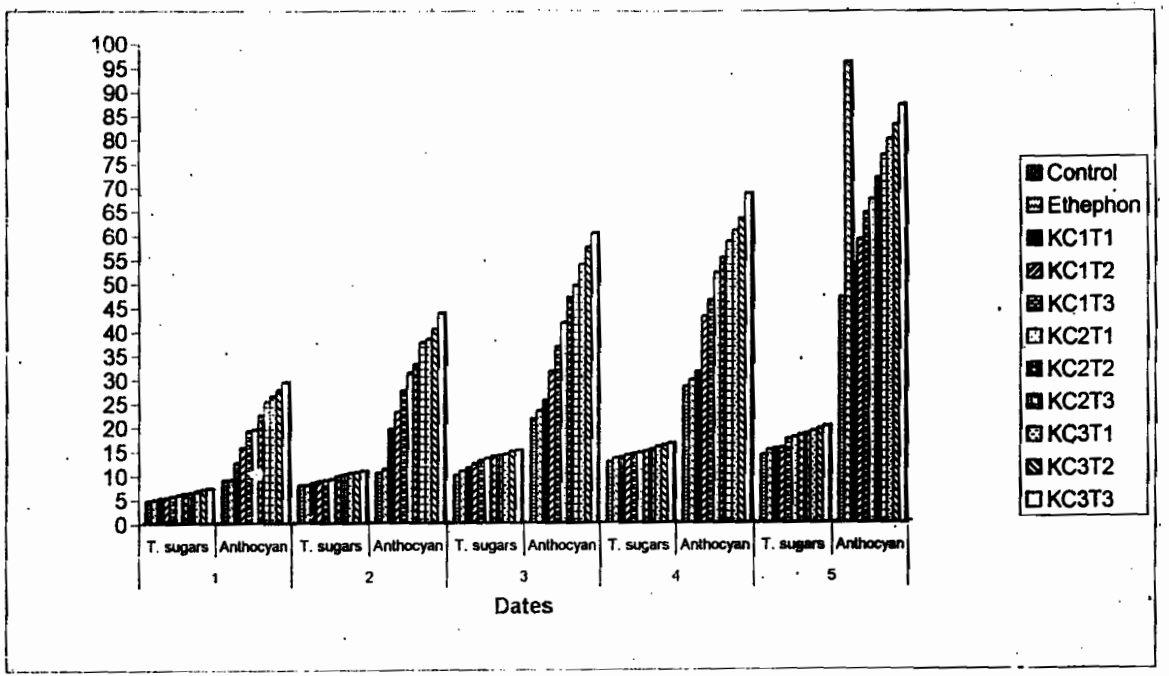

Fig. (3) : Developmental changes in anthocyanin and total sugars as affected by ethephon and potassium thiosulphate (season 2005)

Dates : 1: 29/7, 2: 4/8, 3: 11/8, 4: 18/8, 5: 25/8

K : Potassium thiosulphate, C : Concentration, T : Time

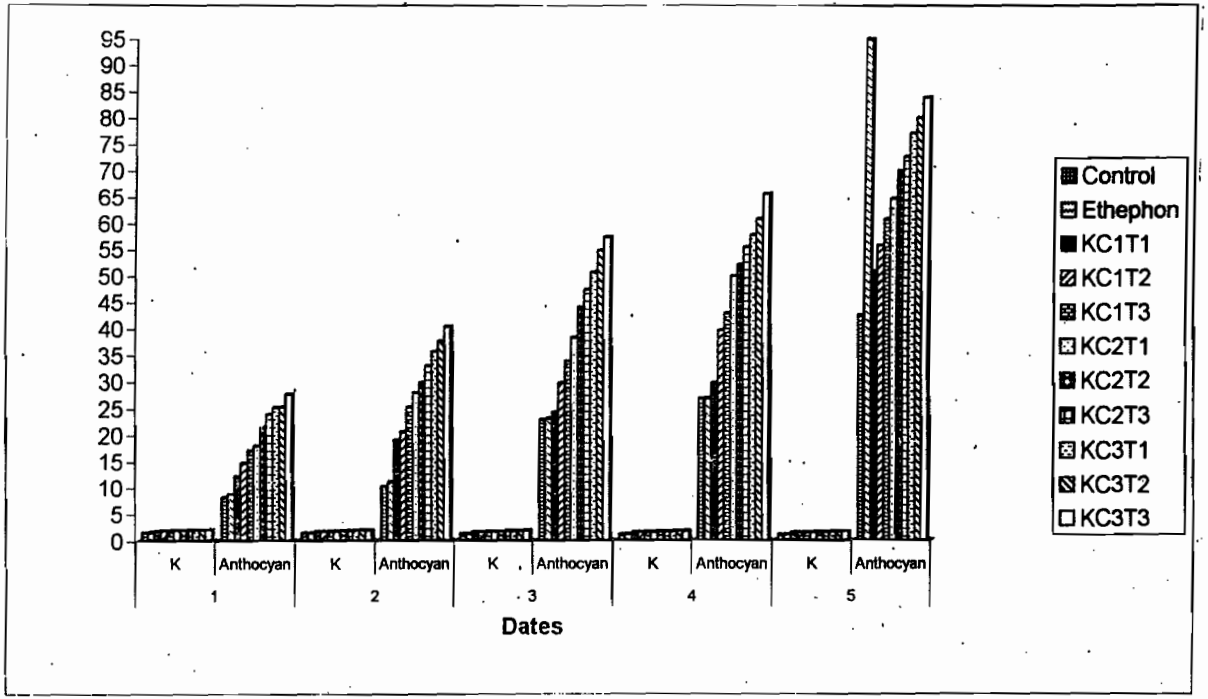

Fig. (4) : Developmental changes in anthocyanin and potassium as affected by ethephon and potassium thiosulphate (season 2004)

Dates : 1: 29/7, 2: 4/8, 3: 11/8, 4: 18/8, 5: 25/8

K : Potassium thiosulphate, C : Concentration, T : Time

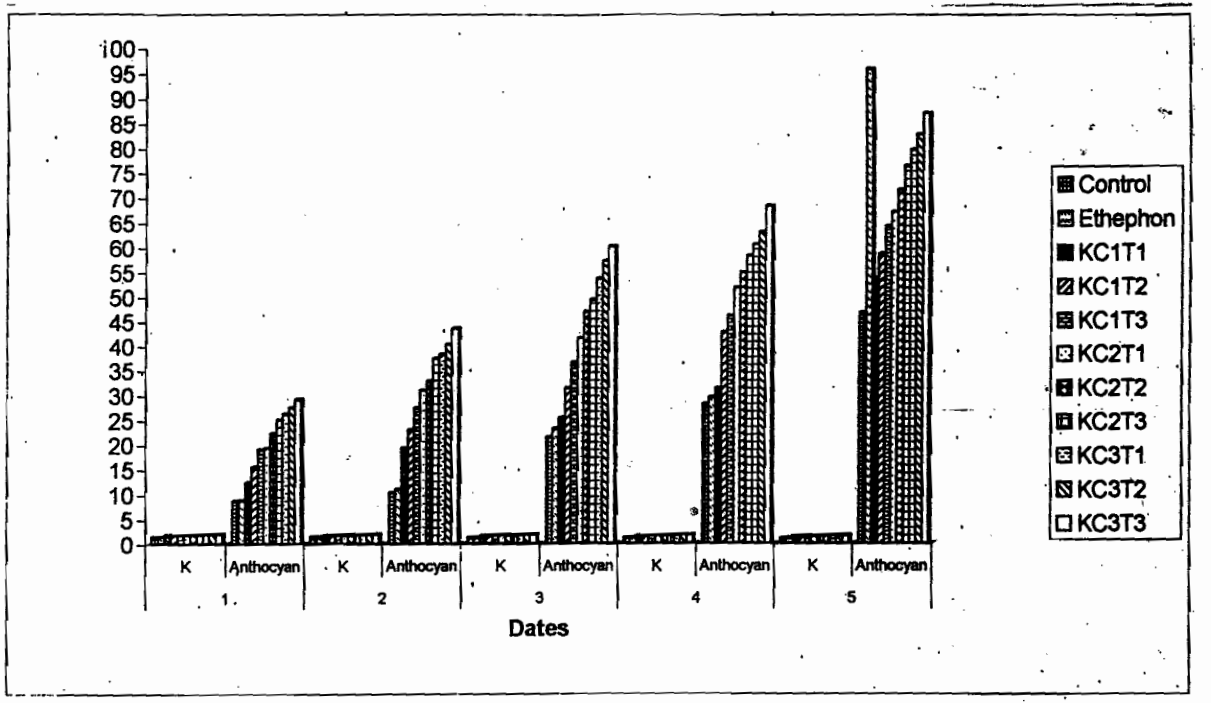

Fig. (5) : Developmental changes in anthocyanin and potassium as affected by ethephon and potassium thiosulphate (season 2005)

Dates : 1: 29/7, 2: 4/8, 3: 11/8, 4: 18/8, 5: 25/8

K : Potassium thiosulphate, C : Concentration, T : Time

berries. Moreover, Chris *et al.* (1984); Peacock (1997) and Abd El-Mohsen (2003) found that vines severely deficient in K tend to have unevenly colored.

There is a good relation between sugar content and the content of anthocyanin in the skin of the berries. Yokotsuka *et al.* (1999) reported that, in the period from berry colouration to ripening, sugar content of the berry rose, TSS and the content of anthocyanins per berry increased as ripening proceeded and that amounts were maximal at 18-20 °Brix. In this respect, it is noticed that decreasing the concentration of K in leaf petioles in this period caused an exhaustion and depletion in the translocation of carbohydrates. This gives an explanation to the positive effect of K in increasing sugar content and subsequently by anthocyanin synthesis in skin berries. The treatment including 2.1% K^- significantly increased the percentage of F.C.B. Thus, it obviously seems that the T_3 at all concentrations of K increased the F.C.B. %. An astonishing relationship was discovered between total sugars, potassium and anthocyanins content when estimated at 7 days intervals from 29 July till 25 August during the two seasons under investigation. Hence, it can be noticed from Figs (2, 3, 4, and 5) that as potassium increased total sugars and anthocyanins content increased gradually from 29 July till 25 August as the beginning of colouration during the two seasons. Also, it is obvious from the Figs that, there were differences between the treatments under study. However, KC_3T_3 in both seasons gave the highest percentages of potassium, total sugars and anthocyanin concentration in comparison with other treatments. Alternatively, the control showed the least percentage of total sugars, potassium and anthocyanin in both seasons. The results of Morris and Cowthan (1982); Calo *et al.*, (1984) and Abd El-Mohsen (2003) confirmed the present findings.

In conclusion the results demonstrate, the promotive influence of spraying Crimson seedless vines with Ethephon at 300 ppm (5% coloration) and the foliar application of potassium thiosulphate at 2.1% at berry set till harvest on improving berry colour and fruit quality. It is recommended to apply such treatments in order to get maximal beneficial effects on berry colour of Crimson Seedless grapevine.

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دراسة حول إمكانية تحسين تلون الحبات في عناقيد العنب الكريمسون سيدلس تحت ظروف الأراضي الصحراوية بإستخدام بعض المعاملاد ا: الرش بالبوتاسيوم والإيثيفون

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ملخص

أجريت الدراسة الحالية علي كرمات عنب صنف كريمسون سيدلس لمدة موسمين متتاليين ٢٠٠٤ ، ٢٠٠٥ ، وكان الهدف الرئيسي من الدراسة إستكشاف فعالية الإيثيفون أو ثيوسلفات البوتاسيوم رشاً للتغلب علي مشكلة قلة تلون الحبات. لذا فإن الإيثيفون بتركيز ٣٠٠ جزء في المليون والبوتاسيوم (في صورة ثيوسلفات البوتاسيوم) وبثلاث تركيزات (٠,٧ ، ١,٤ و ٢,١%) قد تم إختبارهما في ثلاثة مواعيد وهى (١) عند بداية التزهير وبعد العقد وعند بدأ الطراوه أوالليونه في الحبه veriason (٢) عند بداية التزهير ثم كل أسبوع حتي الجمع (٣) بعد العقد ثم كل أسبوع حتي الجمع لكل تركيز علي حده . وبغض النظر عن تركيز البوتاسيوم المستخدم فإن زيادات واضحة في صفات الحبات حدثت بتأخير المعاملة لكل تركيز كل علي حده . كلما زاد التركيز كلما زادت الفعالية لذا فإن أفضل معاملة كانت عند إستخدام البوتاسيوم بالتركيز الأعلي في التوقيت الثالث حيث حدثت زيادات في وزن العنقود والمحصول وطول وقطر الحبات والتصاق الحبات وتماسكها. كما أن المعاملات بالبوتاسيوم أدت إلي حدوث زيادة في المواد الكلية الصلبة الذائبة والسكريات الكلية والنسبة ما بين المواد الصلبة الذائبة والحموضة بينما قللت من الحموصة. كما كانت هناك زيادات معنوية في محتوي الأوراق من البوتاسيوم من خلال المعاملة بالبوتاسيوم خصوصاً عند التركيز الأعلي والذي أدي إلي حدوث زيادة معنوية في المحتوي من الأنثوسيانين أيضاً. كانت هذه الزيادة نسبية مع نسبة البوتاسيوم في كل معاملة كما كانت هناك علاقة عامة بين السكر والأنثوسيانين في جلد الحبات. أدت المعاملة بالإيثيفون إلي تقليل وزن العنقود والتصاق الحبات وتماسكها بينما لم يؤثر علي وزن الحبات والصفات

الكيماوية لها وبصفة عامة فإن رش العناقيد بالإيثيفون بتركيز ٣٠٠ جـزء فـي المليون عند ٥% تلون والرش الورقي بالبوتاسيوم بتركيز ٢,١% من عقد الثمار حتي الجمع هي المعاملة المفضلة (يوصي بها) لتحسين تلون الحبات.

المجلة العلمية لكلية الزراعة – جامعة القاهرة – المجلد (٥٧) العـدد الرابـــــع (أكتوبر ٢٠٠٦) :٧٠١-٧٢٢.