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Effect of Yeast Extract, Algae Extract and Humic Acid on Vegetative Growth and Some Chemical Constituents of Prime Grape Transplants Grafted on Freedom and Paulsen Rootstocks

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Abstract

The effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on some vegetative growth parameters, chlorophyll content and N, P, K% of Prime grape transplants grafted on Freedom and Paulsen rootstocks were studied during 2018 and 2019 seasons. A great effect on vegetative growth including stem height, stem diameter, number of lateral shoots/ plant, number of leaves/ plant, leaf area and root length were obtained with Prime grape transplants grafted on Freedom rootstock. All applied treatments were superior to control in improving growth parameters and the great effect was gained with combining treatment (T8) which including 0.2% yeast extract + 0.2% algae extract + 2.5 g/L./tree humic acid. However, the highest values of total chlorophyll, N and K% were obtained with Prime grape transplants grafted on Freedom rootstock, whereas P% values did not affect the type of rootstocks. Moreover, the highest values of total chlorophyll, N and P% were recorded by the combining treatment (T8) whereas; the highest K% values were obtained with 0.4% algae extract treatment. It could be concluded that Prime grape transplants grafted on Freedom rootstock were superior to Prime grape transplants grafted on Paulsen rootstock either on vegetative growth parameters or on some chemical constituents.

Keywords: Prime grape, Freedom rootstock, Paulsen rootstock, Vegetative growth, Total chlorophyll, N, P, K

Introduction

Prime Seedless is the earliest white seedless variety and was developed and patented by the Volcani Institute in Israel. The medium-sized berries are rounded and bunches are well filled out without being compact. This is the earliest South African seedless variety. It has a light Muscat flavor and a fresh and crispy new season taste and it ripens in the second half of May. The Volcani Institute receives royalties on both on the initial purchase of the vine and per carton harvested once the vines start to produce, and despite this, Prime is becoming a very popular variety as it ripens before all the other white seedless cultivars, and its early entrance into the market holds the promise of premium returns to growers **(Xu, et al 2017**). However, Bunches similar shape to Sugar one (Superior) , sugar content ranged from 14 to 18 °Brix, low acidity. However, Prime Seedless cv. is very fertile with short pruning, **(Walker et al 2007).**

It is well known that selecting the suitable grape rootstock for different grape cultivars are depending on the purpose of selecting. Freedom grape rootstock is one of the rootstocks group that is resistant to nematodes and makes scions more vigorous, whereas Paulsen 1103 is highly resistant to drought and moderately resistant to salinity **(Jogaiah et al., 2014)**

In viticulture, rootstocks are widely used and make a significant contribution to scion performance under several cultivation conditions. Although the mechanism for grapevine scion vigor controlled by rootstocks is poorly understood, several authors have shown effects on water relations **(Souza et al., 2015),** gas exchange **(Soar et al., 2006),** vegetative vigor **(Keller et al., 2001),** yield and grape quality **(Nuzzo and Mathews, 2006**). Therefore, the selection of an appropriate rootstock may provide a powerful tool for managing the growth and fruiting of grapevine scions subjected to the double pruning technique.

The first study on rootstock effects implemented under double pruning management showed that Syrah grafted onto 1103 Paulsen had a better vegetative and reproductive performance as compared to SO4 and 110 Richter rootstocks (**Dias et al., 2012).** Yeast extract (*Saccharomyces cervicisae*, L.) is one of the biofertilizers used for many crops It activates many physiological processes in plants such as photosynthesis through enhancing Co_2 release. Besides, it contains some natural growth regulators such as auxins as well as increase uptake of various nutrients, i.e. N, P and K and some common amino acids **(Gomaa and Mohamed 2007).**

However, yeast extract contains large amounts of essential minerals, vitamins (B1, B2 and B6), proteins and the natural plant hormones namely cytokinins. The application of yeast extract as foliar fertilizer is successfully able to promote growth and enhance the final production of plants **(Marzauk et al., 2014).** In addition to direct nutrients amendments via yeast extract, its cytokinins and auxin contents play a role in delay the aging of leaves through retardation the degradation of chlorophyll and enhancing protein synthesis **(Abou El- Yazied and Maday, 2012).** Moreover, yeast extract, considered bio-stimulant, canto enhance the yield of and fruit quality of several

fruit trees **(El-Sayed, 2013).** In this regard, **Ahmed et al., (2011),** pointed out that yeast extract is considered good foliar fertilization due to its contents of vitamins and amino acids. For this, it has a positive influence on the plant growth parameters of their studied plants. Microalgal extracts are known to contain substances that promote the enhance plant growth as well as its root exudates. Also, it is rich in macro and micronutrients that benefit plants either by foliar or soil applications **(Renuka et al., 2017).**

Additionally, **El-Baz *et al*., (2002)** reported that algal extract is one of the potential organisms, is a rich source of several fine chemicals such as vitamins, carotenoids, polycobiliprotein, polysaccharides, fatty acids, etc. with varied properties like an antioxidant. However. **Molnar and Ordog (2005**) concluded that microalgae stimulated the growth of plants, due to the presence of auxin, cytokinins, gibberellins. The various positive effects of applying Algae extract were attributed to its content of different nutrients with a higher percentage of N, greater amounts of B1, B2 and B6 vitamins and the natural plant hormone-like cytokinins **(Dahama, 1999). Abd El-Baky *et al*., (2008)** stated that the application of algal extracts significantly increased the contents of total chlorophyll and antioxidants. Also, exhibited an increase in grain weight and yield components of the wheat plant

Regarding, humic acid (polymeric polyhydroxy acid) is considered the most significant component of organic substances in aquatic systems. Humic acid is highly beneficial to both plant and soil; it is important for increasing microbial activity, it is considered as a plant growth bio-stimulate, an effective soil enhancer; it promotes nutrient uptake

as a chelating agent and improves vegetative characteristics, nutritional status, and leaf pigments 9,10. Humic acid treatments (foliar and soil applications) markedly increased the growth parameters (shoot length, number of leaves/shoot and leaf area), yield and fruit physical and chemical properties (fruit firmness, juice SSC and SSC / acidity ratio) of 'Canino' apricot **(Eissa, 2003 & Fathy et al., 2010.).**

Humic acid is one of the bio-stimulants is known as the organic substances which promote plant growth and help the trees to withstand harsh environments when applied in small amounts **(Chen et al., 1994).** It is highly beneficial also for both the trees and the soil since it maintains proper plant growth as well as increases nutrient uptake, tolerance to drought and temperature extremes, the activity of beneficial soil microorganisms, and availability of soil nutrients particularly in alkaline soils and low

The main goal of this research was to evaluate the effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on vegetative and root growth measurements, leaf chlorophyll content and leaf mineral determinations of Prime grape transplants grafted on both Freedom and Paulsen rootstocks.

Materials and Methods

The present investigation was undertaken throughout the two successive seasons of 2018 and 2019 at Fruit Nursery of Horticulture Department, Faculty of Agriculture at Moshtohor, Benha University Qalyubeia Governorate, Egypt.

Uniform and healthy one-year-old transplants of grape Prime cv. grafted on each Freedom and Paulsen rootstocks grape "*Vitis vinifera*, L." was the plant materials used in this study. In both seasons of study and during the first week of February, these transplants were cultivated individually each in a plastic pot of 30-cm in diameter filled with about 3.5 kg of sand and loam mixture at equal parts by volume. Before the experiment had been conducted in the two seasons, both mechanical and chemical analysis of growing soil media was done as shown in **Table (1)**. according to **Jackson (1967).**

Table 1. The physical and chemical properties of the experimental soil media.

Physical analysis					Chemical analysis			
Sand (%)	Silt (%)	Clay (%)	Soil texture	E.C. dS/m	pH (1:25)	$CaCO_3$ (%)	T. N. ppm.	O. M. (%)
19.30	25.78	54.20	Clay loamy	1.05	7.96	2.87	384.33	1.02
Soluble cation (meq/100 g. soil)					Soluble anions (meq/100 g. soil)			
Ca^{++}	Mg^{++}	Na^{+}	K^{+}		Cl^{-}	HCO_3^{-}	CO_3^{--}	SO_4^{--}
3.23	1.71	3.96	0.89		3.93	4.03	-	1.83

Yeast extracts preparation:

Yeast extract, species *Saccharomyces cerevisiae*, was prepared by using a technique that allowed yeast cells (pure active dry yeast 100 gram/liter) to be grown and multiplied efficiently during conducive aerobic and nutritional conditions that allowed to produce denovo beneficial constituents (carbohydrates, sugars, proteins, amino acids, fatty acids, hormones, etc.) then these constituents could be released out of yeast cells in readily form by two cycles of freezing and thawing for disruption of yeast cells and releasing their content. Such technique for yeast preparation was modified after **Spencer *et al.* (1983)**. Chemical analysis of yeast extract according to **Abou- El-Yazied and Mady (2012)**, is presented in **Table (2).**

Table 2-a . Chemical analysis of yeast extract**.**

Amino acid (%)		Vitamins (mg/100 g DW)		Growth regulators (ppm)	
Alanine	1.69	Vit.B1	23.33	Adenine	31
Arginine	1.49	Vit.B2	21.04	Betaines	56
Aspartic acid	2.32	Vit.B6	20.67	**Minerals**	
Cystine	0.63	Vit.B12	19.17	Nitrogen	6.88%
Glutamic acid	3.76	Thimain	23.21	Phosphorus	0.66 %
Glycine	1.45	Riboflavin	27.29	Potassium	0.95 %
Histidine	0.71	Insitol	20.43	Magnesium	0.19 %
Isoleucine	0.85	Biotin	20.04	Calcium	0.17 %
Leucine	1.91	Nicotinic acid	73.92	Sulfur	0.48 %
Lysine	1.13	Panthothenic acid	38.43	Iron	107 ppm
Phenylalanine	1.18	P aminobenzoic acid	29.49	Zinc	77 ppm
Proline	1.29	Folic acid	26.22	Copper	5 ppm
Serine	1.98	Pyridoxine	22.09	Manganese	13 ppm
Threonine	1.54			**Others**	
Tryptophan	0.25			Crude Protein	43.00 %
Tyrosine	0.99			Crude Fat	2.20 %
Valine	1.4			Carbohydrates	33.21 %
Methionine	0.4			Crude Fiber	7.20 %
				Ash	3.80 %

- **Algae extract Preparation:**

The ready-made algae extract was obtained from Algal Biotechnology Unit, National Research Centre (NRC), Giza, Egypt. The blue-green algae, *Spirulina platensis*, belonging to Cyanophyta, and *Amphora cofeaeformis* were massively produced at the Algal Biotechnology Unit, (NRC) in continuous cultures. Algal extracts were prepared and analyzed as shown in **Table (2-b)** as described by **Enan *et al.* (2016).**

Table 2-b. Chemical composition of some macro and micro-nutrients of algae, according to Enan *et al.* (2016).

Elements	N	P	K	Mg	Na	Ca	Fe	Zn	Mn	Cu
Concentration	%						ppm			
	11.2	1.65	0.88	0.22	0.01	0.33	1936	21	68	18

- **Potassium humat components:-**

Produced by Leila Agro Chemistry Co., LTD, China and its properties are shown in Table (2-c).

Table 2-c. Guaranteed analysis and physical data of potassium humat

Humic acid	80 %
Potassium (K2O)	10-12 %
Zn, Fe, Mn, etc.,	100 ppm
Appearance	Black powder
Ph	9-10
Water solubility	< 98 %

This experiment involved eight treatments:

1) Control (Tap water).
2) Foliar sprays with yeast extract 0.2 %.
3) Foliar sprays with yeast extract 0.4 %.
4) Foliar sprays with algae extract 0.2 %.
5) Foliar sprays with algae extract 0.4 %.
6) Soil drench application with Humic acid at 2.5 g/L/transplant
7) Soil drench application with Humic acid at 5.0 g /L/ transplant
8) Mix treatments (Yeast extract 0.2 % + algae extract 0.2 % + humic acid 2.5 g/L/ transplant)

The foliar sprays with yeast extract and algae extract were sprayed three times for seasons as well as the humic acid was fractionated into three equal doses to be soil-applied at the same three times in first March, first May and first July, during both seasons of study.

The treatments were arranged in a randomized complete block design with three replicates for each treatment, however, each replicate was represented by three grape transplants (8 treatments x 3 replicates x 3 transplants = 72 transplants)for each rootstock.

On the first week of October during both seasons of study as an experiment was terminated, the effect of the different investigated treatments on some vegetative growth measurements and chemical composition were evaluated during both seasons as follows:

1. Vegetative growth and root measurements:-

The response of Prime grape transplants cv., grafted on two types of grape rootstocks (Freedom and Paulsen) to the effect of different levels of both yeast

extract, algae extract and humic acid fertilizer on some vegetative growth parameters were studied and evaluated among the following aspects:

1- Stem height (cm.).
2- Stem diameter (cm).
3- Number of leaves/ transplant.
4- No. of lateral shoots/ transplant.
5- Leaf area (cm^2): on mid-August during both seasons, samples of forty mature leaves at different four sides of each tree were collected by picking the third one from the base of the previously labeled shoots and leaf area (cm^2) was estimated by using the planimeter.

Leaf area (cm^2) = ⅔ (leaf length x leaf width).

6- **Root length** (cm).

Three transplants of each replicated were carefully taken out from pots then, washed with tap water and followed by distilled water to free from any residues. The length of the largest root was recorded for each replicate.

2. Chemical analysis:

2.1. Leaf chlorophyll content: were recorded by using a portable chlorophyll meter spad 502 according to **Wood *et al*., (1992)**.

2.2. Leaf mineral determination:

Ten full expanded leaves were carefully collected in the second week of August in both seasons of this study from all directions of every transplant canopy and oven-dried in a ventilated oven at 70 °C till a constant weight, then weighed and ground with a porcelain mortar and pestle, after being ground, the samples were stored in small paper bags until used for the determination of N; P; K; Mg; Fe; Zn and Mn samples of 0.2 g dried material were dissolved in 5 ml concentrated sulphoric acid. After being cold 2 ml of the digesting mixture (1: 1 perchloric acid: sulphoric acid) were added then samples were reheated for clearing, then cooled and disputed with deionized water before it had been transformed quantitatively to 50 ml volume with deionized water **(Piper 1958)**. The contents were used for the following determinations.

2.1.1. Nitrogen content (%):

Total nitrogen was determined by the modified micro-Kjeldahl method as described by **Pregl (1945)**.

2.2.2. Phosphorus content (%):

Total phosphorus content was determined using a Spekol spectrophotometer at 882.0 U.V. according to the method described by **Murphy and Riely (1962)**.

2.2.3. Potassium contents: (%):

Total Potassium content was determined by using the Atomic Absorption Spectrophotometer (3300) according to **Chapman and Pratt (1975).**

- Statistical analysis:

All the obtained data in the two seasons of the study were statistically analyzed using the analysis of variance method according to **Snedecor and Cochran (1980)**. However, means were distinguished by Duncan's multiple range test (**Duncan, 1955)**. Since capital letters were used for distinguishing means within each column or row that represented the specific effect of any investigated factor, however, the small letters were employed for the interaction effect of their combinations

Results and Discussion

1. Vegetative and root growth

1.1. **Stem height (cm)**

It is evident from data in Table (3) that both grape rootstock type and the applied treatments greatly affected stem height of Prime grape transplants, during the 2018 and 2019 seasons.

Table 3. Effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on stem height (cm) of Prime grape transplants grafted on both Freedom and Paulsen rootstocks, during 2018 and 2019 seasons**.**

Parameters	**Stem height (cm)**					
Rootstocks	**Freedom**	**Paulsen**	**Mean**	**Freedom**	**Paulsen**	**Mean**
Treatments	**First season; 2018**			**Second season; 2019**		
T1. Control (Tap water).	81.21h	79.88h	**80.55E**	85.00e	81.33f	**83.17E**
T2. Yeast extract 0.2 %	107.5b	91.73e	**99.62B**	115.7b	95.33d	**105.5B**
T3. Yeast extract 0.4 %	108.3b	95.05d	**101.7B**	117.7b	96.00d	**106.8B**
T4. Algae extract 0.2 %	96.49d	88.53fg	**92.51D**	97.00d	84.00ef	**90.50D**
T5. Algae extract 0.4 %	100.60c	90.13ef	**95.37C**	103.0c	85.67e	**94.34C**
T6. Humic acid at 2.5 g/l	95.90d	86.86g	**91.38D**	94.33d	83.67ef	**89.00D**
T7. Humic acid at 5.0 g /l	101.30c	88.21g	**94.76C**	101.3c	85.33e	**93.33C**
T8. Yeast extract 0.2 % + algae extract 0.2 % + humic acid 2.5 g/l	116.6a	103.40c	**110.0A**	121.7a	103.0c	**112.3A**
Mean	**100.99A**	**90.47B**		**104.5A**	**89.29B**	

- Values within column and row for any of the two investigated factors were individual differences by capital letters, while for the interaction small letters were used.
- Means followed by the same letter/s were not significantly different at 5% level.

Freedom grape rootstock was superior to Paulsen grape rootstock in producing high stem diameters in both seasons. However, all tested treatments were superior to control in recording high values of stem height in both seasons. The mix treatment (TS) was more effective than other treatments in harvesting stem height development and recording the "highest values of stem height in both seasons. Interaction between mixed treatment and Freedom rootstock was superior to other interaction values in producing the highest values of stem height in both seasons. The applied issue of this work could be correlated with that in viticulture, rootstocks are widely used and make a significant contribution to scion performance under several cultivation conditions. Although the mechanism for grapevine scion vigor controlled by rootstocks is poorly understood, several authors have shown effects on water relations **(Souza et al., 2015),** gas exchange **(Soar et al., 2006),** vegetative vigor **(Keller et al., 2001),** yield and grape quality **(Nuzzo and Mathews, 2006).** Therefore, the selection of an appropriate rootstock may provide a powerful tool for managing the growth and fruiting of grapevine scions subjected to the double pruning technique.

Stem diameter (cm)

Data in Table (4) show the effect of two studied factors on stem diameter of Prime grape transplants during the two studied seasons. However, Prime grape transplants budded on Freedom grape rootstock produced high values of stem diameter than those budded on Paulsen grape rootstock in both studies seasons.

Table 4. Effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on stem diameter (cm) Prime grape transplants grafted on both Freedom and Paulsen rootstocks, during 2018 and 2019 seasons**.**

Parameters	**Stem diameter (cm)**					
Rootstocks	**Freedom**	**Paulsen**	**Mean**	**Freedom**	**Paulsen**	**Mean**
Treatments	**First season; 2018**			**First season; 2018**		
T1. Control (Tap water).	0.762c-f	0.738f	**0.750C**	0.804g	0.764g	**0.784F**
T2. Yeast extract 0.2 %	0.825c-e	0.791c-f	**0.808B**	1.190c	0.812g	**1.001C**
T3. Yeast extract 0.4 %	0.834cd	0.799c-f	**0.816B**	1.303b	0.824g	**1.063B**
T4. Algae extract 0.2 %	0.800c-f	0.745ef	**0.773BC**	1.043e	0.769g	**0.906E**
T5. Algae extract 0.4 %	0.809c-f	0.748d-f	**0.779BC**	1.123d	0.775g	**0.949D**
T6. Humic acid at 2.5 g/l	0.831c-e	0.800c-f	**0.815B**	0.928f	0.820g	**0.874E**
T7. Humic acid at 5.0 g /l	0.837c	0.814c-f	**0.826B**	0.934f	0.824g	**0.879E**
T8. Yeast extract 0.2 % + algae extract 0.2 % + humic acid 2.5 g/l	1.467a	1.152b	**1.310A**	1.443a	1.194c	**1.319A**
Mean	**0.896A**	**0.823B**		**1.096A**	**0.848B**	

- Values within column and row for any of two investigated factors were individual differences by capital letter/s, while for the interaction small letters were used.
- Means followed by the same letter/s were not significantly different at 5% level.

All applied treatments increased stem diameter values than control in both studied seasons, but the highest values of stem diameter were recorded by the combining treatment (T8) in both seasons. Interaction between both studied factors showed that Prime grape transplants grafted on Freedom grape rootstock and sprayed with mix treatment (T8) produced the highest values of stem diameter than other interaction values. It is well known that selecting the suitable grape rootstock for different grape cultivars are depending on the purpose of selecting. Freedom grape rootstock is one of the rootstocks group is resistant to nematodes and makes scions more vigorous, whereas Paulsen 1103 is highly resistant to drought and moderately resistant to salinity **(Jogaiah et al.,2014)**

Number of lateral shoots/transplant

Table (5) show that Prime grape transplant grafted on both Freedom and Paulsen grape rootstocks and treated with some treatments greatly affected in producing the number of lateral shoots, plant, in both seasons. However, Prime grape transplants grafted on Freedom rootstock produced a higher number of lateral branches/plant than those grafted on Paulsen rootstock in both seasons.

Table 5. Effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on average No. of lateral shoot/plant Prime grape transplants grafted on both Freedom and Paulsen rootstocks during 2018 and 2019 seasons.

Parameters	Average No. of lateral shoot/plant					
Rootstocks / Treatments	Freedom	Paulsen	Mean	Freedom	Paulsen	Mean
	First season; 2018			Second season; 2019		
T1. Control (Tap water).	10.73de	7.67b	**9.20E**	10.33g-i	8.33j	**9.33E**
T2. Yeast extract 0.2 %	13.33ab	10.67de	**12.00B**	13.67cd	11.33e-g	**12.50B**
T3. Yeast extract 0.4 %	11.00de	10.00ef	**10.50D**	15.67ab	13.33d	**14.50B**
T4. Algae extract 0.2 %	9.33f	6.33h	**7.83F**	10.67f-h	10.00hi	**10.34D**
T5. Algae extract 0.4 %	12.33bc	9.33f	**10.83CD**	10.33g-i	7.00k	**8.67E**
T6. Humic acid at 2.5 g/l	12.67b	10.67de	**11.67BC**	12.00e	9.33ij	**10.67D**
T7. Humic acid at 5.0 g /l	9.33f	12.67b	**11.00CD**	14.00cd	11.67ef	**12.84C**
T8. Yeast extract 0.2 % + algae extract 0.2 % + humic acid 2.5 g/l	14.33a	11.33cd	**12.83A**	16.00a	14.67bc	**15.34A**
Mean	**11.63A**	**9.83B**		**12.83A**	**10.71B**	

- Values within column and row for any of two investigated factors were individual differences by capital letter/s, while for the interaction small letters were used.
- Means followed by the same letters were not significantly different at 5% level.

The applied treatments greatly improved producing more lateral shoots than control in both seasons. The combining treatment (T8) was superior to other treatments in producing the highest number of lateral branches/plant, in both seasons. The highest interaction values were obtained with prime grape transplants grafted in Freedom rootstock and treated with the mixed treatment (T8), in both studied seasons.

In this regard, **Gomaa and Mohamed (2007)** mentioned that yeast extract (Saccharomyces cervicisae, L.) is one of the bio-fertilizers used for many crops It activates many physiological processes in plants such as photosynthesis through enhancing Co2 release. Besides, it contains some natural growth regulators such as auxins as well as increase uptake of various nutrients, i.e. N, P, K and some common amino acids

1.1. Number of leaves /transplant

Data in Table (6) showed that Prime grape transplants budded on Freedom rootstock produced higher values of leaves/ plant those budded on Paulson rootstock with significant differences between than in both seasons. However, all tested treatments were superior to control in producing higher values of leaves in both seasons.

Table 6. Effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on average No. leaves/plant of Prime grape transplants grafted on both Freedom and Paulsen rootstocks, during 2018 and 2019 seasons.

Parameters	Average No. leaves/plant					
Rootstocks / Treatments	Freedom	Paulsen	Mean	Freedom	Paulsen	Mean
	First season; 2018			Second season; 2019		
T1. Control (Tap water).	31.27h	20.80l	**26.04E**	28.17i	23.40j	**25.79F**
T2. Yeast extract 0.2 %	43.84c	30.79h	**37.32C**	37.64de	33.75g	**35.70D**
T3. Yeast extract 0.4 %	45.97e	37.23f	**41.60B**	43.46bc	41.90c	**42.68B**
T4. Algae extract 0.2 %	40.46e	27.70j	**34.08D**	34.95fg	31.92h	**33.44E**
T5. Algae extract 0.4 %	30.16hi	23.44k	**26.80E**	28.98i	24.88j	**26.93F**
T6. Humic acid at 2.5 g/l	40.97de	28.81ij	**34.89D**	36.11ef	33.37gh	**34.74D**
T7. Humic acid at 5.0 g /l	42.43cd	33.79g	**38.11C**	39.27d	36.46ef	**37.87C**
T8. Yeast extract 0.2 % + algae extract 0.2 % + humic acid 2.5 g/l	49.73a	40.30e	**45.02A**	47.82a	43.86b	**45.84A**
Mean	**40.60A**	**30.36B**		**37.05A**	**33.69B**	

- Values within column and row for any of two investigated factors were individual differences by capital letter/s, while for the interaction small letters were used.
- Means followed by the same letter/s were not significantly different at 5% level.

Treatment No. 8 (mix treatment) was superior to other treatments in release more leaves/plants in both studied seasons. Interaction values showed that the higher number of leaves/ plant was obtained with Prime grape rootstock grafted on Freedom rootstock and treated with combining treatment (T8) in both studied seasons. However, yeast extract is considered good foliar fertilization due to its contents of vitamins and amino acids. For this, it has a positive influence on the plant growth parameters of their studied plants. Microalgal extracts are known to contain substances that promote the enhance plant growth as well as its root exudates. Also, it is rich in macro and micronutrients that benefit plants either by foliar or soil applications **(Renuka et al., 2017).**

1.2. Average leaf area (cm^2)

As previously discussed in previous vegetative growth parameters, a similar trend was also noticed due to rootstock type or the applied treatments in both studied seasons.

The higher values of leaf area were obtained with Prime grape transplant grafted in Freedom rootstock than those grafted on Paulsen rootstock in both seasons. The treatment No. 8 (combining) treatment) was superior to other treatments or control in emerging biggest leaves in both seasons. The highest interaction values of leaf area were obtained with Prime grape transplants grafted on Freedom rootstock and treated with treatment No. 8 (combining treatment).

Table 7. Effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on average leaf area (cm^2) of Prime grape transplants grafted on both Freedom and Paulsen rootstocks, during 2018 and 2019 seasons.

Parameters	Average leaf area (cm^2)					
Rootstocks / Treatments	Freedom	Paulsen	Mean	Freedom	Paulsen	Mean
T1. Control (Tap water).	60.13h	55.09j	**57.61F**	58.81ef	53.23g	**56.02D**
T2. Yeast extract 0.2 %	66.82de	59.75h	**63.29C**	63.45c	59.41e	**61.43C**
T3. Yeast extract 0.4 %	68.68bc	68.58cd	**68.98B**	67.33b	65.88b	**66.61B**
T4. Algae extract 0.2 %	64.27fg	54.87j	**59.57E**	63.35c	57.37f	**60.36C**
T5. Algae extract 0.4 %	64.81ef	52.90k	**58.86EF**	60.53de	53.26ef	**56.90D**
T6. Humic acid at 2.5 g/l	65.01ef	56.99i	**61.00D**	61.91cd	58.64ef	**60.28C**
T7. Humic acid at 5.0 g /l	65.14ef	62.50g	**63.82C**	65.57b	65.39b	**65.48B**
T8. Yeast extract 0.2 % + algae extract 0.2 % + humic acid 2.5 g/l	72.27a	71.14ab	**71.71A**	71.72a	71.22a	**71.47A**
Mean	**65.98A**	**60.23B**		**64.08A**	**60.55B**	

- Values within column and row for any of two investigated factors were individual differences by capital letter/s, while for the interaction small letters were used.
- Means followed by the same letter/s were not significantly different at 5% level

The synergistic effect to humic acid (polymeric polyhydroxy acid) is attributed to that it is considered the most significant component of organic substances in aquatic systems. Humic acid is highly beneficial to both plant and soil; it is important for increasing microbial activity, it is considered as a plant growth bio-stimulate, an effective soil enhancer; it promotes nutrient uptake as a chelating agent and improves vegetative characteristics, nutritional status and leaf pigments 9,10. Humic acid treatments (foliar and soil applications) markedly increased the growth parameters (shoot length, number of leaves/shoot and leaf area), yield and fruit physical and chemical properties (fruit firmness, juice SSC and SSC / acidity ratio) of 'Canino' apricot **(Eissa, 2003 & Fathy et al 2010.).**

1.3. Average root length (cm)

As shown in Table (8), the average root length of Prime grape transplants greatly increased with Freedom rootstock than Paulsen rootstock in both studied seasons with significant differences between them. The applied treatments were superior to control in increasing average root length, and the highest root length values were obtained with the treatment of humic acid 5 g/L tree in both seasons. The highest interaction values of root length were obtained with Prime grape transplants grafted on Freedom rootstock and treated with combining treatment (No. 8) in both seasons

Table 80. Effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on average root length (cm) of Prime grape transplants grafted on both Freedom and Paulsen rootstocks, during 2018 and 2019 seasons.

Parameters	Average root length (cm)					
Rootstocks / Treatments	Freedom	Paulsen	Mean	Freedom	Paulsen	Mean
	First season; 2018			Second season; 2019		
T1. Control (Tap water).	47.61k	45.67k	**46.64E**	59.93i	45.49j	**52.71E**
T2. Yeast extract 0.2 %	79.59j	104.70fg	**92.15D**	76.08h	114.90e	**95.49D**
T3. Yeast extract 0.4 %	108.10ef	111.70de	**109.90B**	117.50e	125.30d	**121.40B**
T4. Algae extract 0.2 %	98.02h	119.90bc	**108.96B**	131.40b	106.90f	**119.15B**
T5. Algae extract 0.4 %	118.30c	79.23j	**98.77C**	125.60d	104.00f	**114.80C**
T6. Humic acid at 2.5 g/l	102.90g	93.83i	**98.37C**	123.50d	127.00cd	**125.25A**
T7. Humic acid at 5.0 g /l	123.30b	114.10d	**118.70A**	129.90bc	125.20g	**127.55A**
T8. Yeast extract 0.2 % + algae extract 0.2 % + humic acid 2.5 g/l	130.50a	105.80fg	**118.20A**	135.20a	96.23g	**115.97C**
Mean	**101.04A**	**96.87B**		**112.39A**	**105.69B**	

- Values within column and row for any of two investigated factors were individual differences by capital letter/s, while for the interaction small letters were used.
- Means followed by the same letter/s were not significantly different at 5% level.

2. Chemical analysis

2.1. Leaf chlorophyll content (SPAD reading)

A great effect on total leaf chlorophyll content represented as chlorophyll "meter" reading was obtained due to both studied factors during the two studied seasons (Table 9). Prime grape transplants exhibited higher values of total chlorophyll when grafted on Freedom than Paulsen rootstocks with significant differences between in both seasons of study. However, the combining treatment was superior to other treatments or control in recording the highest values of total chlorophyll in both studied seasons. The highest interaction values of total chlorophyll were obtained with prime grape transplants grafted on Freedom rootstock and treated with mix treatment (Tr. 8) in both studied seasons. The obtained data are in harmony with those found by **Abd El-Baky *et al*., (2008)** who stated that the application of algal extracts significantly increased the contents of total chlorophyll and antioxidants. Also, exhibited an increase in grain weight and yield components of the wheat plant

Table 9. Effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on total chlorophyll (Spad reating) of Prime grape transplants grafted on both Freedom and Paulsen rootstocks, during 2018 and 2019 seasons**.**

Parameters	Total chlorophyll					
Rootstocks / Treatments	Freedom	Paulsen	Mean	Freedom	Paulsen	Mean
	First season; 2018			Second season; 2019		
T1. Control (Tap water).	30.87g	26.72i	**28.80E**	27.57g	28.43fg	**28.00F**
T2. Yeast extract 0.2 %	34.49de	30.34g	**32.42C**	33.90d	33.20d	**33.55D**
T3. Yeast extract 0.4 %	37.20c	34.90d	**36.05B**	36.80c	36.52c	**36.66B**
T4. Algae extract 0.2 %	32.85f	27.34hi	**30.10D**	29.54ef	28.73e-g	**29.14E**
T5. Algae extract 0.4 %	34.77de	28.40h	**31.59C**	30.02e	28.53fg	**29.28E**
T6. Humic acid at 2.5 g/l	37.88bc	32.95f	**35.42B**	38.18b	32.54d	**35.36C**
T7. Humic acid at 5.0 g /l	39.08ab	33.36ef	**36.22B**	38.62ab	32.45d	**35.54C**
T8. Yeast extract 0.2 % + algae extract 0.2 % + humic acid 2.5 g/l	40.30a	37.95bc	**39.13A**	39.87a	36.20c	**38.04A**
Mean	**35.93A**	**31.50B**		**34.31A**	**32.08B**	

- Values within column and row for any of two investigated factors were individual differences by capital letter/s, while for the interaction small letters were used.
- Means followed by the same letter/s were not significantly different at 5% level.

2.2. Macronutrients (N, P, K %)

Data in Table (10) show the effect of both studied factors on leaf N% of prime grape transplants in both studied seasons. The higher N% (2.25) and 2.38%) were obtained with prime grape transplants grafted on Freedom rootstock compared to (2.19 and 2.24%) for prime grape transplants grafted on Paulsen rootstock in both studied seasons, respectively. However, the combining treatment exhibited higher N% than other treatments or control in bath studied seasons. The

interaction between grafted on Paulsen rootstocks and treated with mix treatment (T8) recorded the highest values of N% (2.94% and 3.02% in both seasons).

Regarding P%, it is clear that both Freedom and Paulsen rootstock exhibited similar non-significant values of P% in Prime grape transplants in both studied seasons (Table 11). On the other hand, the treatment of 0.2% yeast extract + 0.2% algae extracts + 2.5 g/L/ tree humic acid was superior to other treatments or control in recording the highest values of P% (0.351 and 0.346% in both seasons). The highest interaction of P% (0.364 and 0.362%) in both seasons were obtained with prime grape transplants grafted on Freedom rootstocks and treated with combined treatment (T8).

Data in Table (12) represented the effect of the two studied factors in this study on K% of Prime transplants during the 2018 and 2019 seasons. Prime grape transplants grafted on Freedom rootstock exhibited higher values of K% (0.535 and 0.538% in both seasons) compared to (0.489 and 0.510% in both seasons) in Prime grape transplants grafted on Paulsen rootstock. However, the treatment of 0.4% algae extract was superior to other treatments or control in recording the highest K % (1.032 and 0.890% in both seasons). Moreover, the highest interaction values of K% (1.159 and 0.991% in the studied seasons) were obtained with Prime grape transplants grafted on Paulsen rootstock and sprayed with 0.4% algae extract.

Table 10. Effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on N (%) of Prime grape transplants grafting on both Freedom and Paulsen rootstocks, during 2018 and 2019 seasons.

Parameters	**N (%)**					
Rootstocks / **Treatments**	**Freedom**	**Paulsen**	**Mean**	**Freedom**	**Paulsen**	**Mean**
	First season; 2018			**Second season; 2019**		
T1. Control (Tap water).	1.55i	1.40j	**1.48F**	1.60i	1.39j	**1.49F**
T2. Yeast extract 0.2 %	2.67c	2.51d	**2.59B**	2.78c	2.60d	**2.69B**
T3. Yeast extract 0.4 %	1.78h	1.79h	**1.79F**	1.92g	1.72h	**1.82E**
T4. Algae extract 0.2 %	1.94g	1.99fg	**1.97D**	2.16e	1.99fg	**2.08D**
T5. Algae extract 0.4 %	1.95fg	2.05f	**2.00D**	2.18e	2.03f	**2.11D**
T6. Humic acid at 2.5 g/l	2.62c	2.39e	**2.50C**	2.70c	2.55d	**2.62C**
T7. Humic acid at 5.0 g /l	2.67c	2.44de	**2.56BC**	2.91b	2.76c	**2.84A**
T8. Yeast extract 0.2 % + algae extract 0.2 % + humic acid 2.5 g/l	2.78b	2.94a	**2.86A**	2.78c	3.02a	**2.90A**
Mean	**2.25A**	**2.19B**		**2.38A**	**2.26B**	

- Values within column and row for any of two investigated factors were individual differences by capital letter/s, while for the interaction small letters were used.
- Means followed by the same letter/s were not significantly different at 5% level.

Table 11. Effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on P (%) of Prime grape transplants grafted on both Freedom and Paulsen rootstocks, during 2018 and 2019 seasons**.**

Parameters	**P (%)**					
Rootstocks / **Treatments**	**Freedom**	**Paulsen**	**Mean**	**Freedom**	**Paulsen**	**Mean**
	First season; 2018			**Second season; 2019**		
T1. Control (Tap water).	0.206h	0.198h	**0.202F**	0.206g	0.199g	**0.202F**
T2. Yeast extract 0.2 %	0.250g	0.268f	**0.259E**	0.253ef	0.244f	**0.248E**
T3. Yeast extract 0.4 %	0.286de	0.308c	**0.297C**	0.271e	0.303cd	**0.287C**
T4. Algae extract 0.2 %	0.330b	0.328b	**0.329B**	0.308cd	0.318bc	**0.313B**
T5. Algae extract 0.4 %	0.276ef	0.274ef	**0.275D**	0.268e	0.260ef	**0.264D**
T6. Humic acid at 2.5 g/l	0.300cd	0.308c	**0.304C**	0.297d	0.303cd	**0.300BC**
T7. Humic acid at 5.0 g /l	0.308c	0.304c	**0.306C**	0.309cd	0.316b-d	**0.312B**
T8. Yeast extract 0.2 % + algae extract 0.2 % + humic acid 2.5 g/l	0.364a	0.339b	**0.351A**	0.362a	0.330b	**0.346A**
Mean	**0.290A**	**0.291A**		**0.284A**	**0.285A**	

- Values within column and row for any of two investigated factors were individual differences by capital letter/s, while for the interaction small letters were used.
- Means followed by the same letter/s were not significantly different at 5% level.

Table 12. Effect of foliar spraying with yeast extract and algae extract, as well as soil drench application with humic acid on K (%) prime grape transplants grafted on both Freedom and Paulsen rootstocks, during 2018 and 2019 seasons.

Parameters	K (%)					
Rootstocks / Treatments	Freedom	Paulsen	Mean	Freedom	Paulsen	Mean
	First season; 2018			Second season; 2019		
T1. Control (Tap water).	0.390h	0.285j	**0.338F**	0.358i	0.280k	**0.319H**
T2. Yeast extract 0.2 %	0.465ef	0.312i	**0.389E**	0.426h	0.325j	**0.376G**
T3. Yeast extract 0.4 %	0.430g	0.324i	**0.377E**	0.419h	0.363i	**0.391F**
T4. Algae extract 0.2 %	0.455f	0.320i	**0.388E**	0.464g	0.353i	**0.409E**
T5. Algae extract 0.4 %	0.905b	1.159a	**1.032A**	0.788b	0.991a	**0.890A**
T6. Humic acid at 2.5 g/l	0.491d	0.404h	**0.448D**	0.557e	0.495f	**0.526D**
T7. Humic acid at 5.0 g /l	0.493d	0.480de	**0.487C**	0.565e	0.564e	**0.565C**
T8. Yeast extract 0.2 % + algae extract 0.2 % + humic acid 2.5 g/l	0.648c	0.628c	**0.638B**	0.728c	0.705d	**0.717B**
Mean	**0.535A**	**0.489B**		**0.538A**	**0.510B**	

- Values within column and row for any of two investigated factors were individual differences by capital letter/s, while for the interaction small letters were used.
- Means followed by the same letter/s were not significantly different at 5% level.

Algae extract is one of the potential organisms, are a rich source of several fine chemicals such as vitamins, carotenoids, polycobiliprotein, polysaccharides, fatty acids, etc. with varied properties like antioxidant **(El-Baz *et al*., 2002).** Also**, Molnar and Ordog (2005**) said that microalgae stimulated the growth of plants, due to the presence of auxins, cytokinins, gibberellins. The various positive effects of applying Algae extract were attributed to its content of different nutrients with a higher percentage of N, greater amounts of B1, B2, B6 vitamins and the natural plant hormone-like cytokinins **(Dahama, 1999).**

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تأثير مستخلص الخميرة ومستخلص الطحالب و حمض الهيوميك علي النمو الخضري والمحتوي الكيماوي لشتلات العنب (البرايم) المطعومة علي اصلي الفريدم – البولسن.

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دراسة تأثير الرش بمستخلص الخميرة ومستخلص الطحالب وكذلك الإضافة الأرضية لحمض الهيوميك علي بعض صفات النمو الخضري – المحتوي من الكلورفيل وعناصر النتروجين والفوسفور و البوتاسيوم لشتلات العنب البرايم المطعومة علي أصل الفريدم والبولسن خلال موسمي 2018 & 2019 حيث كان هناك تأثير كبير علي خصائص النمو الخضري مثل إرتفاع الساق – قطر الساق – عدد الأفرع الجانبية / نبات – عدد الأوراق / نبات – مساحة الورقة وطول الجذور . وقد أحدثت جميع المعاملات زيادة واضحة عن نباتات المقارنة في هذه الخصائص وكان الأثر الأكبر ملحوظا مع المعاملة رقم (8) التي إشتملت علي 0.2 % مستخلص طحالب + 0.2 % مستخلص خميرة + 2.5جم / لتر حمض الهيوميك
وكانت أعلي القيم في الكلورفيل الكلي ومحتوي الأوراق من النتروجين والبوتاسيوم في شتلات العنب البرايم المطعومة علي أصل الفريديم بينما محتوي الأوراق من الفوسفور لم يتأثر بنوع الأصل الجذري المستخدم . ومن ناحية اخري كانت القيم العالية من الكلورفيل الكلي والنتروجين والفوسفور مسجلة مع المعاملة رقم (8) بينما المستوي العالي من البوتاسيوم سجل مع المعاملة الخامسة 0.4 % مستخلص طحالب.
وبناءا علي النتائج المتحصل عليها فانه يمكن التوصية التطبيقية لمشاتل العنب بأن صنف العنب البرايم المطعوم علي أصل الفريديم أفضل و كان متفوقا في خصائص الدراسة عن تلك المطعوم علي البولسن سواء في خصائص النمو الخضري او المحتوي الكيماوي وكذلك التوصية بمعاملة الشتلات % مستخلص طحالب + 0.2 % مستخلص خميرة + 2.5جم / لتر حمض الهيوميك.

الكلمات الدالة : العنب البرايم – أصل الفريدم – أصل البولسن – النمو الخضري – الكلورفيل الكلي – عناصر NPK