Effect of Some Growth-Stimulants on Growth, Yield and Storability of Onion Plants (*Allium cepa* L.)

[1]Ahmed, M.E.M.; A. A. A. Abd El-Hafez[2]; A. A. Al-Araby[1] and A. A.A. Sharaf[1]

1. Horticulture Department, Faculty of Agriculture, Tanta University, Egypt
2. Horticulture Department, Faculty of Agriculture, Ain Shams University, Egypt

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ABSTRACT: Improving growth, quality and increasing yield of onion plants are important goals for growers to realize the requirements of the market and the consumers. Two field experiments were carried out during two successive seasons; 2013/2014 and 2014/2015 at a private farm in El-Mahalla El-Kubra district, El- Gharbia Governorate, Egypt to find out the influence of some growth- stimulants at different rates viz., yeast extract (2, 3and 4 gl^{-1}) seaweed extract (3,4 and 5 gl^{-1}) and NAA (0.8, 1.2 and 1.6 gl^{-1}) on vegetative, yield, and its components as well as bulb storability of onion plants cv. Giza Red. Foliar spray with growth stimulants were applied thrice at 45, 60 and 75 days after transplanting. The design of the experiment was a complete randomized blocks with three replicates. The results showed that foliar spray of seaweeds extract at 4 or 5 g/l followed by yeast extract 4g/l had the highest stimulation effect on onion plant growth traits (plant height, number of leaves and leaf fresh weight) total bulb yield and its components as well as N, P and K content of bulb tissues. Application of seaweed extract (5 g/l) showed the least weight loss (%) and decay (%) of bulbs compared to the control and other treatments.

Keywords: *Allium cepa* L., growth stimulants -growth-yield- storability

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops cultivated all over the world (Mishra *et al*., 2013). It is widely consumed because of its flavouring and health-promoting properties (Malik, 1994). It contains carbohydrates, protein, vitamin A, thiamine, riboflavin, niacin and ascorbic acid. The Egyptian onion is famed all over the world for its higher quality due to its high pungency and storability and early absence in European markets and being one of the sources for hard currency. The acreage of onion crop occupies about 152539 /fed. with average of 10-12 tons of bulbs/fed. according to Ministry of Agriculture and Land Reclamation (2014).

Recently, public health and environmental safety encourage the use of natural extracts, seaweed and yeastes for enhancing growth, nutritional status and production safety foods, therefore recent agriculture is searching for new tools that would allow for a decreasing in the use of agro- chemical inputs without harmfully affecting crop yield or the growers' income (Hansra, 1993). Nowadays, a great attention is focused on the possibility of using seaweeds as fertilizers has allowed for substitution in place of traditional synthetic fertilizer (Hong *et al.* 2007, Kalaivanan and Venkatesalu, 2012). Seaweed extracts are sold as liquid fertilizers and biostimulants then they contain various growth regulators, for example auxin, cytokinins, gibberellins, macronutrients i.e. K, P and Ca and micronutrients such as Fe, Zn, Mn, Cu, B, Mo and Co (Khan *et al*., 2009).

Yeast (*Saccharomyces cerevisiae*) is considered as a type of biofertilizer which is typically added as soil or foliar application on vegetable crops (El- Ghamry *et al.* 1990) because it's one of the richest source of high quality protein, namely the essential amino acids like lysine, tryptophan etc., contains the essential minerals and trace elements, namely calcium, cobalt, iron etc. and the best sources of the B-complex vitamins such as B1, B2, B6 and B12. The extract is a valuable source of bio-constituents especially cytokinins (Amer 2004).The use of plant growth regulators (NAA) has resulted in significant increase in growth and yield of several vegetable crops. The vegetative growth parameters of onion i.e. plant height, number of leaves per plant, fresh and dry weight of plant increased when sprayed with NAA and GA_3 (Salah and Abd, 1989) and Singh (2006).

Therefore, the main objective of this study is to evaluate the possible effects of different rates of some bio-stimulators such as yeast, seaweed extracts and Naphthalene acetic acid (NAA) as foliar application on growth, nutritional status, yield, bulb quality and storability of onion planted in clay soil under Gharbia Governorate conditions.

MATERIALS AND METHODS

The present study was carried out during two successive seasons; 2013/2014 and 2014/2015 at a private farm in El-Mahalla El-Kubra district, El-Gharbia Governorate, Egypt, to investigate the effect of foliar application of growth-stimulants i.e. seaweed extract, yeast extracts and Naphthalene acetic acid (NAA) on growth, nutritional status, yield, bulb quality and storability of onion plants cv. Giza Red. The experimental trails were conducted in clay soil and the plants were irrigated with Nile water by surface irrigation system. Chemical analysis and physical properties of the experimental soil were determined according to (Page *et al.,* 1982) and shown in Table (1).

Table (1): Some physical and chemical properties of the experimental site

Sand = 14.48 %	N (available) = 33.09 mg kg^{-1}	Ca++ = 6.38 (meq/L)	HCO3- = 1.25 (meql)
Silt = 32.67 %	P (available) = 7.11 mg kg^{-1}	Mg++ = 6.35 (meq/L)	Cl- = 8.34 (meql)
Clay = 52.85 %	K (available) = 375.12 mg kg^{-1}	Na+ = 8.01 (meq/L)	SO4-- = 11.51 (meql)
pH(1:5 extract) = 8.30		EC = 2.11 (dS m^{-1})	

*Corresponding author e-mail: dr.memahmed @yahoo. Com

Onion seeds 'Giza Red' were sown in a nursery on October 4th in both seasons. Seedlings were transplanted in the experimental field on December 15th and 13th for 2013/2014 and 2014/2015 seasons, respectively. Planting was done on ridges, the plot area was 14.4 m^2 which including 3 ridges (6 m length and 80cm in width) and the seedlings were transplanted on the two sides of ridges 8-10 cm apart between seedlings. The cultural practices were done according to the recommendation of Ministry of Agriculture, Egypt.

The experiment included ten treatments arranged in a randomized complete block design with three replicates as follows:

T_1: Control (spraying with water only).
T_2 :Yeast spraying at 2g/l.
T_3: Yeast spraying at 3g/l.
T_4:Yeast spraying at 4g/l.
T_5:Seaweed extracts spraying at 3g/l
T_6 : Seaweed extract spraying at 4g/l.
T_7: Seaweed extract spraying at 5g/l.
T_8 : NAA spraying at 0.8 g/l.
T_9: NAA spraying at 1.2 g/l.
T_{10} : NAA spraying at 1.6 g/l.

A commercial seaweed extract product "Alga 600" (Techno green company) mixed of three seaweed viz., *Ascophyllum nodosum, Laminaria* spp and *Sargassum sp*. Seaweed extract also contains N (1%), K (18.5%), Ca (0.17%), Mg (0.42%), Fe (0.06%), S (2.2%), alganic acids (10-12%) and plant hormones (600 ppm). Yeast extract was prepared from brewer's yeast (*Saccharomyces cerevisiae*), dissolved in water followed by adding sugar at a ratio of 1: 1 and kept 24 hours at room temperature according to the methods of Morsi *et al.,* (2008). Chemical composition of yeast is shown in Table (2) according to the analysis of Nagodawithana (1991). Amcotone as a source of NAA is a commercial plant growth regulators product was obtained from Shoura Company for chemicals. Company having the following composition: 0.45% Naphthyl acetic acid, 1.25% Naphthyl acetamide and 98.30% other additives. The tested growth-stimulants, seaweed and yeast extract as well as Amcotone (NAA) were applied as a foliar spray thrice at 45, 60 and 75 days after transplanting (DAT).

Data recorded

Five plants were selected randomly from each replicate at 90 days from transplanting (90 DAT) to measure plant height (cm), number of leaves per plant, leaf length and diameter, and plant fresh and dry weight (g). At harvest (The second week of May), all the remaining bulbs were uprooted and bulbs yield of onion expressed as follows: bulb fresh weight (g), the total yield as ton/ feddan . Also a random sample of 10 bulbs was taken from each replicate to determine bulbing ratio. Bulbing ratio was calculated according to Mann (1952). In addition bulb length and diameter were measured. Total nitrogen (N), phosphorus (P) and potassium (K) in dry matter of leaves and bulbs, and the total carbohydrates in dry bulbs were determined; also TSS% was calculated according to the methods described in A.O.A.C (1995).

After curing, random samples of 20 kg of onion bulbs were taken from each treatment and stored for 240 days at room temperature. Monthly average of air temperature and relative humidity during storage time are presented in Table (3).

Table (2): Chemical composition of active yeast (mg/ 100g dry weight)

Major components%		Approximate composition of minerals (mg/g)				Vitamins content (mg/g)	
Proteins	47	K	21.00	Mn	0.02	Thiamine (vit.B_1)	60-100
Carbohydrates	33	P	13.50	Cu	8.00	Riboflvine(vit.B_2)	350-500
Minerals	8	Ca	0.75	Mo	0.40	Niacin	300-500
Nucleic acids	8	Mg	1.65	Se	0.10	Pyridoxine HCl	28
Lipids	4	S	3.90	Cr	2.20	Pantothenate	70
		Fe	0.02	Ni	3.00	Biotin	1.3
		Zn	0.17	Va	0.04	Cholin	4000
		Na	0.12	Sn	3.00	Folic acid	5-13
		Si	0.03	Li	0.17	Vit-B_{12}	0.001

Table (3): Metrological data for El-Gharbia area during 2013 and 2014 seasons

Month	Temperature (C°)			Relative (RH%)		
	Max	Min	Mean	Max	Min	mean
Season 2013*						
May	31.43	21.85	26.64	75.03	45.78	60.41
June	32.44	23.97	28.21	74.63	51.27	62.95
July	32.32	24.31	28.31	79.57	54.70	97.14
Agus.	33.79	24.72	29.29	83.63	60.52	72.08
Sep.	32.50	22.93	27.72	81.00	56.60	68.80
Oct.	27.79	19.42	23.61	76.23	57.36	66.80
Nov.	25.39	15.14	20.27	87.00	64.43	75.72
Dec.	19.64	8.51	14.06	92.07	67.61	79.84
Season 2014						
May	30.47	19.57	25.02	77.20	48.60	62.90
June	32.65	20.60	26.63	86.23	52.30	69.27
July	33.15	23.64	28.40	83.19	55.11	69.15
Agus.	34.10	21.80	27.95	92.40	53.50	72.95
Sep.	32.49	20.76	26.63	87.57	52.20	69.89
Oct.	29.75	18.75	24.25	80.92	53.39	67.16
Nov.	24.30	13.79	19.05	87.80	60.50	74.15
Dec.	22.27	9.72	16.00	88.60	63.50	76.05

*Data recorded by Meteorological Station, Gharbia Governorate, Egypt.

Weight loss % and decay percent were calculated according to the following formula

1. Weight loss (%) = [(Initial weight - weight at sampling date) ×100] / Initial weight of storage bulb.
2. Decay (%) = (number of decayed bulbs / total bulbs number) ×100

Statistical analysis

Data were analyzed by MSTATC computer software program (Bricker, 1991). The obtained data were subjected to analysis of variance according to Snedecor and Cochran (1990). Duncan's multiple range test (Duncan, 1955) at 5% level was used to compare the means.

RESULTS AND DISCUSSION

Vegetative growth traits

Results in Table (4) show that there were significant differences among treatments in most vegetative growth characters during 2013/2014 and 2014/2015 seasons. Foliar application of seaweed extracts (4 and 5 $g.L^{-1}$) followed by dry yeast (3 and 4 $g.L^{-1}$) and NAA (1.2 and 1.6$g.L^{-1}$) significantly improved growth characters i.e. plant height, leaf length and leaf diameter compared to the control during both seasons. The most pronounced effect was noticed with the highest concentrations of both seaweed extracts at 5 $g.L^{-1}$ and dry yeast at 4 $g.L^{-1}$ but no sign facet effect was noticed on number of leaves at any concentration during the first season only.

The highest significant values of plant fresh weight were recorded by spraying plants with NAA at 1.6 and1.2g/l, seaweed extract at 3,4 and 5 g/l and yeast extract at 4 g/l without significant differences between them while, the control treatment (sprayed with tap water) recorded the lowest values of the mentioned parameter in both seasons Foliar application with seaweed extract at 5 gL^{-1} came in the first order as for plant dry weight (12.23 and 12.08g) while, the control treatment recorded the lowest values (11.95 and 11.86g) of the mentioned parameter in both seasons, respectively.

The stimulatory effect of seaweed extracts on vegetative growth may be due to containing high levels of organic matter, macro and micro i.e., N, Mg, B, S and Mo elements, vitamins and fatty acids (Crouch and Van Staden, 1994) and also rich in growth regulators such as auxins, cytokinins and gibberellins. The present results are in accordance with those reported by Dogra and Mandradia (2012), Fawzy *et al.* (2012) on garlic, Babilie *et al.* (2015) and Hidangmayum and Sharma (2017) on onion plants, who found that foliar spraying of seaweed extract had a significant effect on vegetative growth of onion plants (plant length, number of leaves and fresh weight of leaves, neck and bulb). Also, The positive effect of yeast extract on plant vegetative characteristics can be due to the natural content of cytokinins, enzymes, amino acids, vitamins and mineral nutrients (Khedr and Farid, 2002, Mahmoud, 2001and Bevilacqua *et al.,* 2008) that positively affect cell division and elongation, nucleic acid synthesis, protein and chlorophyll formation (Castelfranco and Beale, 1983). Improving growth and productivity of vegetable crops by application of yeast extract were recorded by several studies such as El-Morsy *et al.,* (2011), Shalaby and El-Ramady (2014) and Ahmed (2015) on garlic. Who found that the foliar application of yeast improvement vegetative traits (plant height, leaf number and leaves fresh weight).

Table (4): Effect of foliar application of yeast, seaweed extracts and NAA on some vegetative growth traits of onion plants during 2013/2014 and 2014/2015 seasons

Treatment	Plant height (cm)	Number of leaves/plant	Leaf length (cm)	Leaf diameter (cm)	Plant fresh weight (g)	Plant dry weight (g)
Season 2013						
Control (water spray)	70.80c	9.00a	58.33d	1.85b	76.67d	11.95d
Yeast at 2g/l	76.65bc	9.60a	65.6bc	2.05a	89.33bc	12.13bc
Yeast at 3g/l	80.46ab	9.56a	64.06c	1.98a	91.33bc	12.14bc
Yeast at 4g/l	84.60ab	10.03a	67.56abc	2.02a	104.33a	12.17ab
Seaweed extract at 3g/l	83.66ab	9.46a	67.5abc	2.03a	97.00ab	12.13bc
Seaweed extract at 4g/l	86.00a	9.86a	70.56a	2.05a	100.66ab	12.16ab
Seaweed extract at 5g/l	87.33a	10.03a	69.83a	2.06a	98.00ab	12.23a
NAA at 0.8g/l	79.60ab	9.53a	68.86ab	1.98a	83.33cd	12.09c
NAA at 1.2g/l	80.83ab	9.73a	68.36ab	1.97a	95.33ab	12.11bc
NAA at 1.6g/l	82.96ab	9.96a	68.9ab	2.01a	104.33a	12.13bc
Season 2014						
Control (water spray)	71.26b	8.93b	64.80b	2.04b	75.20d	11.86d
Yeast at 2g/l	80.50a	9.80a	69.66ab	2.15ab	90.33c	12.04ab
Yeast at 3g/l	82.53a	10.76a	69.7ab	2.15ab	97.66bc	12.05ab
Yeast at 4g/l	85.8a	10.00a	70.73a	2.21a	102abc	12.07ab
Seaweed extract at 3g/l	81.26a	9.46a	68.00ab	2.19a	98.6bc	12.05ab
Seaweed extract at 4g/l	81.46a	10.03a	7186a	2.22a	104.66ab	12.07ab
Seaweed extract at 5g/l	87.16a	10.20a	70.60a	2.19a	101.33abc	12.08a
NAA at 0.8g/l	82.3a	9.76a	70.80a	2.13ab	94.86bc	11.97c
NAA at 1.2g/l	82.46a	10.00a	72.33a	2.18a	106.66ab	12.01bc
NAA at 1.6g/l	82.93a	9.83a	73.06a	2.22a	113.33a	12.02abc

Values having the same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's multiple range test

Yield and its components

All growth stimulants treatments clearly improved the yield and yield components compared with the control treatment in both seasons (Table 5). The highest bulb fresh weight (152.8 and 150.66 g) recorded with application of yeast at 4g/l and seaweed

extract at 5g/l without significant differences between them followed by seaweed extract at 4g/l (141.16 g), yeast at 3g/l (140.2g) and NAA at 1.6g/l (140 g) compared with the lowest value recorded (111.26 g) by control. Regarding to bulb dry weight, plants treated with seaweed extracts at 4g/l and 5g/l gave the highest dry weight (13.23 and 13.23g) in the first season, while seaweed at 5g/l gave the highest value (13.21g) in the second one compared to the lowest values (13.01 and 12.9g) obtained by control treatment in both seasons, respectively.

The highest was length (8 and 8.4 cm) obtained with plants treated with seaweed extracts at 5% compared to untreated plants (control) which recorded the lowest value (7 and 7.6cm). However, plant treated with $5gl^{-1}$ seaweed and 4 gl^{-1} yeast extracts produced the highest bulb diameter (10.26cm) compared with control which had significantly lower value (8.9cm) of bulb diameter than the aforementioned treatments.

All growth stimulants treatments clearly improved the bulbing ratio without significant differences among them compared with the lowest ratio obtained with control treatment in both seasons.

Concerning total yield as ton per feddan ,the maximum yield (17.89 and 18.26 ton/fed.) was produced with seaweed extract at 5 $g.L^{-1}$, followed by yeast extract at 4 $g.L^{-1}$ (16.2 and 16.65ton/fed.) compared with the minimum values (11.58 and 11.76 ton/fed.) obtained with control treatment in the first and second season, respectively. These increases in yield due to seaweed extracts treatments might be attributed to increase the vegetative growth (Table 4) which containing high levels of organic matter, macro and micro i.e., N, Mg, B, S and Mo elements, vitamins and fatty acids (Crouch and Van Staden, 1994). These results were in harmony with those reported by Dogra and Mandradia (2012), El-Miniawy *et al.,* (2014), Ashwini *et al.*,, Hidangmayum and Sharma (2017) and Szczepanek *et al.,* (2017) on onion plants, they found that the highest yield was realized from onion plants treated with Seaweed extract (SE) compared with control. The positive effect of dry yeast is may be attributed to the increase in plant nutrient contents, amino acids, vitamin B and cytokinins (Glick, 1995) and (Fathy and Farid, 1996). Vitamins and amino acids increase the metabolic processes and the levels of endogenous hormones which improvement the growth which reflected in increasing the final bulb weight and yield (Sarhan and Abdullah, 2010). Similar trend of results, as previously, were reported by several scientists for several crops like as, potato plants, Sarhan *et al.,* (2011), on garlic, Shalaby and El-Ramady (2014) and Ahmed (2015) and Shafeek *et al .,* (2015) on onion and turnip plants.

Table (5): Effect of foliar application of yeast, seaweed extracts and NAA on yield and its components of onion plants during 2013/2014 and 2014/2015 seasons

Treatment	Bulb fresh weight (g)	Bulb dry weigh (g)	Bulb length (cm)	Bulb diameter (cm)	Bulbing ratio	Bulb yield (ton/fed.)
Season 2013						
Control (water spray)	111.26d	13.01c	7.00d	9.00b	1.12b	11.58e
Yeast at 2g/l	120.23cd	13.10bc	7.8abc	10.06a	1.28a	13.98d
Yeast at 3g/l	140.2ab	13.14ab	7.9ab	10.16a	1.28a	15.88c
Yeast at 4g/l	152.80a	13.19ab	7.9ab	10.16a	1.27a	16.2bc
Seaweed extract at 3g/l	125.16c	13.19ab	7.76bc	10.00a	1.28a	17.56ab
Seaweed extract at 4g/l	141.16ab	13.23a	7.9ab	10.16a	1.27a	16.81abc
Seaweed extract at 5g/l	150.66a	13.23a	8.00a	10.20a	1.27a	17.89a
NAA at 0.8g/l	120.23cd	13.11bc	7.63c	9.90a	1.29a	12.29e
NAA at 1.2g/l	130.00bc	13.17ab	7.66c	9.83a	1.28a	13.08de
NAA at 1.6g/l	140.00ab	13.21ab	7.73bc	10.13a	1.30a	14.08d
Season 2014						
Control (water spray)	135.63a	12.97e	7.60c	8.90e	1.13b	11.76c
Yeast at 2g/l	109.20a	13.15bcd	8.20ab	9.80cd	1.19a	16.16ab
Yeast at 3g/l	126.16a	13.19abc	8.3ab	10.06abc	1.20a	15.58b
Yeast at 4g/l	139.66a	13.19abc	8.33ab	10.13ab	1.21a	16.65ab
Seaweed extract at 3g/l	117.93a	13.18abc	8.20ab	9.76d	1.18a	16.89ab
Seaweed extract at 4g/l	134.63a	13.20ab	8.30ab	9.96bcd	1.20a	17.62a
Seaweed extract at 5g/l	144.4a	13.21a	8.40a	10.26a	1.22a	18.26a
NAA at 0.8g/l	108.96a	13.11d	8.06b	9.80cd	1.21a	12.16c
NAA at 1.2g/l	112.16a	13.13cd	8.13ab	9.90bcd	1.21a	14.01b
NAA at 1.6g/l	118.50a	13.14bcd	8.16ab	10.03a-d	1.22a	16.04ab

Values having the same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's multiple range test

Chemical constituents

a-N, P,K and carbohydrates content in leaves

The obtained results in Table (6) show that all tested treatments significantly increased N, P and Kas well as total carbohydrates content in leaves during the two growing seasons as compared to the control treatment. Onion plants sprayed with seaweed extract at 4,and 5 g/l and NAA at $1.6gl^{-1}$ clearly showed that the highest significant values of leaf N content without significant differences among them followed by yeast extract at 3 and 4 gl^{-1} . The highest values of leaf P content recorded with seaweed extract at 4 and 5 g/l in the first season and seaweed extracts at 3, 4 and 5g/l and yeast at 3 and 4g/l in the second one.

Seaweed extracts treatment (3, 4 and 5 g/l) and yeast (2, 3 and 4 g/l) significant increased K content without significant differences between them in the first season, but in the second one seaweed extracts at 4 and 5 g/l increased leaf K content. Regarding the enhancement of seaweed extract to N, P and K, seaweed extracts have been found to improve root system which could be influenced by endogenous auxins as well as other compounds in the extracts (Crouch *et al.,* 1992). Seaweed extracts improve nutrient uptake by roots (Crouch *et al.,*

1990), resulting in root systems with improved water and nutrient efficiency, thereby causing enhancement in general plant growth and vigor. Similar results were obtained by Fawzy *et al.,* (2012) on garlic, Shafeek *et al.,* (2015) and Hidangmayum and Sharma (2017) on onion plants. This effect of dry yeast is may be attributed to its high contents of carbohydrates, amino acids, sugars, fatty acids, proteins, hormones, macro and micro- nutrients (Khedr and Farid, 2002). These results are in harmony with those obtained by El-Morsy *et al.* (2011) and Ahmed (2015) on garlic.

Table (6): Effect of foliar application of yeast, seaweed extracts and NAA in leaf N, P and K content and total carbohydrate of onion plants during 2013/2014 and 2014/2015 seasons

Treatment	N (%)	P (%)	K (%)	Total carbohydrate (mg/100g)
Season 2013				
Control (water spray)	1.26b	0.42d	2.19c	1.30e
Yeast at 2g/l	1.46ab	0.50bcd	2.57a	1.54bc
Yeast at 3g/l	1.456ab	0.58abc	2.57a	1.58ab
Yeast at 4g/l	1.43ab	0.58ab	2.50a	1.59ab
Seaweed extract at 3g/l	1.51a	0.57abc	2.61a	1.58ab
Seaweed extract at 4g/l	1.54a	0.60a	2.58a	1.62ab
Seaweed extract at 5g/l	1.51a	0.60a	2.58a	1.65a
NAA at 0.8g/l	1.46ab	0.48cd	2.30bc	1.43d
NAA at 1.2g/l	1.45ab	0.51abcd	2.44ab	1.41d
NAA at 1.6g/l	1.53a	0.52abc	2.45ab	1.48cd
Season 2014				
Control (water spray)	1.36b	0.44c	2.31e	1.37b
Yeast at 2g/l	1.47ab	0.54b	2.53cd	1.48a
Yeast at 3g/l	1.53ab	0.60a	2.55bcd	1.49a
Yeast at 4g/l	1.48ab	0.62a	2.65ab	1.49a
Seaweed extract at 3g/l	1.5ab	0.62a	2.63abc	1.50a
Seaweed extract at 4g/l	1.55a	0.62a	2.68a	1.51a
Seaweed extract at 5g/l	1.55a	0.62a	2.71a	1.53a
NAA at 0.8g/l	1.49ab	0.47c	2.48d	1.45ab
NAA at 1.2g/l	1.51ab	0.49bc	2.45bcd	1.45ab
NAA at 1.6g/l	1.56a	0.49bc	2.56bcd	1.47a

Values having the same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's multiple range test

b- N, P,K and carbohydrates content in bulb

Table (7) displays that bulb N, P and K as well as carbohydrates content responded specifically to seaweed, yeast extracts and NAA. Hence, plants treated with seaweed extracts at4 and 5g/l significant increased N in bulb followed by yeast treatment at 3 and 4g/l comparing to control and NAA treatment at 1.2 g/l which gave the lowest values in this respect. Regarding to bulb P content , the highest value as for this parameter was recorded when onion plants sprayed with 4 or 5 g/l seaweed extracts without significant differences between them followed by NAA treatment at 1.6, 1.2 and 0.8g/l compared with the lowest values obtained with control. The highest values of K and carbohydrates content obtained by seaweed extracts treatment at 5g/l followed by seaweed at 4g/l and yeast at 4g/l compared with untreated plants which gave the lowest values. These results are similar to those obtained by Shafeek *et al.* (2015) Hidangmayum and Sharma (2017) on onion, El-Morsy *et al.* (2011) & Fawzy *et al.* (2012) and Ahmed (2015) on garlic.

Table (7): Effect of foliar application of yeast, seaweed extracts and NAA on bulb N, P, K content and total carbohydrate of onion plants during 2013/2014 and 2014/2015 seasons

Treatment	N (%)	P (%)	K (%)	Total carbohydrate (mg/100g)
Season 2013				
Control (water spray)	1.16b	0.22c	1.01a	1.38f
Yeast at 2g/l	1.20b	0.26bc	0.77a	1.42e
Yeast at 3g/l	1.30a	0.27abc	1.08a	1.43de
Yeast at 4g/l	1.31a	0.25bc	1.11a	1.47bc
Seaweed extract at 3g/l	1.29a	0.25bc	1.09a	1.47bc
Seaweed extract at 4g/l	1.35a	0.33a	1.14a	1.49b
Seaweed extract at 5g/l	1.34a	0.32a	1.16a	1.53a
NAA at 0.8g/l	1.14b	0.28abc	1.05a	1.43de
NAA at 1.2g/l	1.16b	0.29ab	1.07a	1.45cd
NAA at 1.6g/l	1.16b	0.288ab	1.01a	1.48b
Season 2014				
Control (water spray)	1.16c	0.19b	0.92e	1.42b
Yeast at 2g/l	1.23bc	0.25a	0.97cde	1.46ab
Yeast at 3g/l	1.32ab	0.27a	1.02bc	1.48ab
Yeast at 4g/l	1.30ab	0.27a	1.04ab	1.50a
Seaweed extract at 3g/l	1.31ab	0.28a	1.01bcd	1.49a
Seaweed extract at 4g/l	1.39a	0.29a	1.05ab	1.51a
Seaweed extract at 5g/l	1.40a	0.30a	1.08a	1.48ab
NAA at 0.8g/l	1.30ab	0.24ab	0.94e	1.44ab
NAA at 1.2g/l	1.19c	0.25a	0.96de	1.46ab
NAA at 1.6g/l	1.32ab	0.26a	1.01bcd	1.48ab

Values having the same alphabetical letter within each column are not significantly different at the 5% level, according to Duncan's multiple range test

Storability

The weight loss percentage of onion bulbs was gradually increased until 8 months of storage, then, it quickly increased until the end of storage (Figures 1 & 2). Seaweed extracts treatments at 3, 4 and 5g/l had the most obvious effect on bulb weight loss and decay during storage periods compared to the highest percentage of weight loss and decay (Figure 3 & 4) obtained with yeast treatments (2, 3 and5 g/l) and control (untreated bulb)

Generally, it was noticed that plants sprayed with seaweed extracts had better storability of bulbs than other treatments and the control. These results may be due to the stimulatory effect of seaweed extracts on growth parameters (Table 4), which may be reflected on quality and storability of onion bulbs during storage. In addition, natural compounds, including seaweed extracts, possess an antagonistic potential in controlling mould diseases of the fruits (Oros *et al.,* 2003) which significantly reduce fruit diseases and increase the storability(Rizvi and Shameel, 2001).In addition, Seaweed extracts are contain macronutrients i.e. K, P and Ca and micronutrients such as Fe, Zn, Mn and Cu which may be enhancement the storability of crops (Khan *et al*., 2009).These results are in agreement with those obtained by Shalaby and El-Ramady (2014) on garlic and Mahdy (2015) on artichoke plants.

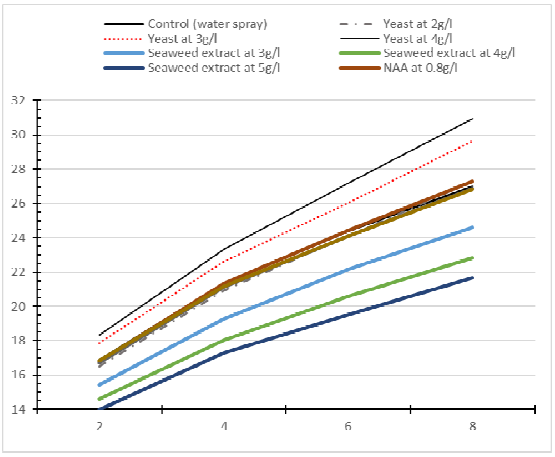

Figure 1: Effect of foliar application of some growth stimulants on weight loss (%) of onion bulbs during 2013/2014 season

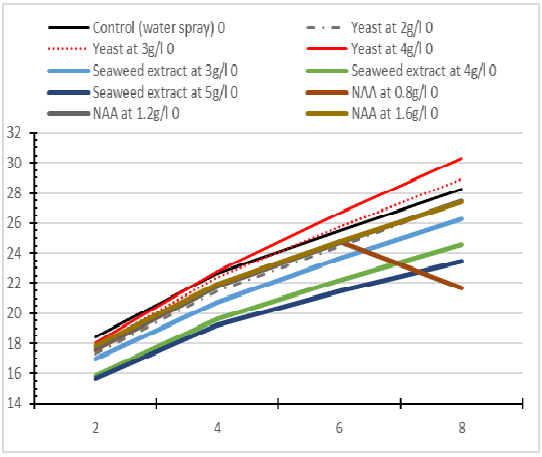

Figure 2: Effect of foliar application of some growth stimulants on weight loss (%) of onion bulbs during 2014/2015 season

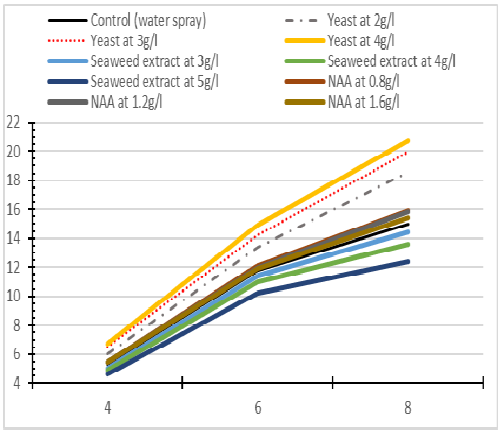

Figure 3: Effect of foliar application of some growth stimulations on decay (%) of onion bulbs during 2013/2014 season

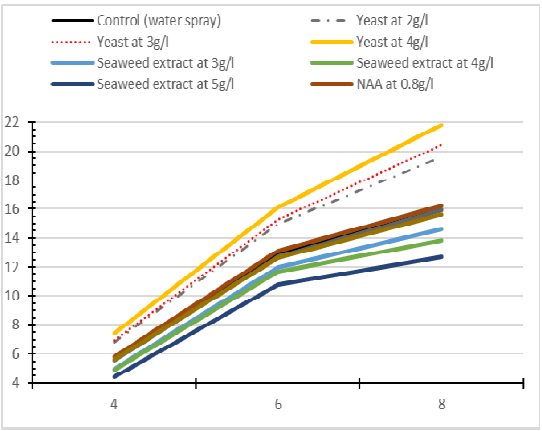

Figure 4:Effect of foliar application of some growth stimulations on decay (%) of onion bulbs during 2014/2015 season

CONCLUSION

From the previous results it could be concluded that the foliar application of seaweed extracts (4 and 5g.L^{-1}) and yeast (3 and 4 g.L^{-1}) can be used to enhance yield, quality and storability of onion plants grown in clay soil.

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تأثير بعض منشطات النمو على النمو والمحصول والقدرة التخزنية لنبات البصل

محمد السيد محمد احمد[1] و أحمد ابو اليزيد حافظ[2] و عاصم عبد المجيد العربى[1] و عبد الوهاب عيد شرف[1]

1. قسم البساتين كلية الزراعة جامعة طنطا
2. قسم البساتين كلية الزراعة جامعة عين شمس

يعد تحسين النمو والجودة وزيادة محصول نباتات البصل أهدافًا مهمة للمزارعين لتحقيق متطلبات السوق والمستهلكين لذلك أجريت تجربتان حقليتان خلال موسمين متتاليين. 2013و 2014 -2014 و 2015 في مزرعة خاصة في قرية الأبشيط- منطقة المحلة الكبرى ، محافظة الغربية ، مصر لدراسة تأثيرالرش الورقى ببعض المنشطات الحيوية بمعدلات مختلفة مثل مستخلص الخميرة (2و3و4 جم/ لتر) و مستخلص الطحالب البحرية (5,4,3 جم/ لتر) NAA (0.8و 1.2 و1.6 جم/ لتر) على صفات النمو ، المحصول و مكونات المحصول والمحتويات الكيميائية لنباتات البصلصنف .الجيزة الاحمرحيث تم الرش الورقي لمنشطات النمو ثلاث مرات بعد 45 و 60 و 75 يومًا من الشتل وقد أظهرت النتائج أن الرش الورقي لمستخلص الطحالب البحرية بمعدل 4 أو 5 جم / لتر و مستخلص الخميرة بمعدل4 جم / لتر كان له التأثير الأكبر على صفات النموالخضرى (ارتفاع النبات عدد الاوراق الوزن الطازج للاوراق) و محصول البصل الكلي ومكوناته وكذلك محتوى النيتروجين والفسفور والبوتاسيوم فى أنسجة البصلة. أظهرالرش بمستخلص الطحالب البحرية (5 جم / لتر) أقل نسبة فى فقد الوزن عفن الابصال مقارنة بمعاملة الكنترول والمعاملات الأخرى. فى النهاية يمكن التوصية برش نباتات البصل المنزرعة تحت ظروف الاراضى االطينية بمستخلص الطحالب البحرية بتركيز 4 او 5 جرام / لتر وكذلك الرش بالخميرة بتركيز 3 او 4 جم / اللتر لتحسين نمو وانتاجية وجودة والقدرة التخزينية للبصل.