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# Effect of spraying some compounds on berry quality and antioxidants content of three red grape cultivars

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**Abstract**

Grapes grown in high temperature areas encounter serious problems regarding various yield quality characteristic. The most important quality attributes of table grapes

planted in these areas are berry coloring and chemical constitutes. Therefore, improving berry quality are essential aims for growers to fulfill the requirements of the market and the consumers. This study was carried out during 2016/2017 seasons to investigate the effect of foliage sprayed methyl jasmonate at a rate of 5 and 10 ppm and humic acid at a rate of 5 and 10 ppm as well as amino acids (glutathione at a rate of 50 and 100 ppm, tryptophan at a rate of 50 and 100 ppm) and potassium at a rate of 1 and 3% on berry development of *Vitis vinifera*cvs. Flame Seedless, Ruby Seedless and Red Roomy growing on the experimental orchard of Faculty of Agriculture, Assiut University. Result of the present work suggested that spraying clusters of Flame Seedless, Ruby Seedless and Red Roomy grape cultivars with the higher concentration of MJ, HA or K significantly enhanced berry sensory attributes and antioxidants content with no negative effect on the yield. Accordingly, from the majority of the present result of the current work it can be recommended that, for economical purposes, to spray either HA at 10 ppm or K at 3%. They gave the best berry quality with reasonable yield.

## Introduction

Grapevine (*Vitis vinifera* L.) is considered the first economic crop in the world and the second in Egypt. It is considered as one of the foremost well is known and favorite fruits within the world, because of an amazing flavor, decent taste and high nutritional value. Most of grape cultivars planted in Egypt belong to the table grape and all of them are of the European grape cultivars (*Vitis vinifera* L.). Grapes (*Vitis vinifera* L.) and other genera of the family vitaceae are widely distributed in the tropics and subtropics with ranges extending into the temperate regions (Einset and Pratt, 1975).The all-out world zone of grapevines achieved 10.5 million ha with a total production of 89 million ton fruits per year (F.A.O., 2017). In Egypt, the total area devoted for grape was 199212 feddans, while the fruiting area of it was 184254 that produced about 1691194 tons with an average of 9.179 tons/feddan (Yearly Book of Statistic and Agricultural Economic Department, 2016).The high weather temperatures in Egypt region have negative effects on the berry coloring and quality. Accordingly, the grape producers in such region and in the similar climatic regions are using various practices for improving the grapes quality. Several metabolic processes in plants are regulated by internal signals, such as plant hormones. In this context, phytohormones such as methyl jasmonate (MeJA), part of the jasmonate family, regulate important aspects of plant physiology (Chen et al., 2006). Methyl jasmonate is involved in various plant functions from the morphological to the molecular level (Ueda and Saniewski, 2006). It has been shown that foliar applications of MeJA had a positive response in fruits by enhancing the ethylene biosynthetic enzymes 1-aminocyclopropane-1-carboxylic acid (ACC) oxidase, which enhances fruit pigmentation and ripening (Rudell et al., 2005; Ziosi et al., 2008). In recent years, new strategies have been studied in order to improve the sustainability of agricultural ecosystems. A potential tool to improve the agro-environmental performance in farms is the use of humic acids as plant biostimulants. These active natural compounds obtained from soil and compost organic matter can enhance yield and quality parameters of crops, nutrient efficiency, physiological performance of horticultural crops, and abiotic stress tolerance (Calvo et al., 2014). Foliar applications require fewer amounts of biostimulants and it allows for nutrients to be absorbed fast and directly by the leaf. According to Ferrara and Brunetti (2010), foliar sprays of humic compounds applied at different plant phenological growth stages increases berry weight and it enhanced grape fruit quality parameters such as titratable acidity and soluble solids. Amino acids are considered as precursors and constituents of proteins (Rai, 2002), which are important for stimulation of cell growth. They contain both acid and basic groups and act as buffers, which help to maintain favorable pH value within the plant cell (Cerdana, et al., 2009). Amino acids can directly or indirectly influence the physiological activities in plant growth and development such as exogenous application of amino acids have been reported to modulate the growth, yield and biochemical quality of plants (Hounsome et al., 2008; Abd El-Aal et al., 2010; Shiraishi et al., 2010). Amino acids are responsible for improving physical and chemical parameters of fruits as well as increasing the productivity of trees (Mouco et al., 2009). Potassium (K) is an essential plant mineral element (nutrient) having a significant influence on increasing many human-health related quality compounds in fruits and vegetables (Usherwood, 1985). Although K is not a constituent of any organic molecule or plant structure, it is involved in numerous biochemical and physiological processes vital to plant growth, yield, quality and stress (Marschner, 1995; Cakmak, 2005). In addition to stomatal regulation of transpiration and photosynthesis, K is also involved in photophosphorylation, transportation of photoassimilates from source tissues via the phloem to sink tissues, enzyme activation, turgor maintenance, and stress tolerance (Usherwood, 1985; Doman and Geiger, 1979; Marschner, 1995; Pettigrew, 2008). Adequate K nutrition has also been associated with increased yields, fruit size, increased soluble solids and ascorbic acid concentrations, improved fruit color, increased shelf life, and shipping quality of many horticultural crops (Lester et al., 2006; Kanai et al., 2007).The aim of this work was to evaluate the influence of the application of different rates of methyl jasmonate and humic acids well as amino acidsand potassium on yield and berry quality of some grape cultivars.

**Materials and methods**

The foliage sprayed methyl jasmonate (MJ) at a rate of 5 and 10 ppm and humic acid (HA) at a rate of 5 and 10 ppm as well as amino acids (glutathione (GL) at a rate of 50 and 100 ppm, tryptophan (TR) at a rate of 50 and 100 ppm) and potassium (K) at a rate of 1 and 3% as well as control treatment on berry development of *Vitis vinifera* cvs. Flame Seedless, Ruby Seedless and Red Roomy growing on the experimental orchard of Faculty of Agriculture, Assiut University were investigated over two consecutive seasons, 2016 and 2017. Fifty five grapevines from each cultivar were chosen. Each treatment consisted of 5 vines (replicates) and each vine was represented as a replicate. Flame Seedless and Ruby Seedless grapevines were trained according to the bilateral cordon system with 16 Spurs and 3 buds were left on each spur. Thus, the total buds left on each vine in this study were 48 Buds/vine. Red Roomy grapevines were pruned as a traditional head training system with 16 Spurs and 4 buds were left on each spur. The total number of buds left on each vine for their cultivar was 64. A surfactant super film at 0.1% was added to the spraying solution and applied one time at the version stage (the beginning of

sprayed using a hand gun sprayer to the vine until well wetted. Horticultural practices such as irrigation, soil management and fertilization were applied as recommended. At harvest, the clusters of all vines were picked on 26/6-10/7, 7/8-10/8 and 13/9-16/9 during 2016 & 2017 for the three cultivars, respectively. Clusters per/vine were counted and weighted to estimate the total number of cluster and yield/vine (kg). Berry chemical quality in terms of total soluble solids (TSS) was elevated using hand refractometer (Atago Japan), total acidity (TA) was estimated by direct titration with 0.1N NaOH utilizing phenolphthalein as an indicator and expressed as mg tartaric acid per 100 ml juice concurring to A.O.A.C (1995) and percentage of reducing sugar contents in juice was estimated according to A.O.A.C. (1995). Vitamin C (ascorbic acid) was determined by the method described by A.OA.C. (1995). Vitamin C (%) was calculated according to the following equation:

$$\text{Vit. C (\%)} = \frac{\text{Dye volume usedin titration} \times \text{molarity}}{\text{sample volume}} \times 100$$

For total anthocyanin content (TAC), samples were extracted by the method described by Onayemi et al. (2006) using Ethyl alcohol and HCL by volume solution. Absorbance was decided spectrophotometrically at 530 nm (Unico 1200 – USA

berry coloring). The vines were a

spectrophotometer). Result is expressed as mg/ 100 g of fresh fruit (Lees and Francis, 1971). For total phenolic content (TPC), juice extracts were prepared by the procedure described by Rababah et al. (2005). Total phenolic contents in the extracts were determined and read at 725 nm using Unico spectrophotometer (Model 2000 UV) according to the method described by Singleton and Rossi (1965). The total content of phenolic compounds was calculated from a calibration curve prepared with gallic acid and calculated as mg/100g of dry peel weight basis and mg/L of juice. For hydrolysable tannin content (HTC), Methanolic extracts were prepared from juice according to the method described by Elfalleh et al. (2011). HTC was determined by the modified method of Cam and Hisil (2010). At the reaction optimum time, absorbance of the red colored mixture was determined at 550 nm versus the blank which containing distilled water. Different concentrations of tannic acid solutions (100 to 1600 mg/L) were used for calibrating standard. The final results were expressed as Tannic acid equivalent (TAE) (mg/L of juice).

**Statistical analysis**

The experiment was set up as Split plot with five replicates and one vine per each. The analysis of variance (ANOVA) was conducted according to Snedecor and Cochran (1989). Means were compared using the least significant differences (LSD) values at 5% level of the probability.

**Results**

**Chemical constituents**

Data found in Table 1 demonstrated that the most effective treatments respecting the percentage of TSS were HA at 10 ppm, MJ at 44 mM and K at 3%. The percentages of these later treatments were 22.52, 22.00 and 21.07 during the 1st season, respectively. During the second season they recorded 22.28, 21.89 and 20.40, respectively. Flame Seedless significantly surpassed the other two cultivars in this respect. Ruby Seedless also significantly exceeded Red Roomy cultivar which exhibited the least TSS%.The interaction effect showed that HA at 10 ppm, HA at 5 ppm, MJ at 44 mM on Flame Seedless grapes recorded the highest percentages. Likewise, HA at 10 ppm and MJ at 44 mM gave the lowest acidity percentage during the two studied seasons (Table 1). TR at 100 ppm in the 1st season of study and GL at 100 ppm during the 2nd season also exhibited lower acidity %, however, the control recorded the highest percentages. On the other side, Ruby Seedless gave the lowest acidity followed by Flame Seedless while Red Roomy had the highest percentages during the two seasons of study. The effect of various treatments on TSS/acid ratio was illustrated in (Table 2). Data found in such Table showed that the highest ratio was taken from the treatments HA at 10 ppm, MJ at 44 mM and GL at 100 ppm during the two seasons of study. The control gave the lowest ratio (25.41 and 28.01 during the two seasons, respectively). Ruby Seedless produced the highest ratio during the two studied seasons while Red Roomy gave the lowest one. The interaction effect showed that MJ at 44 mM, HA at 10 ppm and GL at 100 ppm on Ruby Seedless during the 1st season produced the highest ratio. During the second season, HA at 10 ppm on Flame Seedless and MJ 44 mM and HA at 10 ppm on Ruby Seedless gave the highest ratios. In addition, Data presented in Table 2 showed that, MJ at 44 mM and HA at 10 ppm produced the highest percentage of reducing sugars %during the two seasons of study. HA at 5 ppm in the 1st season and GL at 100 ppm during the 2nd season also represented higher reducing sugars percentage. On the other side, control vines gave the lower percentage and the difference between it and any other treatment was significant during the two seasons. Concerning the differences between cultivars, it could be observed that Flame Seedless and Ruby Seedless significantly exceeded Red Roomy. However, the differences between Flame Seedless and Ruby Seedless were not significant in the 1st season while Flame Seedless significantly surpassed Ruby Seedless during the 2nd one.

**Antioxidants content**

**Ascorbic acid (vitamin C)**

All the treatments significantly exceeded the control (Table 3) Vitamin C content was found the highest in berries as a result of spraying with MJ at 44 mM and HA at 10 ppm during the two seasons of study. Red Roomy berries contained the highest V.C in the 1st season while Flame Seedless had the highest value in the 2nd one; however, Ruby Seedless gave the least values during the two studied seasons. On the other side, K at 3%, MJ at 44 mM and HA at 10 ppm on Red Roomy during 2016 and HA at 5 ppm, K at 3% on Flame Seedless and MJ at 44 mM on Red Roomy during 2017 exhibited the highest V.C content of grape berries, while the control gave the lowest values.

**Total anthocyanins**

Data found in Table 3 revealed that all the treatments significantly overcame the control during the two seasons of study. The most effective treatments during the two studies seasons were MJ at 44 mM, HA at 10 ppm, K at 3% and GL at 100 ppm. The total anthocyanins content (mg/100 g) in berry skins associated with the later treatments were 76, 67, 69.38, 72.66 and 68.39 during the 1st season of study. During the 2nd season, such treatments reached 78.11, 73.52, 62.29 and 52.27 mg/100 g, respectively. However, the control values in this respect were 21.63 and 19.08 during the 1st and 2nd season, respectively, which represented the lowest values among all the treatments. Results also suggested that total anthocyanins of Flame Seedless grapes exhibited the highest values and significantly surpassed the other two cultivars. The total anthocyanins content of Flame Seedless cultivar was 81.49 and 72.97 mg/100 g during the two seasons, respectively. Ruby Seedless also significantly exceeded Red Roomy cultivar in this respect during the two seasons of study. On the other side, the interaction effect revealed the Flame Seedless grapes was more responsive the treatments than the other two cultivars. The results showed that GL at 100 ppm, HA at 10 ppm and K at 3% on Flame Seedless and MJ at 44 mM on Ruby Seedless gave the highest values of anthocyanins during the two studied seasons.

**Total phenols**

The obtained results showed that HA at 10 ppm, K at 3% and MJ at 44 mM exhibited the highest values, while the control recorded the least ones. The values of these superior treatments were 67.03, 64.21, 61.29 (mg/kg) during the 1st season while they were 63.98, 62.49 and 58.75 in the 2nd season, respectively. On the other side, Flame Seedless significantly exceeded the other two cultivars, while Red Roomy gave the lowest values (Table 4). The interaction effect revealed that, HA at 10 ppm, K at 3% and MJ at 44 mM on Flame Seedless produced the best results during the two seasons of study.

**Tannins percentage**

During the two seasons, Table 4 showed that MJ at 44 mM, HA at 10 ppm, K at 3% and GL at 100 ppm recorded the lowest percentages of tannin. Ruby Seedless produced the lowest percentages followed by Red Roomy and then Flame Seedless grapes. K at 3%, HA at 10 ppm and MJ at 44 mM on Ruby Seedless gave the lowest percentage during the 1st season, while such treatments on Red Roomy exhibited the lowest percentages during the 2nd season.

**Discussion**

The quality parameters of grapes mostly made up of coloring, berry contents of sugar, TSS and acidity as well as vitamin C, phenols, anthocyanins and tannins. The later are called antioxidants. They are compounds that are capable even in small quantities to prevent or reduce the oxidative destruction of the important compounds (Baliket al., 2008).

Our results suggested that, MJ, HA, K and sometimes GL at the higher levels had a positive impact on berry quality and its content of the antioxidants. Results of the present study have been supported by many investigators. For instance, it was found that anthocyanin bio synthesis was strongly stimulated by the individual application of JA (Jia et al., 2016; Wang et al., 2017). Bidabadi et al. (2014) noted that application of MJ enhancing the activity of antioxidants leading to enhanced grapevine performance. Ruiz-Garća et al. (2013) suggested that, treating grapes with MJ presented a higher anthocyanin and flavonol contents. Ju et al. (2016) reported that, exogenous MJ treatment improved the anthocyanin content in grape berries. MJ also elated to fruit maturation of apple (Kondo et al., 2009) and strawberry (Mukkun and Singh, 2009). The later was due to its role of ethylene and/or abscisic acid production.

The present work suggested that HA especially at 10 ppm had a distinguish effect on most of the berry sensory attributes and antioxidants content. The beneficial effects of HA on fruit quality has been demonstrated by many workers. Mohamadineia et al. (2015), Ibrahim and Ali (2016), Kok and Bal (2016), Ahmed et al. (2017), Popescu and Popescu (2018) on grapes how found that HA application improved various fruit quality parameters.

Berry quality in terms of sensory attributes and antioxidant contents could be enhanced by spraying with GL and TR various researches revealed that amino acids application has a positive effect on fruit quality attributes. For instance, Khan et al. (2012) found that foliar application of mixture of amino acids increased TSS, sugars and TSS/acid ratio. Portu et al. (2015) found that foliar application of amino acids could enhance the phenolic contents of grapes. Belal et al. (2016) found that amino acids applications enhanced TSS%, sugars %, total anthocyanins and total phenols and reduced the total acidity. Ahmed et al. (2017) suggested that application of amino acids enhanced quality attributes of grapes.

Potassium nutrient should be sufficiently and timely applied both at full bloom and berry coloring stages to the table grape cultivars to ensure fruit growth (Zhenming et al., 2008). Potassium may be involved in the translocation of solutes into the grape berry through its role in phloem loading and uploading. After veraison there are large increase in both K and TSS, so positive relationship between berry K and berry sugar would be expected (Mpelasoka et al., 2003). At maturity, adequate K is needed for translocation of sugars to the berries. Optimum K at harvest provides an attractive look and a long shelf life to grapes (Ganeshamurthy et al., 2011). Supplementary soil K with foliar K application to the fruit-bearing plants improves fruit quality by increasing firmness, sugar content, ascorbic acid and coloring (Lester et al., 2010). The current study showed that K spraying especially at 3% greatly enhanced both berry sensory attributes and antioxidant contents.

**Conclusion and recommendation**

Result of the present work suggested that spraying clusters of Flame Seedless, Ruby Seedless and Red Roomy grape cultivars with the higher concentration of MJ, HA or K significantly enhanced berry sensory attributes and antioxidants content with no negative effect on the yield.

Accordingly, from the majority of the present result of the current work it can be recommend that, for economical purposes, to spray either HA at 10 ppm or K at 3%. They gave the best berry quality with reasonable yield .

**Table (1) Effect of Methyl jasmonate (MJ), Humic acid (HA), Amino acids (Glutathion (GL) and Tryptophan (TR) and Potassium (K) on TSS (%) and Total acidity (%) of Flame Seedless, Ruby Seedless and Red Roomy grape cultivars during 2016 and 2017 seasons.**

| Cultivar / Treatment | TSS (%) | | | | | | | | Total acidity (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flame Seedless | | Ruby Seedless | | Red Roomy | | Mean (T) | | Flame Seedless | | Ruby Seedless | | Red Roomy | | Mean (T) | |
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| **MJ 22 mM** | 22.88 | 22.84 | 19.32 | 19.92 | 18.72 | 19.04 | **20.31** | **20.60** | 0.59 | 0.49 | 0.43 | 0.45 | 0.57 | 0.56 | **0.53** | **0.49** |
| **MJ 44 mM** | 24.20 | 23.72 | 21.84 | 22.28 | 19.96 | 19.68 | **22.00** | **21.89** | 0.54 | 0.44 | 0.36 | 0.37 | 0.50 | 0.49 | **0.47** | **0.43** |
| **HA 5 ppm** | 24.28 | 23.20 | 19.84 | 19.76 | 18.64 | 17.64 | **20.92** | **20.20** | 0.52 | 0.44 | 0.44 | 0.49 | 0.51 | 0.51 | **0.49** | **0.48** |
| **HA 10 ppm** | 25.36 | 25.20 | 22.44 | 21.92 | 19.76 | 19.72 | **22.52** | **22.28** | 0.47 | 0.42 | 0.37 | 0.39 | 0.49 | 0.46 | **0.45** | **0.43** |
| **GL 50 ppm** | 22.88 | 21.84 | 18.88 | 18.36 | 16.76 | 16.84 | **19.51** | **19.01** | 0.59 | 0.49 | 0.43 | 0.44 | 0.56 | 0.56 | **0.53** | **0.49** |
| **GL 100 ppm** | 23.88 | 23.40 | 20.44 | 20.04 | 17.88 | 18.96 | **20.73** | **20.80** | 0.47 | 0.44 | 0.37 | 0.37 | 0.64 | 0.47 | **0.49** | **0.43** |
| **TR 60 ppm** | 22.80 | 21.16 | 18.48 | 18.36 | 16.48 | 16.64 | **19.25** | **18.72** | 0.56 | 0.60 | 0.43 | 0.46 | 0.65 | 0.55 | **0.55** | **0.53** |
| **TR 100 ppm** | 23.72 | 23.00 | 19.92 | 19.72 | 17.40 | 17.88 | **20.35** | **20.20** | 0.50 | 0.56 | 0.39 | 0.37 | 0.56 | 0.49 | **0.48** | **0.47** |
| **K-1 %** | 22.26 | 20.48 | 18.96 | 19.52 | 17.84 | 17.96 | **19.69** | **19.32** | 0.63 | 0.47 | 0.45 | 0.45 | 0.65 | 0.60 | **0.58** | **0.51** |
| **K-3 %** | 24.08 | 21.12 | 20.00 | 20.76 | 19.12 | 19.32 | **21.07** | **20.40** | 0.58 | 0.42 | 0.45 | 0.39 | 0.52 | 0.49 | **0.52** | **0.44** |
| **Control** | 17.56 | 16.68 | 17.32 | 17.20 | 15.64 | 16.00 | **16.84** | **16.63** | 0.71 | 0.62 | 0.59 | 0.51 | 0.69 | 0.69 | **0.67** | **0.61** |
| **Mean (C)** | **23.08** | **22.06** | **19.77** | **19.80** | **18.02** | **18.15** | **20.29** | **20.01** | **0.56** | **0.49** | **0.43** | **0.43** | **0.53** | **0.53** | **0.52** | **0.48** |

| | TSS (%) | | Total acidity (%) | |
|---|---|---|---|---|
| | **R.L.S.D.$_{0.05}$(2016)** | **R.L.S.D.$_{0.05}$(2017)** | **R.L.S.D.$_{0.05}$(2016)** | **R.L.S.D.$_{0.05}$(2017)** |
| T | 0.29 | 0.39 | 0.02 | 0.02 |
| C | 0.23 | 0.21 | 0.02 | 0.01 |
| T x C | 0.52 | 0.70 | 0.04 | 0.04 |

**Table (2) Effect of Methyl jasmonate (MJ), Humic acid (HA), Amino acids (Glutathion (GL) and Tryptophan (TR) and Potassium (K) onTSS/acid ratioand reducing sugars (%) of Flame Seedless, Ruby Seedless and Red Roomy grape cultivars during 2016 and 2017 seasons.**

| Cultivar / Treatment | TSS/Acid ratio (%) | | | | | | | | Reducing sugars (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flame Seedless | | Ruby Seedless | | Red Roomy | | Mean (T) | | Flame Seedless | | Ruby Seedless | | Red Roomy | | Mean (T) | |
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| **MJ 22 mM** | 38.93 | 46.45 | 45.45 | 44.64 | 32.84 | 34.59 | **39.07** | **41.89** | 15.66 | 17.14 | 15.78 | 16.16 | 15.09 | 14.92 | **15.51** | **16.07** |
| **MJ 44 mM** | 45.32 | 54.18 | 61.31 | 60.07 | 39.84 | 40.43 | **48.82** | **51.56** | 17.45 | 18.37 | 17.45 | 17.58 | 15.60 | 16.18 | **16.83** | **17.38** |
| **HA 5 ppm** | 47.06 | 53.01 | 45.03 | 40.76 | 36.69 | 35.38 | **42.93** | **43.05** | 16.09 | 17.62 | 16.09 | 16.14 | 15.02 | 14.95 | **15.74** | **16.24** |
| **HA 10 ppm** | 54.04 | 59.73 | 60.89 | 55.10 | 39.99 | 43.01 | **51.64** | **52.61** | 16.66 | 18.52 | 17.36 | 17.36 | 15.69 | 16.09 | **16.57** | **17.33** |
| **GL 50 ppm** | 38.77 | 43.93 | 43.76 | 41.99 | 30.13 | 30.43 | **37.55** | **38.78** | 14.94 | 15.84 | 15.11 | 15.29 | 13.71 | 13.49 | **14.59** | **14.88** |
| **GL 100 ppm** | 50.44 | 52.79 | 55.23 | 54.55 | 28.46 | 40.03 | **44.71** | **49.12** | 15.77 | 17.56 | 16.70 | 16.54 | 14.11 | 15.05 | **15.53** | **16.38** |
| **TR 60 ppm** | 40.44 | 35.29 | 43.13 | 40.54 | 25.21 | 30.49 | **36.26** | **35.44** | 15.58 | 15.53 | 14.59 | 14.82 | 12.77 | 13.27 | **14.32** | **14.54** |
| **TR 100 ppm** | 47.16 | 41.44 | 51.73 | 53.67 | 31.27 | 36.36 | **43.39** | **43.82** | 16.22 | 16.57 | 15.68 | 15.69 | 13.89 | 14.20 | **15.26** | **15.49** |
| **K-1 %** | 35.53 | 43.78 | 42.15 | 43.69 | 27.72 | 29.82 | **35.13** | **39.09** | 15.16 | 16.22 | 15.16 | 15.19 | 13.39 | 14.28 | **14.57** | **15.23** |
| **K-3 %** | 41.87 | 50.68 | 44.18 | 52.46 | 36.78 | 39.83 | **40.94** | **47.66** | 16.35 | 17.60 | 16.35 | 15.78 | 14.37 | 15.25 | **15.69** | **16.21** |
| **Control** | 24.74 | 26.89 | 29.07 | 33.95 | 22.41 | 23.19 | **25.41** | **28.01** | 13.42 | 13.76 | 13.15 | 13.37 | 12.26 | 12.64 | **12.94** | **13.25** |
| **Mean (C)** | **42.21** | **46.19** | **47.45** | **47.40** | **31.94** | **34.87** | **40.53** | **42.82** | **15.75** | **16.79** | **15.77** | **15.81** | **14.17** | **14.57** | **15.23** | **15.73** |

**TSS/Acid ratio (%)**

| **R.L.S.D.$_{0.05}$(2016)** | | **R.L.S.D.$_{0.05}$(2017)** | |
|---|---|---|---|
| T | 1.68 | T | 1.97 |
| C | 1.19 | C | 1.20 |
| T × C | 3.05 | T x C | 3.71 |

**Reducing sugars (%)**

| **R.L.S.D.$_{0.05}$(2016)** | | **R.L.S.D.$_{0.05}$(2017)** | |
|---|---|---|---|
| T | 0.290 | T | 0.260 |
| C | 0.080 | C | 0.200 |
| T x C | 0.590 | T x C | 0.610 |

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**Table (3) Effect of Methyl jasmonate (MJ), Humic acid (HA), Amino acids (Glutathion (GL) and Tryptophan (TR) and Potassium (K) on Vitamin C and Total anthocyanins (mg/100g) of Flame Seedless, Ruby Seedless and Red Roomy grape cultivars during 2016 and 2017 seasons.**

| Cultivar / Treatment | Vitamin C (mg/100g) | | | | | | | | Total anthocyanins (mg/100g) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flame Seedless | | Ruby Seedless | | Red Roomy | | Mean (T) | | Flame Seedless | | Ruby Seedless | | Red Roomy | | Mean (T) | |
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| **MJ 22 mM** | 3.40 | 4.18 | 3.70 | 3.94 | 4.64 | 4.06 | **3.91** | **4.06** | 73.83 | 68.49 | 46.74 | 56.39 | 32.17 | 33.47 | **50.91** | **52.78** |
| **MJ 44 mM** | 4.08 | 4.78 | 4.10 | 4.44 | 5.88 | 4.98 | **4.69** | **4.73** | 87.93 | 84.46 | 96.47 | 98.91 | 45.59 | 50.97 | **76.67** | **78.11** |
| **HA 5 ppm** | 3.60 | 5.54 | 3.46 | 3.70 | 4.12 | 3.60 | **3.73** | **4.28** | 97.24 | 85.43 | 40.09 | 40.11 | 26.68 | 35.26 | **54.67** | **53.59** |
| **HA 10 ppm** | 4.32 | 4.64 | 4.10 | 4.38 | 5.00 | 3.94 | **4.47** | **4.32** | 113.04 | 101.27 | 46.58 | 49.02 | 48.54 | 70.25 | **69.38** | **73.52** |
| **GL 50 ppm** | 4.14 | 4.38 | 3.08 | 4.12 | 3.78 | 3.82 | **3.67** | **4.11** | 80.52 | 73.47 | 42.81 | 42.16 | 24.66 | 22.90 | **49.33** | **46.18** |
| **GL 100 ppm** | 4.32 | 4.58 | 3.98 | 4.72 | 4.48 | 4.10 | **4.26** | **4.47** | 115.39 | 78.65 | 58.45 | 50.80 | 31.34 | 27.36 | **68.39** | **52.27** |
| **TR 60 ppm** | 3.48 | 4.06 | 3.34 | 3.94 | 3.88 | 3.94 | **3.57** | **3.98** | 56.79 | 63.33 | 35.67 | 35.62 | 26.02 | 22.05 | **39.49** | **40.33** |
| **TR 100 ppm** | 3.94 | 4.36 | 4.02 | 4.16 | 4.82 | 4.10 | **4.26** | **4.21** | 72.66 | 71.28 | 42.04 | 39.97 | 30.52 | 30.36 | **48.41** | **47.20** |
| **K-1 %** | 3.94 | 4.92 | 3.84 | 3.04 | 4.62 | 3.06 | **4.13** | **3.67** | 64.10 | 61.24 | 40.86 | 45.58 | 34.66 | 42.97 | **46.54** | **49.93** |
| **K-3 %** | 4.12 | 5.04 | 3.98 | 3.58 | 5.92 | 3.26 | **4.67** | **3.96** | 107.41 | 94.49 | 62.18 | 40.54 | 48.38 | 51.83 | **72.66** | **62.29** |
| **Control** | 3.18 | 3.26 | 3.10 | 2.96 | 3.30 | 4.60 | **3.19** | **3.61** | 27.49 | 20.51 | 19.62 | 22.49 | 17.78 | 14.24 | **21.63** | **19.08** |
| **Mean (C)** | **3.87** | **4.52** | **3.70** | **3.91** | **4.59** | **3.95** | **4.05** | **4.13** | **81.49** | **72.97** | **48.32** | **47.42** | **33.30** | **36.51** | **54.37** | **52.29** |

**Vitamin C (mg/100g)**

| **R.L.S.D.$_{0.05}$(2016)** | | **R.L.S.D.$_{0.05}$(2017)** | |
|---|---|---|---|
| T | 0.11 | T | 0.27 |
| C | 0.11 | C | 0.18 |
| T × C | 0.20 | T × C | 0.47 |

**Total anthocyanins (mg/100g)**

| **R.L.S.D.$_{0.05}$(2016)** | | **R.L.S.D.$_{0.05}$(2017)** | |
|---|---|---|---|
| T | 2.51 | T | 4.69 |
| C | 1.01 | C | 3.95 |
| T × C | 4.35 | T × C | 8.42 |

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**Table (4) Effect of Methyl jasmonate (Mj), Humic acid (HA), Amino acids (Glutathion (GL) and Tryptophan (TR)) and Potassium (K) on phenols and Tannins of Flame Seedless, Ruby Seedless and Red Roomy grape cultivars during 2016 and 2017 seasons.**

| Cultivar / Treatment | Total phenols (mg/kg) | | | | | | | | Tannins (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flame Seedless | | Ruby Seedless | | Red Roomy | | Mean (T) | | Flame Seedless | | Ruby Seedless | | Red Roomy | | Mean (T) | |
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| **MJ 22 mM** | 56.61 | 45.21 | 44.62 | 39.40 | 29.49 | 29.68 | **43.57** | **38.10** | 1.17 | 1.28 | 1.09 | 1.11 | 1.31 | 0.77 | **1.19** | **1.05** |
| **MJ 44 mM** | 77.82 | 68.31 | 61.50 | 58.27 | 44.54 | 49.67 | **61.29** | **58.75** | 1.08 | 1.22 | 0.88 | 0.82 | 0.95 | 0.66 | **0.97** | **0.90** |
| **HA 5 ppm** | 60.77 | 52.63 | 49.26 | 45.06 | 30.39 | 31.26 | **46.81** | **42.98** | 1.24 | 1.23 | 0.89 | 1.09 | 1.11 | 0.799 | **1.08** | **1.04** |
| **HA 10 ppm** | 83.46 | 76.79 | 69.60 | 62.64 | 48.02 | 52.51 | **67.03** | **63.98** | 1.09 | 1.14 | 0.76 | 0.82 | 0.87 | 0.64 | **0.91** | **0.87** |
| **GL 50 ppm** | 37.95 | 31.21 | 31.32 | 28.53 | 21.40 | 22.71 | **30.22** | **27.48** | 1.24 | 1.32 | 0.90 | 1.16 | 1.16 | 0.88 | **1.10** | **1.12** |
| **GL 100 ppm** | 48.52 | 48.59 | 41.46 | 38.70 | 28.20 | 33.29 | **39.39** | **40.19** | 1.02 | 1.17 | 0.82 | 0.78 | 0.79 | 0.66 | **0.88** | **0.87** |
| **TR 60 ppm** | 33.85 | 28.22 | 29.26 | 24.39 | 19.68 | 20.79 | **27.60** | **24.47** | 1.25 | 1.12 | 1.01 | 1.17 | 1.32 | 0.99 | **1.19** | **1.09** |
| **TR 100 ppm** | 42.88 | 36.95 | 38.08 | 32.88 | 23.63 | 30.25 | **34.86** | **33.36** | 1.18 | 0.99 | 0.90 | 1.05 | 1.05 | 0.90 | **1.04** | **0.98** |
| **K-1 %** | 58.87 | 49.01 | 48.82 | 43.50 | 30.18 | 31.19 | **45.96** | **41.24** | 1.14 | 1.18 | 0.87 | 0.77 | 1.22 | 0.82 | **1.08** | **0.92** |
| **K-3 %** | 79.99 | 75.28 | 65.51 | 59.84 | 47.12 | 52.35 | **64.21** | **62.49** | 1.07 | 1.07 | 0.63 | 0.58 | 0.93 | 0.61 | **0.88** | **0.75** |
| **Control** | 30.75 | 22.81 | 29.09 | 24.42 | 19.35 | 21.32 | **26.40** | **22.85** | 1.41 | 1.32 | 1.46 | 1.29 | 1.57 | 1.25 | **1.48** | **1.29** |
| **Mean (C)** | **55.59** | **48.64** | **46.23** | **41.60** | **31.09** | **34.09** | **44.30** | **41.45** | **1.17** | **1.19** | **0.93** | **0.97** | **1.12** | **0.82** | **1.07** | **0.99** |

**Total phenols (mg/kg)**

| **R.L.S.D.$_{0.05}$(2016)** | | **R.L.S.D.$_{0.05}$(2017)** | |
|---|---|---|---|
| T | 1.11 | T | 1.21 |
| C | 0.78 | C | 0.67 |
| T × C | 1.93 | T × C | 2.15 |

**Tannins (%)**

| **R.L.S.D.$_{0.05}$(2016)** | | **R.L.S.D.$_{0.05}$(2017)** | |
|---|---|---|---|
| T | 0.04 | T | 0.04 |
| C | 0.02 | C | 0.01 |
| T × C | 0.08 | T × C | 0.07 |

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**تأثير رش بعض المركبات على المحصول وجودة الحبات والمحتوى من مضادات الأكسدة في ثلاثة أصناف من العنب الاحمر**

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تواجه زراعة العنب في المناطق الحارة ومن ضمنها مصر مشاكل خطيرة تتعلق بجانب كمية المحصول نقص تلوين حبات العنب وانخفاض صفات الجودة للحبات. ولذلك اتجه عديد من المزارعين ومنتجي العنب لتحسن هذه الصفات والتي تعد من الأهداف الرئيسية لتلبية متطلبات السوق والمستهلك.

تم دراسة تأثير الرش بكل من حامض الجاسمونيك في صورة ميثايل جاسمونيت وحامض الهيوميك بمعدل 5 ، 10 جزء في المليون وكذلك الأحماض الأمينية مثل الجلوتاثيون والتربتوفان كل بمعدل 50 ، 100 جزء في المليون وأيضاً استخدام الرش بالبوتاسيوم السائل بتركيز 1 ، 3 ٪ عل عناقيد ثلاثة أصناف من العنب (الفليم عديم البذور ، الروبي عديم البذور ، الرومي الأحمر) النامية بمزرعة كلية الزراعة جامعة أسيوط خلال موسمين متتاليين 2016 ، 2017م. وتم تقدير العديد من الصفات الكيماوية للحبات والمتمثلة في تقدير النسبة المئوية للمواد الصلبة الكلية والحموضة الكلية ونسبتهما لبعض وكذلك السكريات المختزلة بالإضافة لتقدير محتوى الحبات من صبغة الأنثوسيانين والفينولات الكلية والمواد التانينية.

أظهرت النتائج بصفة عامة أن رش عناقيد العنب للأصناف الثلاثة بتركيزات عالية لكل من ميثايل جاسمونيت وحامض الهيوميك وكذلك البوتاسيوم أدت لحدوث زيادة معنوية في جودة الحبات ومحتواها من مركبات مضادات الأكسدة دون حدوث تغير في كمية المحصول.

وعليه يمكن أن نوصي من الناحية الإقتصادية الرش إما باستخدام حامض الهيوميك بتركيز 10 جزء في المليون أو البوتاسيوم بتركيز 3 ٪ وذلك للحصول على أفضل جودة لحبات العنب مع كمية محصول جيدة.