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Effect of Potassium Humate on Growth, Yield and Berries Quality of 'Red Roumi' Grapevines

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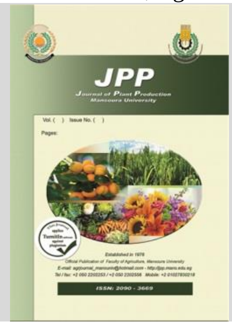

ABSTRACT

This experiment was carried out during the two seasons of 2019 and 2020 to study the effect of potassium humate as soil application at different concentrations 1.5, 3.0, 4.5, and 6.0 g/vine on vegetative growth, nutrient content in leaf petioles, yield and berries quality of 'Red Roumi' grapevines grown in clay soil in a private farm at Sanbukht, Dakahlia Governorate, Egypt. Obtained results indicated that adding K-humate at the rate of 6.0 or 4.5 g/vine enhanced vegetative growth, leaf mineral content, yield, and berry physical and chemical qualities as compared with the other treatments. Furthermore, the application of 6.0 g/vine produced the highest significant values of yield per vine or per feddan, SSC per vine, cluster and berry weight, total anthocyanin content in berry skin, and total carbohydrates and proteins in canes compared to other treatments used in both tested seasons.

***Keywords*:** Potassium humate, soil application, Grapevines, Red Roumi

INTRODUCTION

Grapevine (*Vitis vinifera* L.) is considered one of the major commercial fruit crops in Egypt, it ranks the second fruit crop after citrus. The harvested area reached about 78,853 hectars, which produced 1,759,472 tons according to FAO (2018). Humic substances (humates, humic acids, and fulvic acids) make up the bulk of humus, which resulted from organic soil decomposition and constituting 65-75% of organic matters (Shahryari *et al*., 2009). Since, it plays an important role in plant nutrition and consider one of the most important soil consistency factors of the life processes and can be a source of nutrients for soil microorganisms (Theunissen *et al*., 2010).

Humic acids play indirect and direct effects on plant growth such as enrichment in soil nutrients, an increase of microbial population, higher cation exchange capacity (CEC), and improvement of soil structure. Whereas, other effects are various biochemical actions exerted at the cell wall membrane or cytoplasm and mainly of hormonal nature (Varanini and Pinton, 2001; Chen *et al*., 2004). The biostimulator activity of humic substances (HS) was usually due to hormone-like activity, which may be due to auxins, which were analyzed in the HS (Nardi *et al*., 2016). Roots appear to be affected by the growth-promoting effects of HS, with increases in size, branching, and/or greater density of root hairs with a larger surface area (Canellas and Olivares, 2014).

Humic substances are commercially available in the form of inexpensive soluble salts, referred to as potassium humates and potassium fulvates (Imbufe *et al*., 2005). Humates are salts of humic acids, the most active component of HS, which are more soluble and thus more reactive in soil (Burdick, 1965). Potassium humate increases the rate of nutrient uptake, enhances plant biomass, and reduces soil compaction (Canellas *et al.*, 2015). Moreover, Mayhew (2004) and Ouni *et al.* (2014) documented numerous benefits of humate application to plants, including increases in soil water retention, growth of beneficial soil micro-organisms (especially if exposed to contaminant toxicity), root respiration, enzyme activity, root growth, and plant yield.

Potassium is one of the essential macronutrients required for the growth and metabolism of the plant, the available potassium level in soil dropped in the last decade due to the rapid development of agriculture and application of imbalanced fertilizers (Rawat *et al.*, 2016). So, it plays a substantial role in plant growth including osmoregulation, plant-water relation, and internal cation/anion balance. It also has an essential effect on enzyme activation involved in the formation of organic substances, starch and protein synthesis, photosynthetic and respiratory metabolism (Lauchli and Pfluger, 1979; Wyn Jones *et al.*, 1979; Marschner, 2012), stomatal movement, turgor regulation, and osmotic adjustment by increasing protein production in plants (Marschner 2012).

The objective of this investigation was to evaluate the effect of adding potassium humate at different concentrations on growth, nutrient uptake, yield and, berry qualities of **'**Red Roumi**'** grapevines. Since, K is required in large amounts to maintain plant health but it often receives less attention than N and P in many grower's production systems.

MATERIALS AND METHODS

This study was carried out during the seasons of 2019 and 2020, to evaluate the effect of potassium humate as soil application at different rates on growth, yield, and berry quality of **'**Red Roumi**'** grapevines. This experiment was conducted on 5-year-old **'**Red Roumi**'** vines grown on their own roots in a private farm at Sanbukht, Dakahlia Governorate, Egypt in clay soil under a flood irrigation system. The vines were planted at 2 m within rows and 2.5 m between rows under the Parron trellis system, sixty vines similar in growth were chosen for this study. Spur pruning was done in mid-February in both seasons of study, leaving 48 eyes/vine (6 fruiting spurs/cordon × 2 eyes × 4 cordons). The experiment was carried out based on a complete

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randomized blocks design with five treatments, each replicated 3 times with 4 vines per each replicate.

The treatments are presented as follow:

1- Control (received the normal culture practices)
2- Potassium humate at 1.5 g/vine.
3- Potassium humate at 3.0 g/vine.
4- Potassium humate at 4.5 g/vine.
5- Potassium humate at 6.0 g/vine.

Potassium humate fertilizer was delivered from Sub-bituminous coal, it contains 67 % humic acid and 12% K_2O. It was applied as a soil application, since the amount of K-humate was dissolved in water and added around the vines two times, after the fruit set and at the beginning of véraison stage.

The vines under the study were received the normal culture practices, since the growers added the following fertilizer amounts per feddan:

1- 200 Kg super phosphate after pruning at the beginning of irrigation.
2- 50 Kg ammonium sulphate + 50 Kg magnesium sulphate when the shoot length was about 10 – 15 cm.
3- 75 Kg ammonium nitrate + 50 Kg potassium sulphate after fruit set.
4- 75 Kg ammonium nitrate one month after fruit set.

The vineyard soil is clayey and its some physical and chemical properties were determined and presented in Table 1.

Table 1. Mechanical and chemical properties of the experimental soil at the depth of (40-60 cm).

Soil properties	Values	Soil properties	Values
Coarse sand (%)	2.18	$CaCO_3$ (%)	3.77
Fine sand (%)	20.05	Organic matter (%)	1.65
Silt (%)	30.78	Saturation point (%)	61.2
Clay (%)	46.99	Available N (mg/Kg)	48.6
Texture	Clayey	Available P (mg/Kg)	4.85
pH	7.89	Available K (mg/Kg)	275
EC (dSm^{-1})	1.07		

The following parameters were undertaken to present the effect of potassium humate on growth, yield and berries quality of **'**Red Roumi**'** grapes.

Vegetative growth Measurements:

Vegetative growth measurements were taken after two weeks from the last application as follow:

1- Internode length and diameter (cm): internode length (cm) was determined at the third internode basal and internode diameter (cm) was taken from the same place by using a caliper.
2- Average leaf area (cm^2 / leaf): it was estimated for the 6^{th} or 7^{th} leaf from the top of the growing shoot according to the following equation (Montero *et al.,* 2000):

$$\textbf{Leaf area (cm}^2\textbf{ / leaf) = 0.587 (L × W)}$$

Where L= the length of leaf blade. W= the width of leaf blade.

3- Total chlorophyll content (mg/g FW): it was determined in leaf samples of the 6^{th} or 7^{th} leaf from the shoot top according to the following equation as described by Arnon (1949):

$$\textbf{Total chlorophyll} = 25.5\ OD_{650} + 4.0\ OD_{665}$$

Where: OD = Optical Density at wave length of 650 or 665 nm

Leaf petioles mineral content analysis:

The contents of N, P, and K leaf petioles were determined after two weeks from the last application from leaves opposite to clusters, 0.4 g dried leaves powder from each sample was wet digested with a mixture of concentrated sulphoric (H_2SO_4) and perchloric ($HClPO_4$) acids, then heated until become clear solution. This solution was quantitively transferred into 100 ml measuring flask and kept for determinations (Gotteni, 1982). The modified Micro-kjeldahl apparatus was employed for total N-determination as described by Jones *et al.* (1991).

Total phosphorus was determined spectrophotomitrically by Milten Roy Spectronic 120 at wavelength 725 nm using stannous chloride reduced molybdosulphoric blue colour method in sulphoric system as described by Peters *et al.* (2003). Total potassium was estimated flame photometerically using Jenway Flame photometer, Model Corning 400 according to the modified method of Peters *et al.* (2003).

Measurements at harvest time:

Yield per vine (Kg) was measured, whereas estimated yield per feddan (ton) was calculated, and SSC/vine, which represented the vine productivity was estimated according to Shaulis and Steel (1969) as follow:

SSC/vine (Kg) = SSC% x yield/vine (Kg) x 0.01

When the soluble solids content reached about 16 – 17 % samples per each replicate were taken to Laboratory of Pomology Department to determine the average cluster and berry weight (g).

Samples of 100 berries from each replicate were collected to determine soluble solids percentage in berry juice using Carlzeiss hand refractometer, total acidity according to AOAC (1984), and soluble solids content/acid ratio. Total anthocyanin content in berries skin (mg/100 g FW) was determined according to the method of Mazumadar and Majumder (2003).

Measurements after harvest:

Total carbohydrates (%) in canes was estimated, samples of mature canes were taken at mid-October from the basal end of canes to determine total carbohydrates according to the method described by Hedge and Hofreiter (1962).

Total proteins in canes (g/100g DW) were extracted in a solution of 10% SDS, 1% mercaptoethanol, 65 ml Tris/HCL, pH 6.8 as described by Dure & Chlan (1981) and Oster *et al.* (1992). Proteins content was determined spectrophotometrically at 595 nm according to the method of Bradford (1976).

Statistical analysis:

Obtained data were analyzed using Analysis of Variance (ANOVA) method in a complete randomized blocks design by CoStat Version 6.0 (CoStat, 2008). Treatment means were compared using Duncan's Multiple Range Test at 5% of probability (Waller and Duncan, 1969).

RESULTS AND DISCUSSION

1- Effect of potassium humate on vegetative growth of 'Red Roumi' grapevines.

As for the effect of potassium humate on internode length and diameter, data from Table 2 show clearly that adding K-humate as a soil application increased both internode length and diameter than the control. Furthermore, K- humate at 6.0 or 4.5 g/vine gave a higher effect in this respect than other treatments at 3.0 and 1.5 g/vine or the control. Since, these treatments gave the lower values of both internode length and diameter in both seasons of study.

Regarding the effect of potassium humate on leaf area, data from Table 3 show that all K-humate applications at different rates showed a higher leaf area than the untreated vines. Whereas, K-humate at 6.0 g/vine gave the highest significant value as compared to other treatments in both seasons of study.

Concerning the effect of K-humate on total chlorophyll content, data from the same table indicate that adding K-humate at different rates significantly increased the values of total chlorophyll content in leaves of 'Red Roumi' grapes than the control. Once again, adding K-humate at 6.0 and 4.5 g/vine showed the higher values than those of 3.0 or 1.5 g/vine treatments during the two seasons under the study. It is also clear that the control treatment recorded the lowest values of both leaf area and total chlorophyll content as compared with other treatments in both studied seasons.

Table 2. Effect of potassium humate on internode length and diameter (cm) of 'Red Roumi' grapevines.

Treatments	Internode length (cm)		Internode diameter (cm)	
	2019	2020	2019	2020
Control *	6.47 c	7.03 c	0.86 c	0.90 b
Potassium humate at 1.5 g/vine	7.37 b	7.27 c	0.89 bc	0.98 b
Potassium humate at 3.0 g/vine	7.33 b	7.43 c	0.99 b	0.97 b
Potassium humate at 4.5 g/vine	8.37 a	8.27 b	1.18 a	1.08 ab
Potassium humate at 6.0 g/vine	8.80 a	9.20 a	1.15 a	1.23 a

*** Received the normal culture practices.**
Values in the same column followed by the same letter (s) don't significantly differed using Duncan's Multiple Range Test at 5% of probability.

Table 3. Effect of potassium humate on leaf area (cm^2 / leaf) and total chlorophyll content (mg/g FW) of 'Red Roumi' grapevines.

Treatments	Leaf area (cm^2 / leaf)		Total chlorophyll content (mg/g FW)	
	2019	2020	2019	2020
Control *	76.25 d	83.79 c	0.54 e	0.59 d
Potassium humate at 1.5 g/vine	81.55 c	85.15 c	0.67 d	0.76 c
Potassium humate at 3.0 g/vine	81.14 c	98.75 b	0.77 c	0.84 b
Potassium humate at 4.5 g/vine	88.11 b	99.10 b	0.82 b	0.85 b
Potassium humate at 6.0 g/vine	97.05 a	110.86 a	0.86 a	1.01 a

*** Received the normal culture practices.**
Values in the same column followed by the same letter (s) don't significantly differed using Duncan's Multiple Range Test at 5% of probability.

From the above-mentioned results, it's obvious that adding K-humate at 6.0 and 4.5 g/vine produced a longer internode length and a greater internode diameter than the other treatments. Since, these treatments accelerated the growth of the shoots, which is reflected in increasing leaf area. In accordance to these findings, Ferrara and Brunetti (2010) reported that even one application of humic acid was able to increase chlorophyll content in 'Italia' grapes, similarly (Hager and Magda, 2016) found that adding humate NPK or humate micro-elements increased leaf content of total chlorophyll in 'Flame seedless' grapes. Also, Abd El-Rhman (2017) on 'Manfalouty' pomegranate mentioned that adding K-humate at 25 or 50 g/tree was more effective in increasing leaf area and total chlorophyll as compared with control. Since, humic acid probably caused an increase in the synthesis of the chlorophyll or delayed chlorophyll degradation (Vaughan and Malcolm, 1985; Nardi *et al*., 1996; Ferrara and Brunetti, 2010).

2- Effect of potassium humate on N, P and K% in leaf petioles of 'Red Roumi' grapevines.

Results in Table 4 show that adding K-humate at different amounts (6.0, 4.5, 3.0, and 1.0 g/vine) significantly increased N, P, and K content in leaf petioles of 'Red Roumi' grapevines than the control. Moreover, adding K-humate at 6.0 g/vine gave the highest contents of N, P, and K in leaf petioles than the other doses of K-humate. However, the control treatment significantly gave the lowest values in this respect in both seasons.

The obtained results are in accordance with those found by El- Khawaga (2011) on 'Floridaprince' peach, Shaheen *et al.* (2012) on 'Crimson seedless' grapevines, and El-Boray *et al.* (2013) on 'King Ruby' grapevines. Since, they mentioned that humic acid increased nitrogen, phosphorus and potassium content in leaves as compared with that of the control. Also, Hager and Magda (2016) reported that all humate treatments increased N, P, and K content in leaves of 'Flame seedless' grapes. Improving nutrient uptake by K-humate may be due to its effect of increasing root surface area or increasing cell membrane permeability (Rauthan and Schnitzer, 1981). Besides, humic acid also improves the absorption of mineral elements such as N, P, K, Ca and Mg (Bohme and Thi-Lua, 1997; Atieyeh *et al.,* 2002).

Table 4. Effect of potassium humate on N, P and K (%) content in leaf petioles of 'Red Roumi' grapevines.

Treatments	N (%)		P (%)		K (%)	
	2019	2020	2019	2020	2019	2020
Control *	1.52 d	1.56 d	0.155 d	0.158 d	1.44 d	1.46 d
Potassium humate at 1.5 g/vine	1.63 c	1.65 c	0.174 c	0.169 c	1.52 c	1.55 c
Potassium humate at 3.0 g/vine	1.72 b	1.68 c	0.176 bc	0.172 c	1.61 b	1.64 b
Potassium humate at 4.5 g/vine	1.77 ab	1.80 b	0.182 b	0.185 b	1.65 ab	1.69 a
Potassium humate at 6.0 g/vine	1.83 a	1.87 a	0.189 a	0.193 a	1.71 a	1.68 a

*** Received the normal culture practices.**
Values in the same column followed by the same letter (s) don't significantly differed using Duncan's Multiple Range Test at 5% of probability.

3- Effect of potassium humate on yield, and SSC/vine of 'Red Roumi' grapevines.

It is clear from data in Table 5 that both yield per vine and per feddan were increased by increasing the concentration of K-humate in the both seasons of study. Moreover, K-humate at 6.0 g/vine gave the highest significant effect than the other treatments used, since this application increased both yield/vine and yield /feddan by about 47% over the untreated control.

With regard to the effect of K-humate on SSC/vine, this parameter was estimated to be as an index to vine productivity (Shaulis and Steel, 1969). From our data in the same Table, it's clear that adding K-humate at 6.0, 4.5, and 3.0 g/vine increased the values of SSC/vine (Kg) than K-humate at 1.5 g/vine or the control during the both seasons of study.

Table 5. Effect of potassium humate on yield/vine (Kg) and yield/feddan (Ton) of 'Red Roumi' grapevines.

Treatments	Yield/vine (kg)			Estimated yield/feddan (Ton)			SSC/vine (Kg)	
	2019	2020	Over control %	2019	2020	Over control %	2019	2020
Control *	10.73 c	11.00 d	-	8.60 c	8.80 d	-	1.85 c	1.97 d
Potassium humate at 1.5 g/vine	11.03 c	11.20 d	2.30	8.83 c	8.97 d	2.30	1.96 c	1.88 d
Potassium humate at 3.0 g/vine	11.47 c	12.57 c	10.58	9.17 c	10.03 c	10.34	2.06 c	2.28 c
Potassium humate at 4.5 g/vine	13.80 b	14.07 b	28.24	11.03 b	11.27 b	28.16	2.76 b	2.63 b
Potassium humate at 6.0 g/vine	15.83 a	16.27 a	47.65	12.63 a	13.00 a	47.36	3.22 a	3.42 a

*** Received the normal culture practices.**
Values in the same column followed by the same letter (s) don't significantly differed using Duncan's Multiple Range Test at 5% of probability.

4- Effect of potassium humate on average cluster and berry weight (g) of 'Red Roumi' grapevines.

Data in Table 6 clearly show that adding K-humate at both 6.0 and 4.5 g/vine significantly increased average cluster weight than those applied with 3.0 and 1.5 g/vine or the control. Since the two above mentioned treatments increased cluster weight by about 47.39 and 27.76 %, respectively over the control. In case of average berry weight, data from the same table reveal that K-humate at 6.0 g/vine significantly gave the highest weight of berries than the other treatments, since the increment from this treatment was about 40% over the control.

Table 6. Effect of potassium humate on average cluster and berry weight (g) of 'Red Roumi' grapevines.

Treatments	Average cluster weight (g)			Average berry weight (g)		
	2019	2020	Over control %	2019	2020	Over control %
Control *	430.1 c	440.9 d	-	5.16 c	5.17 d	-
Potassium humate at 1.5 g/vine	441.2 c	449.0 d	2.20	6.27 b	6.30 c	21.66
Potassium humate at 3.0 g/vine	466.1 c	488.8 c	9.64	6.33 b	6.55 b	24.56
Potassium humate at 4.5 g/vine	551.4 b	561.4 b	27.76	6.47 b	6.53 b	25.73
Potassium humate at 6.0 g/vine	633.5 a	650.4 a	47.39	7.25 a	7.24 a	40.23

*** Received the normal culture practices.**
Values in the same column followed by the same letter (s) don't significantly differed using Duncan's Multiple Range Test at 5% of probability.

Our results go in line with those reported by Shaheen *et al.* (2012) on 'Crimson seedless' grapevines, and Ibrahim and Ali (2016) on 'Superior seedless' grapes, they found a significant increase in cluster weight and the production of vines fertilized with humic acid compared to control vines. Similarly, an increase in berries weight was observed on 'Italia' grapes due to the application of humic acid (Ferrara and Brunetti, 2010). Moreover, Hager and Magda (2016) found that the application of both humate NPK and humate micro-elements on 'Flame seedless' grapes produced a significant increase in yield/vine, average cluster and berry weight as compared with untreated vines. Also, Abd El-Rhman (2017) on 'Manfalouty' pomegranate indicate that K-humate at 25 or 50 g/tree was more effective and significantly increased fruit weight, yield per tree and yield per feddan compared with control. Hoda *et al.* (2016) mentioned that soil applying of potassium humate to papaya plants had a positive impact on yield and fruit weight.

The increase in yield and berry physical properties as a consequence of humic acid application is probably due to the stimulation of plant growth by humic substances, thus increasing yield by acting on mechanisms involved in photosynthetic process, cell respiration, synthesis of proteins, uptake of water and mineral nutrients, and enzyme activities (Vaughan *et al.,* 1985 and Chen *et al.,* 2004).

5- Effect of potassium humate on berry chemical characteristics of 'Red Roumi' grapevines.

Data from Table 7 indicate that vines treated with K-humate at 6.0 or 4.5 g/vine caused a significant increase in both SSC% and SSC/acid ratio, but a significant reduction of total acidity in berry juice of 'Red Roumi' grapes with respect to the untreated one during the two seasons of study. Moreover, vines treated with K-humate at 6.0, 4.5, and 3.0 g/vine resulted in an increment in both SSC% and SSC/acid ratio than K-humate at 1.5 g/vine or the control treatments.

Regarding the effect of K-humate on total anthocyanin content in skin berries, it is clear from the same table that among all K-humate treatments, the highest dose (6.0 g/vine) significantly increased total anthocyanin content in skin berries, which recorded the highest values 20.43 and 23.94 mg/100g FW in 2019 and 2020 seasons, respectively, while the lowest significant values were recorded with the control vines.

Table 7. Effect of potassium humate on SSC, acidity, SSC/acid ratio in berry juice and total anthocyanin in skin berries of 'Red Roumi' grapevines.

Treatments	SSC (%)		Acidity (%)		SSC/acid ratio		Total anthocyanin (mg/100 g FW)	
	2019	2020	2019	2020	2019	2020	2019	2020
Control *	17.20 b	17.87 c	0.865 a	0.820 a	19.94 c	21.90 d	10.59 e	11.89 e
Potassium humate at 1.5 g/vine	17.80 b	16.77 d	0.785 ab	0.760 ab	22.71 bc	22.07 d	13.25 d	13.21 d
Potassium humate at 3.0 g/vine	17.93 b	18.20 bc	0.710 bc	0.680 bc	25.49 b	26.97 c	14.44 c	16.58 c
Potassium humate at 4.5 g/vine	20.00 a	18.73 b	0.660 c	0.605 c	30.30 a	30.97 b	17.04 b	19.78 b
Potassium humate at 6.0 g/vine	20.33 a	21.00 a	0.620 c	0.600 c	32.86 a	35.00 a	20.43 a	23.94 a

*** Received the normal culture practices.**
Values in the same column followed by the same letter (s) don't significantly differed using Duncan's Multiple Range Test at 5% of probability.

Our data are in harmony with that of Mohamadineia *et al.* (2015) on 'Askari' grapevines, they reported that the highest SSC% was observed in 2.5 gl^{-1} humic acid treatment as a soil application. In addition, Ferrara and Brunetti (2010) observed a slight increase in SSC%, a significant decrease in acidity, and a significant increase in SSC/acid ratio as a result for the application of humic acid. Similar results were reported by Ibrahim & Ali (2016), and Hager & Magda (2016). Considering total anthocyanin in skin berries, in accordance to our findings Abd El-Rhman (2017) found a significant increase of total anthocyanin in pomegranate fruit juice compared with control, in the same line Hager & Magda (2016) mentioned that all humate treatments increased total anthocyanin in berry skin of 'Flame seedless' grapes compared to the control. Moreover, Hoda *et al.* (2016) reported that adding potassium humate to papaya plants enhanced fruit quality. Potassium is known to promote sugar translocation in plants; thus, it increases the sugar content as well as soluble solids in fruits (Marschner, 2012).

6- Effect of potassium humate on total carbohydrates and total proteins in canes of 'Red Roumi' grapevines.

Data from Table 8 indicated that adding K-humate to 'Red Roumi' grapevines at different amounts increased total carbohydrates content in canes than the control in the two seasons under the study. Furthermore, adding K-humate at 6.0 g/vine significantly increased the percentage of total carbohydrates than the other treatments of K-humate. Whereas, K-humate at 1.5 g/vine produced a lower content of total carbohydrates than the other levels of K-humate.

Concerning the effect of K-humate on total proteins in the canes, data in the same table reveal that all K-humate treatments caused an increase in total proteins than the control, and K-humate at 6.0 or 4.5 g/vine gave the higher values than those at 3.0 and 1.5 g/vine. The increment of both total carbohydrates and total proteins in canes due to the application of K-humate may be due to these treatments gave a more effect for increasing both internode length and diameter and leaf area than the untreated vines, as a result these treatments gave more growth, which reflected for increasing total carbohydrates and total proteins in canes.

Table 8. Effect of potassium humate on total carbohydrates (%), and total proteins in canes of 'Red Roumi' grapevines.

Treatments	Total carbohydrates (%)		Total proteins (g/100g DW)	
	2019	2020	2019	2020
Control *	15.78 d	16.09 d	8.81 c	8.94 d
Potassium humate at 1.5 g/vine	15.81 d	16.35 c	9.19 c	9.44 c
Potassium humate at 3.0 g/vine	16.15 c	16.68 b	9.69 b	9.88 bc
Potassium humate at 4.5 g/vine	16.54 b	16.61 b	10.13 ab	10.25 b
Potassium humate at 6.0 g/vine	16.65 a	16.77 a	10.50 a	10.75 a

*** Received the normal culture practices.**
Values in the same column followed by the same letter (s) don't significantly differed using Duncan's Multiple Range Test at 5% of probability.

These results are in agreement with those reported by Ali *et al.* (2013), they mentioned that total carbohydrates increased proportionally in relation to increase in the level of applied humic acid and magnetic iron. Also, Doaa (2013) mentioned that the combination between humic acid, bio-fertilizers and micro-elements was the most effective treatment for increasing the average values of total carbohydrates in canes of 'King Ruby seedless' grapes. Potassium nutrient element has essential effect on enzyme activation, which needed to metabolize carbohydrates for the manufacture of amino acids and proteins (Rawat *et al.*, 2016). In grapevines total carbohydrates play a key role for the leaf area development, shoot growth as well as in the flower induction (Yang & Hori 1979, Keller & Koblet 1994).

CONCLUSION

From the results of this study, it might be concluded that soil application of K-humate to 'Red Roumi' grapevines induced a positive effect on vegetative growth, leaf chlorophyll and nutrient content, yield, berry quality, and the content of both total carbohydrates and proteins in the canes. Our results also indicated that adding K-humate at the rate of 6.0 g/vine significantly increased the above-mentioned parameters when compared with the untreated control vines. Therefore, this organic fertilizer can be recommended for 'Red Roumi' grapevines to improve productivity and fruit quality, besides decreasing the amount of chemical fertilizers and thus, reducing environmental pollution and cost of production

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تأثير هيومات البوتاسيوم على نمو كرمات العنب الرومى الأحمر والمحصول وجودة الحبات

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أجريت هذه الدراسة خلال موسمى 2019 و2020 فى مزرعة خاصة بمحافظة الدقهلية على كرمات العنب الرومي الأحمر عمرها خمسة أعوام منزرعة فى تربة طينية وتروى بنظام الرى بالغمر ومنزرعة على مسافة 2 × 2,5 م وذلك بهدف دراسة تأثير التسميد الأرضى بسماد هيومات البوتاسيوم بمعدلات مختلفة (1,5 و3 و 4،5 و 6 جم/كرمة) على النمو الخضرى ومحتوى الأوراق من الكلورفيل والعناصر الغذائية والمحصول وجودة الحبات وكذلك محتوى القصبات من الكربوهيدرات والبروتين ، وقد أظهرت نتائج الدراسة أن اضافة هيومات البوتاسيوم بمعدل 6 جم/كرمة أدت الى زيادة معنوية فى المحصول ووزن العنقود وجودة الحبات وكذلك محتوى القصبات من الكربوهيدرات والبروتين مقارنة بمعاملة الكنترول خلال موسمى الدراسة ، كما أظهرت تلك المعاملة زيادة معنوية في محتوى عصير الحبات من المواد الصلبة الذائبة الى الحموضة الكلية وكذلك محتوى قشرة الحبات من الأنثوسيانين مقارنة بباقى المعاملات مما كان له أفضل الأثر على تحسين خواص الحبات.