The Effects of Exogenous Application of Some Bio Stimulant Substances on Growth, Physical Parameters and Endogenous Components of Onion Plants.

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Abstract

The field experiments were carried out in 2016/2017 and 2017 /2018, respectively aimed to evaluate the effect of a new stimulating plant growth product based on a combination of whey, molasses and yeast and comparing them with both of seaweed extract and amino acids as well as whey + molasses and whey + yeast on onion plants. The foliar applications of all growth active substances were used three times after 30 days from planting date and every 10 days after with a concentration of 5 ml/l then its effect on vegetative growth, yield and some nutritional values of onion plants. The obtained results indicated that plants were treated with all stimulants gave significantly the higher values of vegetative growth parameters, photosynthetic pigments, yield and characteristics of bulb quality as well as and some the phytochemical compounds than plants that not received any stimulants. Using the foliar spray of the mixture (whey + molasses + yeast) gave the most significant results of all evaluated characters in a comparison with other treatments. Such increment was more pronounced when whey, molasses and yeast were combined. The application of whey combined with molasses and yeast could be partially substitution for other bio stimulants for sustainable crops production and it is believed to be a promising useful and eco-friendly agriculture practice.

Keywords: *Whey, Molasses, Yeast, Seaweed, Amino acid, onion (Allium cepa L.,)*

1. Introduction

Onion (*Allium cepa L.*) is one of the most important vegetable crops grown in Egypt, for consumption and exportation. Onion is ranked the third most important vegetable crops after tomato and potato in Egypt which is the 9th onion producer in the world and in 2017 onion production area was 68057 ha. with a total production of 2'379'035 tons and an average yield of about 36 t.ha-1 (***FAOSTAT, 2017***). Onion is one of vegetables of the highest economic importance, which results from its taste and health supporting qualities including anticancer properties, antithrombotic and antiasthma tic activity as well as antibiotic effects (**Suleria *et al.*, 2015**). Also, Egyptian onion varieties distinguish with high quality due to its high nutritional value and pungency therefore, it has a high potential for exportation.

Globally, magnificent efforts have been made to ensure more and better food production to bridge the food gap between production and consumption, and to meet food demand of rising populations in the developing countries. In order to achieve the highest yield, farmers tended to apply excessive amounts of the foliar application of growth active substances.

du Jardin (2015) reported that seaweed extract is one of the naturally organic stimulators for plant growth. it contains of a mix of usefully biological active substances, polyphenols, polysaccharides, alginates, polyamines, pigments, free amino acids, betaines, vitamins, micro and macro-nutrients and natural phytohormones (**Khan *et al.*, 2009; Papenfus *et al.*, 2013; Stirk *et al.*, 2014; Mahmoud *et al.*, 2019**). Its promoting effect might be a result

to contain deferent substances which might affect some metabolism processes of treated plants (**Kulkarni *et al.*, 2019**).

Amino acids play essential roles in cell life because it is one of the most important primary metabolites. However, it could be considered as secondary metabolites, especially in the case of proline, glycine and betaine. It effects on deferent physiochemical characteristics, tissues and organs (**Rai 2002; Marschner 2011**). Optimizing nutrient uptake, translocation and metabolism, encourage the environmental stresses tolerance, vitamin biosynthesis and, growth bio stimulation (**Souri and Hatamian 2019**). Its exogenous application resulted growth promotion effects on various crops especially leafy vegetable ones which got affected beneficially in both yield and quality. (**Sadak *et al.*, 2015; Souri *et al*. 2018; Shaheen *et al.*, 2019**).

Molasses is produced yearly in major amounts and is used in different industries including animal feeding, alcohol and fertilizers. Blackstrap molasses is high in magnesium, calcium, potassium and iron. It also contains sulfur and a host of micronutrients. Molasses uses as fertilizer provides plants with a quick source of energy and motivates the growth of beneficial microorganisms (**Samavat and Samavat 2014**; **Sanli *et al.*, 2015**; **Pyakurel *et al.*, 2019**). **Chandraju *et al.*, (2008)** mentioned that using a diluted molasses solution increases nutrient uptake and yield of leafy vegetables. Mainly it is a source of K, it has small amounts of P, S, Ca, Mg with many trace elements. It also has amounts of humic, fulvic and amino acids exhibiting hormone-like activity (**Leventoğlu and Erdal, 2014; Samavat and Samavat 2014**).

Active dry bread yeast (*Saccharomyces cerevisiae*) is a natural safety biofertilizer which is commonly added to soil or used as a foliar application on different crops because of their bioactivity and safety for human and the environment **(Dawood *et al.*, 2019)**. It has been reported to be a rich source of phytohormones (especially cytokinins), carbohydrates, protein, vitamins, enzymes, amino acids and minerals. It induces the nucleicacid synthesis, chlorophyll formation, cell division, and enlargement and have protective role against environmental stress **(Shehata *et al.*, 2012; Lonhienne *et al.*, 2014).**

Over the last few years, several studies were carried out concerning the beneficial properties of whey i.e. its nutritional value and pharmacological properties like as antimicrobial, antiviral and anti-oxidant properties **(Ocak and Demir 2012)**. A few number of investigators mentioned that whey was used on some crops as nutritive or resistance to some diseases. In this regard, when whey was sprayed at different concentrations (25-100%) with nutrient elements on some vegetable crops caused significant increases of vegetative growth, yield and fruit quality **(Demir and Ozrenk 2009; Demir *et al.*, 2015; Abd AL-Razaq 2019).**

This experiment aimed to explore the effects of exogenous applications of some bio stimulants substances on growth, pigment concentration, physical parameters and endogenous components of onion plants.

2. Material and Methods

2.1. Site description and plant material

Two field experiments were conducted during 2016/2017 and 2017/2018 growing seasons under newly reclaimed sandy soil conditions at the National Research Centre Experimental Farm at El-Nubaria, El-Behira Governorate, north of Egypt (30°29'50"N 30°19'16"E). The Physical and chemical properties of the experimental soil are shown in Table 1

Table 1: Physical and chemical properties of the experimental soil

Physical properties							
Sand		Clay	Silt	Texture	Field capacity %	Wilting point %	
90.08		9.26	0.66	sandy	16.57	5.25	
Chemical analysis							
E.C. M/m	pH	Meq/L					
		Ca	Mg	Na	K	Hco_2	Cl
1.7	8.2	7.02	0.527	0.982	0.31	1.3	0.566

Current study was carried out to investigate the effects of exogenous application of some bio stimulants substances on growth, pigment concentration, physical parameters and endogenous components of onion plants.

Seaweed extract (Kalpak) is a natural liquid extract of seaweed, and it is a global commercial product of seaweed. All rates of seaweed extract were sprayed three times, starting 30 days after planting with 10 – day intervals. The properties of seaweed extracts are shown as N 1%, K 18.5%, Ca 0.17%, Mg 0.42 %, Fe 0.06%, S 2.2 %, Auxin 11 mg/L, Cytocinin 0.03 mg/L, Other hormones 600 ppm, Alganic acid 12%, Glycine 20 %.

Amino mix (naturally amino acid stimulant, obtained from AGRICO International Co. Egypt), is a mixture of amino acids, vitamins and micro nutrients.

The Molasses (M) used in the present study was obtained from the sugar beet industry. The molasses was obtained from The Centralized Management of Afforestation and the Environment, Ministry of Agriculture and Land Reclamation, Giza, Egypt. Some chemical properties of molasses used in the study: TSS: 79.5%, TS: 51%, pH: 5.8, Ash: 9.2%, N: 2.12%, P: 0.34%, K: 3.9%, Ca: 0.9%, Mg: 0.5%, S: 1.7%.

Active dry yeast (Y) was dissolved in warm water followed by adding sugar at a ratio 1:1 and kept overnight for activation and reproduction of yeast (*Saccaromycesr cervisiae*).

Whey (W) is the basic by-product of cheese manufacturing. It is the liquid remaining after the precipitation and removal of milk casein during cheese manufacturing and although there are hundreds of types of cheese, all cheese has to undergo the same basic processes, producing this liquid cloudy water, known as whey. Cheese-whey represents about 85-95% of the milk volume and retains 55% of milk nutrients. The characteristics of the whey (W) were as follows, fat, 0.55%; pH, 6.34; lactic acid, 0.18%; protein, 1.09%; N, 0.17%; dry matter, 7.19%; ash, 0.56%; lactose, 4.88%; P, 50.00 ppm; K, 1261.31 ppm; Ca, 485.73 ppm; Mg, 105.69 ppm; Mn, 0.01 ppm.

All the plant growth stimulant substances were sprayed for 3 times with 10 days interval starting at 30 days after planting date. All sprays were done in the morning using a hand pressure sprayer.

2.2. Experimental design:

Experimental design the experiments were set in a randomized complete block design (RCBD) with three replicates per treatment. The experimental treatments (six treatments) were randomly arranged within the block, each block consisted of three plots.

Onion seedlings cv. Giza 20 was transplanted at the second week of December in the two seasons. Seedlings were planted on drip irrigated laterals that were 1 m apart and 25 m long with 25cm between drippers (standard 4 L/h discharge @ 1.5 bar drippers). Three irrigation lines were used as a border between treatments and were not included in the experiment to prevent the interaction between treatment plots. Four seedlings were planted around each dripper with 10 cm apart.

2.3. Experimental site preparation and cultivation:

As for fertilization, 30 m^3 organic manure per feddan plus 75 units /feddan of calcium superphosphate (15% P_2O_5) at were added during the soil preparation. Nitrogen fertilizer was added in the form of ammonium sulphate (20.6 N /fed) at 150 units/ fed. (Last N dose was 90 days after transplanting; about 60 days before lifting). Potassium sulphate (48 % K_2O) was applied at a rate of 96 units per feddan at two times. The first dose (48 units) was added during preparation the soil for planting and the second dose (48 units) at the beginning of the formation of the bulbs. Cultural practices, disease and pest control management were followed according to the recommendations of the Egyptian Ministry of Agriculture.

2.4. Experimental treatments:

The Molasses (M) was dissolved in Whey (W) at a ratio 1:1 (v/v) and the composition of the mixture is well stirred. Also, Active dry yeast (Y) was dissolved in warm water followed by adding sugar and it added to whey a ratio 1:1 (v/v) and kept overnight for activation and reproduction of yeast (*Saccaromycesr cervisiae*) to preparing the mixture. The third mixture that formed from (molasses + whey + yeast) was prepared by dissolving the molasses and yeast in whey at ratio 1:1:1 (v/v) where the yeast was dissolved in warm water followed by adding sugar and it added to the whey that contains the molasses.

The six experiment treatments were applied as follow:

1- Foliar spray of seaweed (Kalpak) (*Ecklonia maxima*) at the rate of 5 cm^3/L.
2- Foliar spray of amino acid at rate 5 cm^3/L.
3- Foliar spray of whey (W) at 1:1 the molasses (M) (v/v) at rates of 5 cm^3/L (W + M).
4- Foliar spray of whey (W) at 1:1 the yeast (v/v) at rates of 5 cm^3/L (W + Y).
5- Foliar spray of whey (W) + the molasses (M) + the yeast (Y) at rates of 5 cm^3/L (W+M+Y).
6- Foliar spray of tap water as control.

2.5. Measurements of crop parameters:

2.5.1. Vegetative growth:

Random sample of ten plants from each plot were taken at 75 days after transplanting to measure the vegetative growth parameters such as plant height (cm), number of leaves, diameter of bulb and nick (cm) and fresh and dry weight of whole plant.

2.5.2. Leaf pigment contents:

Photosynthetic pigments i.e., chlorophyll a, b, a + b and carotenoids contents were determined in fresh leaves sampled at 75 days after planting date according to **Moran (1982)**. Fresh leaf disks (500 mg) were immersed overnight in 10 ml of N,N- dimethyl formamide. The obtained extracts were measured at 470, 647 and 663 nm in a UV/VIS spectrophotometer (T-60, PG instrument, Wibtoft Leicestershire, UK), for carotenoids, chlorophyll b and chlorophyll a, respectively, N,N-dimethyl formamide was used as a blank.

2.5.3. Bulb characteristics:

At harvesting time (when bulbs reach the variety normal bulb size and skin color which is about 150 DAT), onions were lifted by hand. Immediately after lifting, onions were subjected to field curing on the ground under shaded area for 10 days. After curing period bulbs were sorted and the following variables were measured: Average bulb weight (g): by dividing the total yield of the plot area on the number of bulbs. Dry matter percentage (D.M.%): Bulb tissue was oven dried at 70 C for 72 hours and weighed then attributed to the initial fresh weight, neck diameter (cm), bulb diameter (cm) and bulb length (cm).

2.5.4. Yield and yield components.

After harvesting and bulb curing the following variables were also measured. Total yield (kg/m^2): It was calculated on basis of total yield for the experimental plot.

2.5.5. Bulb chemical quality parameters.

Another sample was taken to the lab in Vegetable Research Department, NRC, to measure bulb quality characteristics. Bulb quality was evaluated by measuring, total nitrogen was determined using micro Kjeldahl method according to the procedures described by **Cottenie *et al.* (1982)**. Phosphorus percentage was assayed according to the modified colorimetric (molybdenum blue) method using spectrophotometer (SPECTRONIC 20 D, Milton Roy Co. Ltd., USA) according to the procedures described by **Cottenie *et al.* (1982)**. Moreover, potassium percentage was measured using flame photometer method (JENWAY, PFP-7, ELE Instrument Co. Ltd., UK) as described by **Chapman and Pratt (1982)**. Sulphur was determined by the modified colorimetric method using spectrophotometer (SPECTRONIC 200, Milton Roy Co., Ltd, USA) as described by **Chapman and Pratt (1982)**.

Total soluble solids (TSS %; determined by Hanna Digital Refractometer Model HI96801). Total phenolic content. The total phenolic content was determined in absolute ethanolic extract using Folin - Ciocalteau reagent as described by **Stratil *et al.* (2006)**. The reaction mixture absorbance was read at 725 nm using a UV/VIS spectrophotometer. Gallic acid was used as the standard reference and total phenolic content was expressed as mg gallic acid equivalent per gram of dry weight tissue (mg GAE/g DW). Total flavonoid content. Total flavonoid content was determined in absolute ethanolic extract using the aluminum chloride colorimetric method described by **Chang *et al.* (2002)**. The absorbance of the reaction mixture was measured at 415 nm in a UV/VIS spectrophotometer. The total flavonoid content was expressed as mg quercetin equivalent per gram of dry weight tissue (mg QCE/g DW).

2.6. Statistical analysis:

The obtained data were subjected to the statistical analysis of variance procedure using Two-way-ANOVA of the Statistical Package for the Social Sciences software (SPSS 2008 release 17.0 for Windows, SPSS Inc., Chicago, IL, USA). Values are expressed as an average of three measurements ± standard deviation (SD). The least significant differences (LSD) test was employed to compare the significant differences among treatment means at$p \leq 0.05$level of significance according to the procedures reported by **Snedecor and Cochran (1980).**

3. Results and Discussion

3.1. Plant vegetative growth characters

Results from Table 2 shows that the new mixture that contains whey, molasses and yeast (W + M +Y) ($p \leq 0.05$) had significantly improved all evaluated parameters of vegetative growth and that was true in both studied seasons. Whereas, the foliar application of this mixture gave better significant values of plant length, number of leaves/plants, neck diameter, fresh and dry weights of leaves and bulbs compared with other treatments in both gowning seasons of 2016/2017 and 2017/2018. Followed insignificantly by application of both of the yeast that dissolved in whey milk (W +Y) and the molasses that dissolved in whey milk (W+ M). It is appeared that these treatments caused a remarkable promotion of plant vegetative growth parameters in relative to other treatments. Where, application of seaweed extract or amino acid mixture treatments gave significantly the lowest values of all measured characters of plant vegetative growth of onion plant compared with the rest of treatments in both seasons of the study and this is surprising. In general the all treatments of foliar spraying of bio stimulants cause an enhancement in all measured characters of vegetative growth of onion plant if compared with plants sprayed with tap-water (as control).

The superiority of the mixture (W+M+Y) to other treatments on vegetative growth parameters may be due to its content of valuable components such as polysaccharides, alginates, polyamines, amino acids, nutrients, natural cytokinins, auxins and auxin-like compounds and gibberellins which affect celles metabolism processes which Encourage the plant vegetative growth this is due to the effect of yeast **(Mirabal-Alonso *et al*., 2008; Olaiya 2010; Paungfoo-Lonhienne *et al*., 2010)**. In addition to humic, fulvic and amino acids exhibiting hormone-like activity that existed it in molasses (**Leventoğlu and Erdal, 2014**; **Samavat and Samavat 2014; Abo-Baker, 2017**). also to presence the high nutrient content in whey that improves the nutritional status of the plant and Aliphatic polyamines i.e., spermidine, spermine and their obligate di-amine precursor putrescine are polycationic compounds of low molecular weight that have been proposed to be a new category of plant growth regulators or secondary hormonal messenger. They are implicated in a wide range of plant physiological processes (**Gupta *et al*., 2012; Abed AL-Hussain and Muhammed, 2016; Abd AL-Razaq 2019).**

Table (2): Effect of growth active substances on vegetative growth parameters of onion plants during seasons of 2016/2017 and 2017 /2018.

Treatments	Plant length (cm)	No. leaves	Fresh weight (g)		Dry weight (g)		Neck diameter (cm)
			Leaves	Bulb	Laves	Bulb	
Frist season							
Control	30.20 ± 1.37	7.50 ± 0.76	44.50 ± 2.00	65.30 ± 3.00	9.25 ± 0.72	12.30 ± 1.17	1.50 ± 0.12
Sea weed	36.67 ± 0.61	9.33 ± 0.19	50.00 ± 1.12	80.75 ± 1.85	11.25 ±0.53	14.67 ± 0.59	2.20 ± 0.10
Amino acid	36.67 ± 0.92	9.33 ± 0.69	50.67 ± 1.41	81.85 ± 1.93	11.65 ±0.73	14.78 ± 0.71	2.30 ± 0.15
W + M	39.33 ± 0.19	10.33 ± 0.25	56.60 ± 0.74	89.54 ± 1.13	13.72 ±0.37	18.07 ± 0.54	2.50 ± 0.12
W + Y	39.67 ± 0.35	11.00 ± 0.17	58.39 ± 0.73	96.89 ± 0.95	14.33 ±0.37	19.32 ± 0.45	2.65 ± 0.06
W+ M + Y	42.33 ± 0.07	12.33 ± 0.08	62.82 ± 0.41	101.53 ±0.74	14.74 ±0.29	20.37 ± 0.21	2.75 ± 0.03
LSD	**1.71**	**0.62**	**3.82**	**1.89**	**0.88**	**0.68**	**0.17**
Second season							
Control	30.26 ± 1.45	8.00 ± 0.87	45.23 ± 1.88	68.85 ± 3.33	9.63± 0.77	12.54 ± 1.20	1.20 ± 0.26
Sea weed	37.67 ± 0.71	9.67 ± 0.19	54.67 ± 1.16	83.34 ± 1.95	11.2 ± 0.56	14.85 ± 0.56	2.30 ± 0.15
Amino acid	37.33 ± 0.79	9.33 ± 0.73	55.65 ± 1.24	84.18 ± 1.99	11.79± 0.75	14.95 ± 0.73	2.76 ± 0.15
W + M	40.00 ± 0.18	10.33 ± 0.21	62.10 ± 0.83	90.40 ± 1.10	13.50± 0.37	17.21 ± 0.44	2.67 ± 0.12
W + Y	40.67 ± 0.25	10.67 ±0.18	65.31 ± 0.71	96.89 ±1.00	14.17± 0.39	17.78 ± 0.42	270 ± 0.05
W+ M + Y	42.33 ± 0.10	12.33 ± 0.09	69.09 ± 0.36	103.53 ± 0.68	14.77± 0.22	19.71 ± 0.21	2.88 ± 0.03
LSD	**0.83**	**0.84**	**1.72**	**2.51**	**1.07**	**0.69**	**0.11**

3.2. Yield and physical properties of bulb

Data presented in Table 3 indicate that the highest values of all determined parameters of yield and physical properties of bulb (bulb diameter, bulb length and average weight of bulb) were recorded when onion plants treated with the mixture (W+M+Y). The same trends were noticed in both seasons of the study. On the other hand, the onion plants which not received any treatments (as control) showed significantly ($p \leq 0.05$) the lowest values of total yield and physical properties of bulb in both seasons of 2016/2017 and 2017 /2018.

It is appears that the parameters from the table of vegetative growth that shown in previous Table (2) this parameters were highly reflected on total onion yield and some physical properties of bulb that shown in Table (3) which ultimately led to increase the total yield. In this concern, total yield ton/fed and average weight of bulb as g/bulb were increased by up to

31.69- 34.97% and 28.33 - 28.27% among both first and second seasons, respectively, when onion plants received foliar application of (W+M+Y). In another mean, the increment of average weight of bulb of onion plants was mainly attributed to the increase in total yield per plant which accompanied by this treatment.

The obtained results are in coincidence with **Demir *et al*., (2015); Abed AL-Hussain and Muhammed (2016); Abd AL-Razaq (2019); Pyakurelet *et al*., (2019); Dawood *et al* (2019)**. All of them mentioned that treated plants with a mixture of (W+M+Y) as an independent factor showed a significant increase in yield as well as quality in a variety of vegetables. The increment of yield with application of the mixture of (W+ M +Y) is related to natural phytohormones contents in the extracts, mainly cytokinin and other components **(Lonhienne *et al*., 2014)**. In this regard, the increment in plant yield may be explained as a result of vigorous vegetative growth as previously mentioned.

Table (3): Effect of growth active substances on total yield and some physical properties of bulb of onion plants during seasons of 2016/2017 and 2017 /2018.

Treatments	Total yield ton/fed.	Bulb (cm)		Average weight g/bulb
		Diameter	Length	
Frist season				
Control	13.00 ± 0.51	4.80 ± 0.46	4.62 ± 0.32	135.22 ± 11.02
Sea weed	15.93 ± 0.52	5.17 ± 0.59	5.17 ± 0.15	141.86 ± 5.89
Amino acid	16.00 ± 0.50	5.20 ± 0.25	5.47 ± 0.10	149.58 ± 6.23
W + M	17.83 ± 0.43	5.90 ± 0.15	6.13 ± 0.15	172.30 ± 4.85
W + Y	18.40 ± 0.26	5.93 ± 0.15	6.30 ± 0.12	178.62 ± 3.51
W+ M + Y	19.03 ± 0.10	6.30 ± 0.12	6.53 ± 0.06	188.65 ± 2.60
LSD	**0.37**	**0.28**	**0.37**	**4.36**
Second season				
Control	13.20 ± 0.53	4.80 ± 0.52	4.76 ± 0.35	135.00 ± 10.25
Sea weed	16.00 ± 0.53	5.13 ± 0.54	5.00 ±0.30	142.20 ± 6.35
Amino acid	16.22 ± 0.51	5.23 ± 0.51	5.20 ± 0.18	153.63 ± 6.10
W + M	17.90 ± 0.48	6.00 ± 0.32	6.10 ± 0.13	176.41 ± 4.90
W + Y	18.66 ± 0.28	6.07 ± 0.20	6.17 ± 0.13	183.22 ± 4.00
W+ M + Y	20.30 ± 0.15	6.23 ± 0.20	6.33 ± 0.08	188.20 ± 2.85
LSD	**0.19**	**0.22**	**0.24**	**4.27**

3.3. Leaf pigment contents

The highest significant ($p \leq 0.05$) values of onion leaf pigment contents (chlorophyll a, b, a,b and carotenoids) in both seasons resulted by using (W+ M+Y) mixture while control treatment scored the lowest values as introduced in (Table 4).

Similar results recorded by Makhlouf **(2015)** who stated that foliar application of yeast increased leaf pigment contents of sugar beet. Further, **Pyakurel *et al*., (2019)** said spraying molasses boost the photosynthetic pigments content in spinach leaves.

These results are similar to those recorded by **Haroun and Ibrahim (2003)** who stated that using whey led to increase total chlorophyll value in Wheat seedlings leaves consequently, reflected on the capacity and efficiency of photosynthetic process. Such increasement could be explained by the fact of whey promote gibberellin biosynthesis which encourage chlorophyllase activity (**Drazkiewicz, 1994 and Cihangir and Aksz, 1996**).

In this regard, the enhancement of yeast application on leaf pigment contents might be due to delaying of leaf senescence by decreasing leaf pigments decomposition or by improving its biosynthesis (**Dawood *et al.*, 2019**). Furthermore, the fermentation Molasses contained sugar produces CO2 (**Mweresa *et al.*, 2014**). This CO_2 release produce an additional carbon source (**Quan *et al.*, 2005)** allows a reduction in photorespiration rate and net increasement of photosynthesis (**Nonomura and Benson 1992**).

Table (4): Effect of growth active substances on leaf pigment contents of onion plants during seasons of 2016/2017 and 2017 /2018.

Treatments	Chl a mg/g F.W.	Chl b mg/g F.W.	Chla+b mg/g F.W.	Carotenoids mg/g F.W.
Frist season				
control	1.30 ± 0.017	0.32 ± 0.015	1.65 ± 0.025	1.20 ± 0.014
Sea weed	1.66 ± 0.010	0.41 ± 0.010	2.07 ± 0.017	1.30 ± 0.021
Amino acid	1.69 ± 0.010	0.42 ± 0.010	2.11 ± 0.010	1.31 ± 0.028
W + M	1.72 ± 0.006	0.48 ± 0.006	2.20 ± 0.010	1.32 ± 0.007
W + Y	1.78 ± 0.006	0.48 ± 0.012	2.26 ± 0.006	1.35 ± 0.007
W+ M + Y	1.84 ± 0.004	0.51 ± 0.006	2.34 ± 0.006	1.38 ± 0.001
LSD	**0.041**	**0.023**	**0.11**	**0.021**
Second season				
control	1.33 ± 0.015	0.36 ± 0.017	1.69 ± 0.020	1.2 ± 0.012
Sea weed	1.70 ± 0.021	0.43 ± 0.024	2.13 ± 0.022	1.35 ± 0.006
Amino acid	1.69 ± 0.001	0.43 ± 0.021	2.12 ± 0.021	1.36 ± 0.012
W + M	1.73 ± 0.017	0.48 ± 0.025	2.21 ± 0.017	1.40 ± 0.012
W + Y	1.78 ± 0.006	0.50 ± 0.014	2.28 ± 0.014	1.42 ± 0.006
W+ M + Y	1.84 ± 0.001	0.53 ± 0.011	2.37 ± 0.011	1.44 ± 0.006
LSD	**0.088**	**0.041**	**0.12**	**0.017**

3.4. Nutritional values of bulb sand its Mineral contents

The phytochemical compounds i.e. total phenolics, total flavonoids and ascorbic acid in addition to TSS as well as Mineral contents in bulbs was higher with the foliar application of the (W+M+Y) mixture than other treatments in both growing seasons Tables 5 and 6.

Foliar spraying treatments of the (W+M+Y) mixture gave significant effects on bulbs mineral contents of N, P, K, Ca and S within both study seasons as appears in Table 8.

The (W+M+Y) mixture treatment resulted the highest significant values of mineral contents and phytochemicals compounds i.e. total phenolics, total flavonoids and ascorbic acid in addition to TSS in onion bulbs followed significantly by (W+Y) treatment then by (W+M) treatment and lastly by control treatment which resulted the lowest values of some chemical components.

Table (5): Effect of growth active substances on ascorbic acid, TSS, total phenolics, flavonoids and ascorbic acid contents of onion plants during seasons of 2016/2017 and 2017 /2018.

Treatments	TSS %	Ascorbic acid (mg/100 gFW)	Total phenols	Total flavonoids
			mg/g100 DW	
Frist season				
Control	9.00 ± 0.50	2.62 ± 0.28	132.50 ± 6.91	27.83 ± 2.74
Sea weed	9.53 ± 0.29	3.77 ± 0.19	148.43 ± 5.28	34.90 ± 1.33
Amino acid	9.93 ± 0.23	4.06 ± 0.16	155.73 ± 3.02	38.77 ± 1.76
W + M	10.77± 0.14	4.66 ± 0.19	190.64 ± 3.43	42.13 ± 0.53
W + Y	11.37± 0.20	4.90 ± 0.04	200.30 ± 2.25	45.17 ± 1.11
W+ M + Y	11.33± 0.08	5.80 ± 0.03	204.97 ± 2.40	48.07 ± 1.00
LSD	**0.45**	**0.44**	**8.73**	**0.86**
Second season				
Control	8.86 ± 0.55	2.66 ± 0.31	130.56 ± 7.48	30.20 ± 2.97
Sea weed	9.67 ± 0.30	3.76 ± 0.21	148.43 ± 5.66	34.90 ± 1.68
Amino acid	9.93 ± 0.24	4.10 ± 0.18	155.73 ± 4.33	37.40 ± 1.72
W + M	10.87± 0.18	4.87 ± 0.16	190.64 ± 3.25	43.87 ± 1.00
W + Y	11.00 ± 1.80	5.10 ± 0.10	200.30 ± 3.00	47.27 ± 1.10
W+ M + Y	11.17± 0.10	5.76 ± 0.10	204.97 ± 2.55	48.50 ± 1.00
LSD	**0.18**	**0.41**	**8.73**	**1.32**

Table (6): Effect of growth active substances on mineral contents of onion plants during seasons of 2016/2017 and 2017 /2018.

Treatments	%				
	N	P	K	Ca	S
Frist season					
Control	1.50 ± 0.15	0.30 ± 0.05	1.33 ± 0.11	1.40 ± 1.00	0.22 ± 0.14
Sea weed	1.57 ± 0.07	0.32 ± 0.06	1.40 ± 0.06	1.50 ± 0.17	0.32 ± 0.09
Amino acid	1.58 ± 0.02	0.32 ± 0.02	1.50 ± 0.15	1.57 ± 0.14	0.34 ± 0.02
W + M	1.63 ± 0.03	0.34 ± 0.01	1.64 ± 0.02	1.83 ± 0.04	0.39 ± 0.11
W + Y	1.70 ± 0.01	0.35 ± 0.02	1.74 ± 0.10	1.87 ± 0.09	0.37 ± 0.04
W+ M + Y	1.80 ± 0.01	0.37 ± 0.03	1.83 ± 0.02	1.90 ± 0.01	0.42 ± 0.01
LSD	**0.07**	**0.02**	**0.07**	**0.10**	**0.02**
Second season					
Control	1.45 ± 0.18	0.28 ± 0.09	1.45 ± 0.16	1.33 ± 1.10	0.21 ± 0.10
Sea weed	1.57 ± 0.06	0.30 ± 0.08	1.50 ± 0.06	1.50 ± 0.17	0.37 ± 0.09
Amino acid	1.67 ± 0.06	0.33 ±0.06	1.57 ± 0.11	1.63 ± 0.19	0.37 ± 0.21
W + M	1.69 ± 0.10	0.35 ± 0.06	1.67 ± 0.02	1.87 ± 0.06	0.45 ± 0.10
W + Y	1.70 ± 0.02	0.36 ± 0.04	1.70 ± 0.10	1.90 ± 0.06	0.42 ± 0.06
W+ M + Y	1.83 ± 0.02	0.37 ± 0.04	1.88 ± 0.02	1.90 ± 0.04	0.48 ± 0.05
LSD	**0.11**	**0.01**	**0.04**	**0.05**	**0.03**

These results might refer to high amounts contents of phenolic compounds and antioxidants in this mixture which might have an impact on metabolic processes leading to accumulate the phytochemicals compounds and increase antioxidant activity, accordingly the nutritional values of the treated plants were enhanced. Furthermore, vegetables of Alliaceae

family tended to accumulate the biologically active and strong antioxidant substances (**Mishu *et al.*, 2013)**.

Increasing bulbs Sulphur content that resulting from spraying with the (W+M+Y) mixture can affect bulb quality, especially its pungency, which is defined as the combination of onion flavor and odor that are functions of the concentrations of sulphonic and thiosulphonic volatile acids containing Sulphur (**De Souza *et al.*, 2015).**

The obtained results probably due to various phytohormones presented in yeast and molasses in addition to whey that rich in mineral contents that led to improve the formation of vigorous plant root system which increased water and nutrients absorption from the soil (**Ocak and Demir 2012; Sanli *et al.*, 2015; Dawood *et al.*, 2019; Pyakurel *et al.*, 2019).**

4. Conclusion

Considering its stimulatory effect (whey+ molasses+ yeast) mixture can be used at a rate of 5ml/L as foliar spraying three times starts at 30 day after planting date and every 10 days after to improve onion plants vegetative growth, yield and nutritional quality. Further, its use can be promising and useful as a good agricultural practice for crop production in both sustainable and organic agriculture. Future researches are needed to generate a better understanding of how to use (W+M+Y) supplementation alters plant morphology and how it can induce specific changes that are beneficial for crop systems.

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