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YIELD AND QUALITY OF THOMPSON SEEDLESS FRESH GRAPES AND RAISINS AS INFLUNCED BY POTASSIUM APPLICATION

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ABSTRACT

The present work was carried out during 1999 and 2000 seasons to investigate the influence of potassium application on fresh and subsequent raisins yield and their qualities. Potassium applications; especially at 350 g K_2SO_4 /vine significantly increased clusters and berries weight, juice volume and total soluble solids (TSS%). The increase in TSS reached 23.4 % over the control of the two seasons of the study. Total acidity took almost an opposite trend to that of both TSS% and TSS/acid ratio.

Potassium applications prolonged the sun-drying period by 5-6 days over the control, whereas the longest period of sun-drying adequate to reach to raisins; 16-18 % moisture content was obtained with the highest rate of potassium (350 g/vine). Thus, the sun-drying ratio was lowered as a result of potassium applications.

Also, the weight and size of raisin berries significantly increased over control level due to potassium application. An obvious effect of potassium on rehydration ratio of raisins was noticed, the highest rate of potassium applied, increased the ratio by 29 % over control.

Potassium application also improved both sugar content and yield of raisins per ton fresh grape as well as quality of produced raisins.

Keywords: Potassium application, Raisins quality, Thompson Seedless grape, Rehydration ratio, Sugar content.

INTRODUCTION

Grape acreage in Egypt has increased rapidly during the last decades; especially in the new reclaimed land. Thus its total area reached about 141 thousand feddans, producing about 975000 metric tons according the statistics of the Ministry of Agriculture (1999).

Thompson Seedless table grape is considered one of the most important cultivars grown in Egypt. Since its acreage represented about 80 % of the total cultivated area of grapes. Most of the production is consumed as a table grape, while a little portion of this crop is used for raisins making. Therefore, it is very important to increase its yield and improve the quality of berries and subsequently the produced raisins. This will reduce the amount of imported raisins and cover the local increased demand at certain period of the year.

Potassium had a pertinent role in many metabolic processes, such as carbohydrate synthesis and development of meristematic tissues, as well as, encourages lignification and regulates water absorption and transpiration (Clarkson & Hanson, 1980 and Mengel & Arneke, 1982). Also potassium increases cold hardiness of plants (Eifert & Eifert, 1976), supports the plant's resistance to pathogen (Ruiz and Moyana, 1998 and Tamim *et al.*, 2000) and improves qualitative aspects of production such as colour, taste, consistency

and preservation of many fruits, (Koj-Tassar *et al.*, 1989; Arafat, 1996 and Dhillon *et al.*, 1999).

The importance of potassium as a very essential nutrient element has greatly increased especially after the construction of the High Dam in 1964, since the total suspended matter of the River Nile was decreased by 98 % (Helal and Rasheed, 1976). This sharp decrease deprived the soil of Egypt from about 91 % of the annual replenishment rate of mineral potassium (Faizy, 1980). Accordingly, application of adequate amounts of potassium became very essential to replenish such soil with the required amount of this element. Previous studies indicated that potassium fertilization improves quality of grapes as a result of increasing both clusters and berry weight (Gopalswamy and Rao, 1972; Kilani, 1979; Haeseler *et al.*, 1980 and Terra *et al.*, 1997). Also, increase of TSS and sugar content of berries (Arafat, 1996 and Ramadan, 1997).

Therefore, this work was carried out to study the effect of potassium on Thompson Seedless fresh table grape, raisins yield and their qualities.

MATERIALS AND METHODS

Ten years old vines of Thompson Seedless grape cultivar grown in a clay loam soil, nearly uniform in vigour according to the similarity of trunk girth were chosen to carry out this work. The chosen vines spaced 2 x 2.5 m and trained on cane pruning system. All vine received the same cultural management of pruning severity, bud load i.e. 48 buds/vine, irrigation, diseases and insects control.

The experiment consisted of 5 treatments with 4 vines replicated 3 times, arranged in a randomized complete block design. Potassium sulphate (48 % K_2O) levels used were 0, 50, 150, 250 and 350 g per vine. The fertilizer was applied to the soil in two equal doses at the end of March and end of May in both seasons of the study.

For raisins making the grapes were harvested when TSS of berry juice reached more than 20% in the control. Clusters were used to determine cluster weight, weight of 100 berries, juice volume of 100-berries and total acidity of juice.

Clusters from each vine per each treatment wise were taken and dipped in a boiling sodium hydroxide solution (0.5 %) at 90 °C for 15 seconds according to Heikal *et al.* (1972). After that, clusters immediately washed with tap water to remove sodium hydroxide residues, and then were subjected to direct sun till raisin moisture content reached about 16-18 % according to El-Shawaf (1980).

The following physical and chemical determinations were carried out; weight and size of raisins, sun drying period, drying ratio, yield of raisins per ton fresh grapes (kg), rehydration ratio of raisins, and total sugar of raisins. The following equations according to Ranganna, 1977 and Hifny *et al.*, 1982 were used.

$$\text{Drying ratio} = \frac{\text{Weight of fresh grape}}{\text{Weight of produced raisins}}$$

$$\text{Yield of raisins per ton} = \frac{1000 \text{ kg fresh grapes}}{\text{Drying ratio}}$$

$$\text{Rehydration ratio} = \frac{\text{Increase in raisin berries after soaking in water}}{\text{Raisins weight}}$$

Total sugars were colorimetrically determined according to Somogyi (1952).

The obtained data were statistically analyzed according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1- Average cluster weight, berry weight and juice of berries:

The results presented in Table (1) indicate that all potassium levels gave a significant increase in both cluster weight, berry weight and juice volume of berries. The lowest cluster weight was recorded for untreated vine (242.0, 257.7 g/cluster), whereas the highest weight was gained by potassium application at 350 g K_2SO_4/vine, in the two seasons respectively

Table (1): Effect of potassium fertilization on some physical and chemical properties of Thompson Seedless fresh table grapes during 1999 and 2000 seasons.

Properties / Potassium sulphate (g/vine)	Average cluster weight (g)	Average weight of 100-berry (g)	Juice volume of 100-berries (ml)	TSS % of juice berries	Acidity %	TSS/acid ratio
1999, season						
0 (Control)	242.0	136.5	120.0	16.8	0.832	20.24
50	287.1	142.2	125.6	17.8	0.816	21.81
150	320.6	155.0	132.6	18.7	0.799	23.67
250	335.5	166.5	140.0	19.5	0.730	26.71
350	355.6	183.2	153.2	20.1	0.689	29.55
LSD at 5%	15.6	9.9	6.3	1.4	0.035	1.22
2000, season						
0 (Control)	257.7	140.5	127.2	16.9	0.870	19.42
50	293.4	146.7	132.7	18.0	0.846	21.27
150	327.5	160.4	140.4	18.7	0.821	22.74
250	338.0	173.8	152.7	19.6	0.778	25.14
350	362.1	188.9	168.5	20.0	0.734	27.24
LSD at 5%	19.6	10.5	6.7	1.5	0.037	2.19

In comparison with the untreated vine, potassium applications increased cluster weight by 46.9 % and 40.5 %, respectively. Whereas, berry weight increased by 34.2 % and 25.6 % over the values of untreated vines, at

the first and second seasons respectively. Also, juice volume of berries was similarly increased as that found with both cluster and berry weight. These increments could be attributed to the highest rate of potassium, 27.0 % and 32.4 % over the values of untreated vines, at the first and second seasons respectively.

These findings are in harmony with those found by Kato *et al.* (1977),Arafat (1996), Ramadan (1997) and Terra *et al.* (1997). This tendency reflects the vital role of accumulated potassium in many metabolic processes such as carbohydrate synthesis and regulation of absorption to water and mineral elements as mentioned by Mengel & Arneke (1982).

2- TSS %, acidity and TSS/acid ratio of juice berries:

The data in Table (1) cleared that TSS of juice berries showed a significant increase over the control during both seasons of the study due to potassium application. The highest rate of potassium (350 g K_2SO_4/vine) gave the most significant increase in the juice TSS %. This increase reached to 19.6 % and 18.34 % over the control during both seasons of the study respectively. The higher rates of potassium were the most effective in increasing TSS %.

Furthermore, the data of total acidity took almost an opposite trend to that observed for the TSS %. Thus, fruits obtained from the control vines gave the highest acidity in the berries juice during the two seasons compared to all other potassium levels applied. This decrease reached to 17.1 % and 15.6 % under the level of control at the first and second seasons respectively. This reflects the enhancing of formation more soluble sugars which represent the majority of soluble solids in the juice of berries. Similar results were reported by Arafat (1996) and Dhillon *et al.* (1999). Concerning the effect on the TSS/acid ratio, this parameter took similar trend to that noticed with TSS %.

3- Weight and size of raisins berry:

Table (2) show that potassium application at different levels resulted in a significant increase of berry weight and its size. The increase in weight due to the highest rate of potassium applications (350 g K_2SO_4/vine) reached 60.9 % and 60.4 % over the untreated vines during the first and second season respectively. The results cleared the vital role of potassium application on physiological processes, especially photosynthetic and oxidative phosphorylation, as explained by Cooper *et al.* (1967) and Clarkson and Hanson (1980).

4- Sun-drying period:

From the present data in Table (2), it can be detected that potassium applications prolonged the period; adequate for sun drying. The longest period of sun drying was recorded with the highest rate of potassium applied at (350 g K_2SO_4/vine). The increment imputed to this rate reached 5 days during the first season and 6 days in the second one, over the period required for the untreated grapes respectively.

Table (2): Effect of potassium fertilization on some physical and chemical properties of Thompson Seedless raisin berries during 1999 and 2000 seasons.

Properties Potassium sulphate(g/vine)	Weight of 100 raisin berries (g)	Size of 100 raisin berries (m)	Sun drying period (days)	Drying ratio fresh : dry	Yield of raisins per ton grape (kg)	Re-hydration after soaking raisins rehy.	*Total sugar of raisins%
1999, season							
0 (Control)	32.50	31.20	6.0	4.2 :1	238.0	1.50 : 1	70.2
50	34.50	35.80	7.0	4.1 :1	243.8	1.53 : 1	74.2
150	39.70	42.27	7.8	3.9 :1	256.4	1.63 : 1	77.3
250	44.60	48.63	9.0	3.7 :1	268.2	1.73 : 1	80.3
350	52.30	56.10	11.0	3.5 : 1	285.7	1.83 : 1	80.9
LSD at 5%	2.59	1.69	0.9	0.27	18.4	0.132	2.4
2000, season							
0 (Control)	32.70	25.33	7.0	4.3 :1	232.7	1.53 :1	68.13
50	35.17	31.50	8.0	4.2 :1	239.8	1.57 :1	72.40
150	40.10	39.50	9.0	4.0 :1	250.0	1.67 :1	76.30
250	45.73	44.13	11.0	3.8 :1	263.2	1.80 :1	79.57
350	52.47	50.43	13.0	3.6 :1	277.7	1.90 :1	80.50
LSD at 5%	2.32	2.35	1.1	0.29	19.14	0.174	2.55

* on dry weight basis

Potassium applications appear to affect berry size, toughness and tenderness of berry skin and as such have an effect on sun drying period. Hifny *et al.* 1982) reported that sun-drying period was longer for grapes treated with GA_3 either or after full bloom, while it was shorter for grapes treated either GA_3 or CCC before bloom in contrast to that of control. In connection to the obtained results, Hiekel *et al.* (1972) reported that sun-drying period of Banaty grape (Thompson Seedless) was ranged between 7-12 days, when TSS of berry juice were 18-22 %, also El-Shawaf (1980) mentioned that sun drying period for Thompson seedless grape was 8 days.

5- Sun-drying ratio:

In regard to the effect of the various rates of potassium applied on sun-drying ratio, the obtained results in Table (2), obviously indicate that all potassium rates applied had decreased the drying ratio. The reduction tended to increase as the rate of potassium increased, from 4.2:1 to 3.5:1 at the first season, and from 4.3:1 to 3.6:1 at the second season; untreated vines to potassium at 350 g K_2SO_4/vine respectively. The lower drying ratio was associated with higher yield of raisins. This may be due to the increase in both berry weight and TSS content, Jacob, 1944 and El-Sayed 1995 reported that both berry size and TSS content were the main factors affecting the yield of raisins.

6- Yield of raisins per ton of fresh grapes and total sugar of raisins:

Results in Table (2) revealed that all potassium applications increased both yield of raisins and its total sugar content in contrast to the

control. The yield of raisins took almost an opposite trend to that noticed with the drying ratio. This means that the lowest drying ratio was associated with the highest yield of raisins. The increase of yield of raisins were 20 % and 19.3 % over the untreated vines at the first and second seasons respectively. The data in Table (2) clearly indicated that total sugar content of raisins was significantly increased as a result of potassium application. Similar results were reported by other workers (Muradov, 1975 and Arafat, 1996).

7- Rehydration (reconstitation) of raisins:

Data in Table (2) also showed all potassium rates increased the rehydration ratio in raisins compared with the control during both seasons of study. The highest rates of potassium gave the highest rehydration ratio of raisins since this increase reached 23 % as an average of the two seasons with the rate of 350 g K_2SO_4/vine.

In conclusion, this study cleared the important role of potassium in improving both yield attributes, fresh fruit quality and the produced raisins. Therefore, it is suggested to apply potassium fertilizer at proper rates to correct the balance among the nutrients needed by the grape vines.

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تأثير التسميد البوتاسى على انتاجية وجودة محصول العنب الطازج والزبيب فى العنب طومسون عديم البذور (البناتى)

السيد البدوى طه الباز ــ غازى ابراهيم البنا ــ الرفاعى فؤاد أحمد الدنجاوى ــ أمل نعيم محمد رمضان

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يعتبر العنب طومسون (البناتى) من أهم أصناف عنب المائدة كما وأنه الصنف الرئيسى لإنتاج الزبيب لذلك رؤى إجراء هذه الدراسة بهدف زيادة محصوله والزبيب الناتج منه وتحسين جودتهما.

ولقد أجريت هذه الدراسة خلال عامى ١٩٩٩ ، ٢٠٠٠ على كرمات عنب بناتى منزرعة فى تربة طينية طمية بقرية سللنت بالقرب من مدينة المنصورة ، محافظة الدقهلية. وأختيرت لهذه التجربة ٦٠ كرمة مرباة قصبيا وقد تلقت جميع الكرمات المعاملات العادية مثل التسميد ، الرى والتقليم ومقاومة الحشائش والأمراض ، والكرمات منزرعة على أبعاد ٢ × ٢,٥ متر ، وقد استخدمت تركيزات (صفر مقارنة ،٥٠ ، ١٥٠ ، ٢٥٠ ، ٣٥٠ جم) من سلفات البوتاسيوم (٤٨ % أكسيد بوتاسيوم) أضيفت على دفعتين متساويتين فى الأسبوع الأخير من مارس ومايو.

وكانت أهم النتائج المتحصل عليها كالآتى:

حدوث زيادة معنوية لكل من متوسط وزن العنقود ومتوسط وزن ١٠٠ حبة من العنب الطازج وحجم العصير وخاصة فى المعاملات ذات التركيز العالى من البوتاسيوم (٣٥٠ جم/كرمه) كما أدى إضافة مزيد من البوتاسيوم إلى حدوث زيادة فى المواد الصلبة الذائبة الكلية وصلت إلى أكثر من ٢٠% فوق المقارنة. وأخذت الحموضة اتجاها معاكسا لكل من المواد الصلبة الذائبة والمواد الصلبة الذائبة/الحموضة كما أدت المستويات المرتفعة من البوتاسيوم إلى إطالة فترة التجفيف الشمسى ووصلت زيادة المدة إلى ٥ أيام، ٦ أيام فوق المدة التى تتطلبها معاملة المقارنة فى الموسم الأول والثانى على التوالى وأدت المعاملات إلى زيادة واضحة فى حجم ووزن حبات الزبيب الناتج وكذلك إلى زيادة نسبه التجفيف إلى ما يقرب من ٢٩% فوق معاملة المقارنة.

و يمكن القول بأن معاملات سلفات البوتاسيوم أدت بصفة عامة إلى زيادة نسبة السكريات فى حبات العنب مما أدى إلى تحسين جودة وخواص الزبيب الناتج.

لذلك يوصى بالتسميد البوتاسى وخاصة فى أراضى الدلتا التى قل مخزونها من المواد البوتاسية وخاصة بعد بناء السد العالى.