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Foliar Spray with Some Growth Stimulants for Improving Growth, Productivity, Antioxidant Enzymes and Storability of Onion Plants

Ahmed Abdel-Wahab[1], Mahmoud A. M. Fahmy[2], Moustafa A. Aboel-Ainin[3] and Ghada A. Tawfic[1]

[1]Department of Vegetable Crops, Faculty of Agriculture, Cairo University, Giza, Egypt.
[2]Department of Horticulture, Faculty of Agriculture, Beni-Suef University, Egypt.
[3]Department of Agricultural Biochemistry, Faculty of Agriculture, Beni-Suef University, Egypt.

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Corresponding author:
Mohamed, Mahmoud

Email:
mahmoud.abdelhamed@agr.bsu.edu.eg

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ABSTRACT

One of the most important elements that enhances plant growth, productivity, and development is the integrated the supply of nutrients and growth stimulants in the proper amounts and ratios. Two field experiments were carried out during seasons of 2021/2022 and 2022/2023 at Eastern Experimental Field, Vegetable Crops Department, Faculty of Agriculture, Cairo University, Giza, Egypt to investigate the effects of foliar spray of 6 growth stimulants treatments, humic acid, amino acids, algae extract, micro-elements mixture, moringa extract and ascorbic acid, on growth, productivity, chemical composition and storability of onion plants (Giza 20). This experiment was done in a randomized complete block design with 3 replicates. The results indicated that foliar spray of all growth stimulants exhausted a significant improvement of onion plant height, number of leaves, bulb diameter, neck diameter, total yield, TSS% after one month of storage, activity of antioxidant enzymes, ascorbic acid and total phenolic in both seasons, as compared with control and spraying with humic acid and ascorbic acid gave the highest total yield / feddan. The highest values of average bulb weight were found with foliar spray of humic acid and amino acid in both seasons. Using humic acid in both seasons or amino acids and micro elements treatments in the first season significantly decreased weight loss%, compared to control.

KEYWORDS: onion, humic acid, amino acids, algae extract, moringa extract, yield, keeping quality, antioxidant enzymes

1. INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important vegetable crops grown in Egypt for export, processing, and consumption. The total cultivated area of onion in Egypt was 234727 feddan in2020/2021 (FAO, 2021). Onions are now known as one of the primary sources of hard currency. . Onions also contain a variety of active chemicals that help prevent cardiovascular disease. Fertilisation is one of the key techniques for raising onion bulb yield as well as improving quality and storage capacity. On the other hand, the shallow and unbranched root system of onion plants makes them more susceptible to nutrient deficiencies than most other crop plants (Brewester, 1994). In order to produce onions, the soil must be properly fertile. The amount of nutrients needed depends on the soil type, genotype, and location. Onion bulbs become more susceptible to infections during storage when there is too much nitrogen present. In this regard, the method of foliar spraying with various nutrients or growth stimulants presents excellent chances to increase their efficacy, save expenses, and reduce damage to the environment, all the while ensuring high yields (Khalil, et al. 2008). According to Atiyeh et al. (2002), applying humic acid as a foliar spray encourages plant growth and development in this way. and increases the growth and yields of a variety of vegetables (Zandonadi et al., 2007).The absorption of nutrients by vegetable crops is improved by humic acid (Cimrin and Yilmaz, 2005; Zandonadi et al., 2007), among other advantages for plants regulating hormone levels while acting as growth regulators, enhancing photosynthesis and cell elongation (Serenella et al., 2002), and enhancing soil physical properties. According to the studies of Tantawy et al. (2009) applying amino acids to the leaves of numerous crops cultivated in sparsely fertile soils has been proven to be an effective method of promoting their growth. Furthermore, amino acids are organic nitrogenous compounds that are widely known to function as precursors in the synthesis of proteins. Sarojnee et al. (2009) state that amino acids can improve fertiliser assimilation, improve nitrogen and water uptake, raise photosynthetic rate and dry matter partitioning, and increase yield and quality. Several researchers indicated that applying amino acids directly could enhance the quality, fruit yield, and plant growth of green beans (Abdel-Mawgoud et al., 2011), potatoes (Awad et al. 2007), cucumbers (Kamar and Omar 1987), and garlic (El-Shabasi et al. 2005). Furthermore, according to Pratelli and Pilot (2007), amino acids are necessary for the synthesis of amines, purines, pyrimidines, alkaloids, vitamins, enzymes, terpenoids, and other chemicals. Additionally, Fawzy et al. (2012) found that when seaweed extract was sprayed foliarly on Chinese garlic and onion plants, respectively, the highest values of vegetative growth, yield, and its quality were obtained. Nowadays, the overuse of artificial fertilizers can be decreased by applying various natural stimulating materials, such as algal extract, topically, because these agrochemicals' foliar sprays can enhance dry matter formation and flowering (Milledge, et al., 2016). Rinku et al. (2017) claim that seaweed is an excellent provider of the macro- and micronutrients required for plant nutrition. Vegetable quality can be improved and soil conditioners such as seaweed extract are effective. It is well recognised that micronutrients operate as catalysts to promote a variety of organic reactions in plants, therefore enhancing the chemical structure and general health of vegetable crops (Karthick et al., 2018). Micronutrients are essential for plant development, growth, and metabolism. However, their absence may result in a variety of physiological issues or diseases in plants, which may subsequently result in a decrease in both the number and quality of vegetable crops (Sharma and Kumar, 2016). Moringa leaf extract is also seen to be a viable option and may potentially be used in addition to inorganic fertilizers growth hormones and enough micronutrients are present in moringa leaf extract, which helps a range of crops develop and produce more of their various yield-related components (Muhammed et al., 2013). More research have revealed that moringa leaf extract is regarded as a natural biostimulant that has a significant role in enhancing plant drought resistance (Abd El-Mageed et al., 2017).

Ascorbic acid is a little antioxidant molecule water soluble. According to Pastori et al. (2003), it serves as the human body's primary source of vitamin C by lowering oxygen free radicals. The non-enzymatic complex, ascorbic acid, enables plants to fight themselves against stressors (Shafiq et al., 2014). All living plant cells contain it, although the flowers, leaves, and other actively growing sections typically contain the greatest concentrations (Smirnoff et al., 2001). Usually found scattered throughout the plant's cytoplasm. Additionally, plants with low ascorbate production are more vulnerable to environmental challenges, which can negatively affect their ability to grow and develop (Ahmad et al., 2014).

After harvest, onion bulbs must be stored in order to preserve their availability throughout the off-season. Due to their ability to lose weight, deteriorate quickly, and sprout after harvest, many onion cultivars didn't store well in ambient storage (Obiadalla-Ali et al., 2016). The aim of this study was to investigate the foliar application of some growth stimulants treatment on growth, productivity and storability of onion plants.

2. MATERIALS AND METHODS

2.1. The Experimental Location and Plant Materials

The current study was conducted from December to May in the two consecutive seasons of 2021–2022 and 2022–2023 at the Eastern Experimental Field, Vegetable Crops Department, Faculty of Agriculture, Cairo University, Giza, Egypt (30°1′10″ N and 30°11′5″ E), to examine the effects of six growth stimulant treatments compared to control. Such as: 1- humic acid, (Hammer, Arabian Group for Agriculture Service (AGAS) Co. Egypt) (Hammer composition, humate potassium 86% and potassium oxide 6%), 2- amino acids, (Amino power, AGAS Co.) (Amino power composition, free amino acids, citric acid 3%, potassium oxide 3.5% L-Amino acids), 3- algae extract (trade compound, namely Oligo-X, produced by UAD CO.), 4- micro-elements mixture (Zn 1.5%, Mn 2%, Fe 3%, Cu 1%, Mg O 4% and B 0.5%), 5- moringa extract (Prepared according to Khan et al., 2017) and 6- ascorbic acid (Fooding Group limited Company) on onion growth, productivity, chemical composition and storage-ability. The Seeds of onion (Giza 20) cultivar were purchased from Agricultural Research Centre, Ministry of Agriculture, Giza, Egypt. Soil of the experiment is clay in texture.

2.2. Field Experiments

In the first week of December of both the 2021–2022 and 2022–2023 seasons, uniform onion seedlings cv. Giza 20, measuring 20 cm in height, were transplanted on the experimental field at the Vegetable Crops Department, Faculty of Agriculture, Cairo University, Giza, Egypt. On either side of ridges of 70 cm in width, 5 m in length, and 10 cm apart, seedlings were placed under drip irrigation. A total of five ridges with area 17.5 m2 were present in every experimental plot. This experiment included 7 treatments in a randomized complete block design (RCBD) with three replicates of each treatment were employed. Treatments with foliar spray were initiated 15 days after planting and continued for 3 months. The foliar spray were applied once a month to plants by humic acid (0.3 g/l), amino acids (3 ml/l), algae extract (0.5 ml/l), micro-elements mixture (1.25 g/l), moringa extract (3%) and ascorbic acid (2g/l). All agricultural practices of weed control as well as irrigation, fertilization program (90 kg N, 45 kg P_2O_5 and 30 kg K_2O) and pest control were applied according to recommendations of Egyptian Ministry of agriculture for onion production.

2.3. Data recorded

2.3.1. Plant Growth

Five plants were taken from the third row in each experimental plot after 100 days after planting to measure plant height, number of leaves, bulb diameter and neck diameter.

2.3.2. Antioxidant Enzymes, Ascorbic Acid and Total Phenolic Compounds

The onion leaf samples were prepared using the method described by Volk and Feierabend, (1989) to estimate the activity of catalase (CAT). Also, the method described by Beauchamp and Fridovich, (1971) was employed to estimate the activity of Superoxide Dismutase

(SOD).Peroxidase (POD) enzyme activity was measured as described by Xu et al., (2011). Ascorbic acid (Vitamin C) was extracted as described by Sadasivam and Balasubraminan (1987), was used for determination of ascorbic acid concentration in onion juice. All determinations were performed in triplicates and the mean values were recorded. Total leaf phenolic was determined by Ainsworth and Gillespie (2007), using the reaction with Folin Ciocalteu reagent using the gallic acid as internal standard. The TPC of samples were expressed in mg gallic acid equivalence (GAE).

2.3.3. Mineral Content in onion Leaves

N, P, K, Ca and Na nutrients of onion leaves were measured, 100 days after transplanting. Nitrogen was measured by the modified "Micro Kjeldahl" apparatus of Parnas and Wagner as described by Pregl (1945). Phosphorus was determined spectrophotometricallyas descibed according to AOAC (1975). Potassium was determined as described by Brown and Lilliland (1964). Calcium (Ca) and sodium (Na) contents were measured by Atomic Absorption Spectrophotometer (Pye Unicam, model SP-1900, Cambridge, UK) with air-acetylene fuel according to Helrich (1990).

2.3.4. Yield and Its Components

When the plants were judged to be mature, after 6 months from planting, all plants were harvested. Thereafter, total yield ton/fed were calculated. In addition, five bulbs from each plot selected to determine the mean bulb weight.

2.3.5. Keeping quality

The harvest bulbs were subjected to the curing process for 15 days, then high quality bulbs selected. Bulbs were weighed and stored in plastic nets in common storage for 60 days at room temperature (from the mid of June to the mid of August). Twenty one plastic nets, each 2kg weight, represented all treatments. Three nets from each treatment were taken every 30 days to record percentage of weight loss and percentage of total soluble solids, estimated at harvest and also every 30 days during storage, in the central part of the bulb by using Zeiss Laboratory Refractometer.

2.4. Statistical Analysis

The experimental data was statistically analysed using ANOVA techniques and CoStat software. The MSTAT-C v. 2.1 (Michigan State University, Michigan, USA) was utilised to compare the treatment means using the least significant difference (L.S.D.) test, as provided by Snedecor and Cochran (1976).

3. RESULTS

3.1. Plant Growth and Bulb Traits of Onion Plants

In both seasons, the effect of foliar spraying certain growth stimulators on onion plants was investigated. In comparison to the control, all treatments considerably increased the height of the onion plants, the number of leaves, the diameter of the bulbs, and the diameter of the necks in both seasons, as indicated by the data in Table 1. In general, the application of algal extract resulted in the highest values of plant height, whereas the use of moringa extract in foliar spraying produced greater values of bulb diameter and leaf count. The highest value of neck diameter was also obtained when humic acid was used.

3.2. Antioxidant Enzymes (Catalase (CAT), Superoxide Dismutase (SOD), Peroxidase (POD)), Ascorbic Acid and Total Phenolic Compounds in Onion leaves

Data in Table 2 showed that all growth stimulators significantly increased ascorbic acid and total phenolic compounds in onion leaves in both seasons, as compared to control plants. Generally, foliar applications of amino acids recorded the highest values of CAT, SOD and POD enzymes as well as total phenolic compounds in onion leaves in both seasons, whereas ascorbic acid concentration was higher when onion plants were treated by foliar applications of amino acids or ascorbic acid in both seasons, compared to control.

Table 1. Effect of some growth stimulants on plant growth of onion at 100 days after transplanting during 2021/2022 and 2022/2023 seasons.

Treatment	Plant high (cm)		No. of leaves		Bulb diameter (cm)		Neck diameter (cm)	
	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season
Humic acid	61.33	63.47	9.33	11.07	5.50	5.94	1.33	1.47
Amino acids	58.13	60.67	8.87	10.33	4.90	5.43	0.60	0.80
Algae Extract	64.67	73.33	8.33	9.67	4.96	6.00	0.50	0.74
Micronutrients	58.33	62.87	8.27	9.33	4.90	5.73	0.89	1.07
Moringa Extract	61.33	64.67	9.67	11.13	5.61	6.07	0.57	0.83
Ascorbic acid	56.80	60.00	8.27	9.33	5.03	5.53	0.60	0.88
Control	45.87	49.33	6.33	7.67	2.78	3.90	0.13	0.35
LSD 0.05	2.49	3.96	0.48	1.07	0.32	0.56	0.14	0.19

Table 2. Effect of some growth stimulants on activity of antioxidant enzyme (Catalase, CAT, Superoxide Dismutase, SOD and Peroxidase, POD), ascorbic acid and total phenolic of onion leaves at 100 days after transplanting during 2021/2022 and 2022/2023 seasons.

Treatment	CAT Enzyme Activity (mkat/g)		SOD Enzyme Activity (units/g)		POD Enzyme Activity (mkat/g)		Ascorbic Acid (mg/100g FW)		Total Phenolic Compounds (mg/g FW)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Humic acid	1.79	1.68	79.40	75.43	43.20	40.61	8.95	8.41	57.95	54.47
Amino acids	1.89	1.81	93.20	88.83	51.20	49.15	9.45	9.07	71.25	68.40
Algae Extract	1.83	1.74	83..20	79.87	49.50	47.03	9.05	8.60	63.65	60.47
Micronutrients	1.69	1.55	67.20	61.82	29.10	26.48	7.85	7.14	53.55	48.73
Moringa Extract	1.75	1.63	75.30	70.78	39.40	36.64	8.75	8.14	55.75	51.85
Ascorbic acid	1.72	1.58	72.10	67.05	32.50	29.90	9.55	8.79	69.35	63.80
Control	1.55	1.40	63.20	56.88	25.20	22.68	7.50	6.75	48.25	43.43
LSD 0.05	0.14	0.18	1.90	1.74	1.74	1.74	0.16	0.18	1.40	1.78

3.3. Mineral Content in Onion Leaves

The results in Table 3 show that all treatments, except the treatment of moringa extract in the case of N% in the first season, had a significant improvement in nutrient concentrations such as nitrogen, phosphorus, potassium, and sodium in leaves of onion in both seasons. On the other hand, only using amino acids or ascorbic acid as a foliar applications gave a significant increment of calcium in the leaves of onion, compared with the control. Clearly, plants were treated by amino acids experienced a marked increase in all nutrient concentrations of onion leaves in both seasons, followed by ascorbic acid treatment in the case of P, K and Ca concentrations and algae extract treatment in the case of N and K concentrations in both seasons.

3.4. Total Yield and its Components

Data in Table 4 illustrate that onion plants that sprayed by the all growth stimulators had a significant excess of onion total yield, compared to control plants. On the other hand, onion plants that were treated by humic acid and amino acid in both seasons or were treated by micro-elements or moringa extract in the first seasons or ascorbic acid in the second season showed a significant improvement of average bulb weight, compared to control. Generally, onion total yield and mean bulb weight were higher with humic

Table 3. Effect of some growth stimulants on nitrogen (N), phosphorus (P), potassium (K), calcium (Ca) and sodium (Na) concentrations of onion leaves at 100 days after transplanting during 2021/2022 and 2022/2023 seasons.

Treatment	N (%)		P (%)		K (%)		Ca (%)		Na (ppm)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Humic acid	2.55	2.40	57.85	57.27	149.00	146.00	0.08	0.07	4.55	4.32
Amino acids	2.93	2.81	73.05	71.59	177.00	173.50	1.07	1.03	5.65	5.37
Algae Extract	2.85	2.71	63.65	62.38	169.00	165.60	0.07	0.07	4.75	4.51
Micronutrients	2.74	2.49	53.55	51.41	140.00	137.20	0.06	0.06	4.05	3.85
Moringa Extract	2.53	2.35	55.25	54.15	143.00	140.10	0.08	0.08	4.25	4.04
Ascorbic acid	2.79	2.57	71.75	69.60	175.00	171.50	1.05	1.01	5.35	5.08
Control	2.41	2.17	50.75	48.21	130.00	127.40	0.04	0.04	3.85	3.66
LSD 0.05	0.17	0.14	1.78	1.38	13.45	12.23	0.06	0.06	0.16	0.12

Table 4. Effect of some growth stimulants on average bulb weight and total yield of onion during 2021/2022 and 2022/2023 seasons.

Treatment	Average weight of Bulb (g)		Total yield(ton/fed)	
	1st Season	2nd Season	1st Season	2nd Season
Humic acid	193.30	198.30	14.280	15.020
Amino acids	163.00	172.30	11.410	14.000
Algae Extract	128.60	146.80	10.150	11.200
Micronutrients	146.40	150.00	11.760	12.600
Moringa Extract	139.00	142.00	12.600	13.630
Ascorbic acid	132.50	159.80	13.820	14.630
Control	128.10	127.30	8.190	8.873
LSD 0.05	8.99	25.95	0.159	0.727

application than the other treatments in both season.

3.5 storability

3.5.1 TSS and Weight Loss Percentages of Onion Bulbs

Table 5 showed that at harvest, except using moringa extract in the second season, all treatments in the two seasons significantly increased TSS %, compared to control. After one month from storage, TSS% significantly increased with all growth stimulators, as compared with control. On the contrary, in the second month of storage, only using ascorbic acid in the first season did not change the percentage of TSS of onion bulbs, compared to control even though all the treatments gave a significant increment of TSS%. Generally, using foliar spray with amino acids showed the highest percentage of TSS in the two seasons. In the respect of weight loss percentage as shown in Table 3, except using moringa extract that significantly increased weight loss% in the first season, there no different significant were observed between all treatment and control on weight loss percentage in both seasons, one month after storage. In contradiction, using humic acid in both seasons or amino acids and micro elements treatments in the first season as foliar applications on onion plants gave a significant reduction of weight loss%, compared to umtreated plants.

Table 5. Effect of some growth stimulants on onion TSS and weight loss percentages at 30 and 60 days of storage during 2021/2022 and 2022/2023 seasons.

Treatment	TSS at harvest (%)		TSS, 30 days (%)		TSS, 60 days (%)		Weight loss, 30 days (%)		Weight loss, 60 days (%)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Humic acid	14.13	14.80	14.30	15.07	14.70	15.23	5.07	3.34	11.09	10.02
Amino acids	15.43	16.25	15.63	16.73	15.83	16.97	3.91	4.27	14.02	15.72
Algae Extract	14.27	14.67	15.37	15.53	16.50	16.93	8.51	5.83	23.53	19.59
Micronutrients	12.90	14.93	14.20	16.10	15.33	16.57	6.56	5.56	20.76	18.89
Moringa Extract	12.13	13.40	13.00	14.67	14.23	15.17	11.51	4.94	26.71	19.15
Ascorbic acid	13.40	14.17	13.70	14.67	14.07	14.97	4.65	3.98	21.98	16.40
Control	11.37	13.10	12.43	13.93	13.63	14.50	5.55	5.55	25.75	20.03
LSD 0.05	0.70	0.66	0.46	0.54	0.49	0.33	5.05	N.S.	4.62	5.45

4. DISCUSSION

Onions' shallow, unbranched root system makes them more susceptible to nitrogen shortages than other crop plants. During the growth stages of onion plants, this sensitivity to nutrient deficit might have a negative impact on the plants' quality, productivity, growth, and storage capacity (Brewester, 1994). Based on our observations, all foliar application treatments (humic acid, amino acids, algae extract, micro-elements, moringa extract and ascorbic acid) have the potential to enhance onion yield and plant growth characteristics in both seasons, as compared with control (Tables 1 and 4). In this respect, algae extract treatment achieved the highest value of plant height, whereas the highest values of number of leaves and bulb diameter were achieved with the foliar spray by moringa extract. Also, using humic acid gave the highest value of neck diameter. These results may be attributed to the ability of all growth stimulators treatments to increase enzymes activity (Table 2) and nutrients absorption (Table 3) during the growth season. Our findings are strongly supported by those of Zandonadi et al., (2007) when humic acids added to plants; Sarojnee et al. (2009) when plants treated by amino acids; Abd El-Mageed et al., (2017) when plants applied by moring extract; Fawzy et al. (2012) when algae extract used; Sharma and Kumar (2016) when plants sprayed by micro-elements; Shafiq et al., (2014) when plants sprayed by ascorbic acid.

The findings also illustrated that the total yield of onion was higher when plants were treated by humic acid than the other treatments in both seasons. These results return to increasing the bulb weight those obtained from plots treated by humic acid (193.30 and 198.30 g), compared to the other treatment (Table 4). These results are in agreement with those found by Atiyeh et al., (2002) and Zandonadi et al., (2007).

The reduction of weight loss percentage and increasing TSS % in onion bulbs with using the growth stimulators (Table 5), especially amino acids, humic acid and micro-elements, may be attributed to the improving of elements uptake especially potassium (Table 3) that play an essential role in increasing the quality and storage-ability of onion bulbs (El-Sayed et al., 2005). The increase in TSS content in onion bulbs after the foliar application of micronutrients or other growth stimulators may also be the result of increased metabolic activities that involve the formation of total soluble solid, such as carbohydrates, amino acids, organic acids, and other inorganic constituents (Ballabh et al., 2013). In contrast, the better activity of CAT, SOD and POD enzymes, or the increasing of ascorbic acid and total phenolic as well as increasing nutrients in onion leaves with using growth stimulators, as compared to control plants may be comeback to promoting nutrients uptake (Table 3) or because of it contains organic compounds (Begum et al., 2018) that increasing physiological activities in the synthesis of essential substances like carbohydrates, proteins, enzymes and acids. These results are in agreement with those observed by El-Shabasi et al. (2005); Awad et al. (2007); ; Almaroai and Eissa (2020); El-Sayed et al. (2022).

5. CONCLUSION

Using foliar spray of growth stimulants on onion plants are an acceptable method to improve productivity and antioxidant enzymes as well as it may play an essential role for decreasing weight loss percentage during storage.

6. REFERENCES

Abd El-Mageed TA, Semida WM and Rady MM (2017). Moringa leaf extract as bio stimulant improves water use efficiency, physio-biochemical attributes of squash plants under deficit irrigation. Agricultural Water Management, 193: 46–54.

Abdel-Mawgoud AMR, El-Bassiouny AM, Ghoname A and Abou-Hussein SD (2011). Foliar application of amino acids and micronutrients enhance performance of green bean crop under newly reclaimed land conditions. Australian Journal of Basic and Applied Sciences, 5(6): 51-55.

Ahmad I, Basra SMA and Wahid A (2014). Exogenous application of ascorbic acid, salicylic acid, hydrogen peroxide improves the productivity of hybrid maize at low temperature stress. Int. J. Agric. Biol. 16, 825–830.

Ainsworth EA and Gillespie KM (2007). Estimation of total phenolic content and other oxidation substrates in plant tissues using Folin-Ciocalteu reagent. Nat. Protoc. 2, 875–877.

Almaroai Y and Eissa MA (2020). Role of Marine Algae Extracts in Water Stress Resistance of Onion Under Semiarid Conditions. Journal of Soil Science and Plant Nutrition, 20:1092–1101.

AOAC (1975). Official methods of analysis of the Association of Official Analysis Chemists, 12th ed., Association of Official Analytical Chemists, Washington. C. 200044.

Atiyeh RM, Lee S, Edwards CA, Arancon NQ and Metzger JD (2002). The influence of humic acids derived from earthworm-processed organic wastes on plant growth. Bioresource Technology, 84: 7-14.

Awad EM, Abd El-Hameed AM and El-Shall ZS (2007). Effect of glycine, lysine and nitrogen fertilizer rates on growth, yield and chemical composition of potato. J. Agric. Sci. Mansoura Univ., 32 (10): 8541 – 8551.

Ballabh K, Rana DK and Rawat SS (2013). Effects of foliar application of micronutrients on growth, yield & quality of onion. Indian J. of Hort., 70(2): 260 – 265.

Beauchamp C and Fridovich I (1971). Superoxide Dismutase: Improved Assays and an Assay Applicable to Acrylamide Gels. Analytical Biochemistry, 44, 276-287. http://dx.doi.org/10.1016/0003-2697(71)90370-8

Begum M, Bordoloi BC, Singha DD and Ojha NJ (2018). Role of seaweed extract on growth, yield, and quality of some agricultural crops: A review. Agricultural Reviews, 39(4): 321-326.

Brewester JL (1994). Onions and other vegetable Alliums.CABInternational,Wallingford,UK,p. 36.

Brown JD and Lilliland O (1964). Rapid determination of potassium and sodium in plant materials and soil extracts by flame photometer. In Proceedings of the Society for Horticultural Science, vol. 48, pp. 341 – 346.

Cimrin KM and Yilmaz I (2005). Humic acid applications to lettuce do not improve yield but do improve phosphorus availability. Acta Agriculturae Scandinavica, Section B, Soil and Plant, 55: 58 - 63.

El-Sayed SF, Abdel-Wahab A and El-Taweel HH (2022). The potential of some ameliorative substances in improving growth, yield and quality of carrot under heat stress conditions. Journal of Applied Horticulture, 24(3): 282-289.

El-Sayed SF, Shahein MM and Abdel-Wahab A (2005). Effect of fertilization and weed control on production and storageability of garlic. Annals of Agricultural Science, Moshtohor. 43 (4): 1855-1872.

El-Shabasi MS, Mohamed SM and Mahfouz SA (2005). Effect of foliar spray with some amino acids on growth, yield and chemical composition of garlic plants. The 6th Arabian Conf. for Hort., Ismailia, Egypt.

Fao (2021). Statistics at FAO. Available online: www.fao.org.

Fawzy ZF, El-Shal ZS, Yunsheng L, Zhu O and Sawan OM (2012). Response of garlic (*Allium Sativum*,L.) plants to foliar spraying of some bioStimulants under sandy soil condition. Journal of Applied Sciences Research, 8(2): 770-776.

Helrich K (1990). Method 988.05. Official Methods of Analysis, 15th Edition, The Association of Official Analytical Chemists Inc., Arlington.

Howladar SM (2014). A novel Moringa oleifera leaf extract can mitigate the stress effects of salinity and cadmium in bean (*Phaseolus vulgaris* L.) plants. Ecotoxicology and Environmental Safety, 100, 69–75.

Kamar ME and Omar A (1987). Effect of nitrogen levels and spraying with aminol – forte (amino acids solution) on yield of cucumber and potatoes. J. Agric. Sci. Mansoura Univ., 12 (4): 900-907.

Karthick R, Rajalingam GV, Praneetha S, Sujatha KB and Arumugam T (2018). Studies on the influence of micronutrients on yield, quality and economics of bitter gourd (*Momordica charantia*) cv. CO 1. International Journal of Chemical Studies, 6(2): 678-681.

Khalil AA, Osman EAM and Zahran FAF (2008). Effect of amino acids and micronutrients foliar application on onion growth, yield and its components and chemical characteristics. J. Agric. Sci. Mansoura Univ., 33 (4): 3143 – 3150.

Khan S, Basra SMA, Afzal I and Wahid A (2017). Screening of moringa landraces for leaf extract as biostimulant in wheat. Int. J. Agric. Biol. 19, 999–1006. https://doi.org/10.17957/IJAB/15.0372.

Milledge JJ, Nielsen BV and Bailey D (2016). High-value products from macroalgae: the potential uses of the invasive brown seaweed, Sargassum muticum. Rev Environ Sci Biotechnol, 6:28–36. DOI 10.1007/s11157-015-9381-7

Muhammed R, Olorukooba MM, Akinyaju JA and Kambai EA (2013). Evaluation of different concentrations and frequency of foliar application of moringa extract on growth & yield of onion, (*Allium cepa* L). Agrosearch, 13(3): 196-205.

Obiadalla-Ali HA, El-Shaikh KAA and Sedra AZ (2016). Effect of foliar trace elements application, Potassium Fertilization and storage methods on the characteristics of storage ability of three onion (*Allium cepa* L.) cultivars under Sohag conditions. American-Eurasian J. Agric. & Environ. Sci., 16 (7): 1304-1320.

Pastori GM, Kiddle G, Antoniw J, Bernard S, Veljovic Jovanovic S and Verrier PJ (2003). Leaf vitamin C contents modulate plant defense transcripts and regulate genes controlling development through hormone signalling. Plant Cell15, 1212–1226. 10.1105/tpc.010538

Pratelli R and Pilot G (2007). Altered amino acid metabolism in glutamine dumper1 plants. Plant Signal. Behav.2 182–184. 10.4161/psb.2.3.3972

Pregl F (1945). Quantitative-organic Micro-analysis. 4th ed., London : J. and A. Churchill Ltd.

Rinku VP, Pandya KY, Jasrai RT and Brahmbhatt N (2017). A Review : Scope of utilizing seaweed as a Bifertilizer in agriculture. Int. J. Adv. Res. 5(7), 20462054.

Sadasivam S and Balasubramanian T (1987) Practical Manual in Biochemistry. Tamil Nadu Agricultural University, Coimbatore, India, 14.

Sarojnee DY, Navindra B and Chandrabose S (2009). Effect of naturally occurring amino acid stimulants on the growth and yield of hot peppers (*Capsicum annum* L.). Journal of Animal & Plant Sciences, 5(1): 414-424.

Serenella N, Pizzeghelloa D, Muscolob A and Vianello A (2002). Physiological effects of humic substances on higher plants. Soil Biol. & Biochemi., 34: 1527-1536.

Shafiq S, Akram NA, Ashraf M and Arshad A (2014). Synergistic effects of drought and ascorbic acid on growth, mineral nutrients and oxidative defense system in canola (*Brassica napus* L.) plants. Acta Physiol. Plant 36, 1539–1553. 10.1007/s11738-014-1530-z

Sharma U and Kumar P (2016). Extent of deficiency, crop responses and future challenges. International Journal of Advanced Research, 4(4):1402-1406.

Smirnoff N, Conklin PL and Loewus FA (2001). Biosynthesis of ascorbic acid in plants: a renaissance. Annu. Rev. Plant Physiol. Plant Mol. Biol. 52:437. 10.1146/annurev.arplant.52.1.437

Snedecor GA and Cochran WG (1976). Statistical Method. Iowa State Univ. Press, Ames.

Tantawy AS, Abdel-Mawgoud AMR, El-Nemr MA and Ghorra Chamoun Y (2009). Alleviation of salinity effects on tomato plants by application of amino acids and growth regulators. European Journal of Scientific Research, 30 :(3), 484-494.

Volk S and Feirabend J (1989). Photo inactivation of catalase at low temperature and its relevance to photosynthetic and peroxide metabolism in leaves. Plant Cell.Env.12, 701–712.

Xu HW, Lu Y, Tong SY and Song FB (2011). Lipid peroxidation, antioxidant enzyme activity and osmotic adjustment changes in husk leaves of maize in black soils region of Northeast China. Afr. J. Agric. Res. 6, 3098–3102.

Zandonadi DB, Canellas LP and Facanha AR (2007). Indolacetic and humic acids induce lateral root development through a concerted plasmalemma and tonoplast H+ pumps activation. Planta, 225 (6): 15831595.

الملخص العربى

الرش الورقي ببعض محفزات النمو لتحسين النمو والإنتاجية والأنزيمات المضادة للأكسدة والقدرة التخزينية لنباتات البصل

أحمد عبد الوهاب[١]، محمود عبدالحميد محمد فهمي[٢] و مصطفى أبو العينين مصطفي[٣] و غادة أحمد توفيق[١]

[١] قسم الخضر، كلية الزراعة، جامعة القاهرة، مصر.

[٢] قسم البساتين، كلية الزراعة، جامعة بني سويف، مصر.

[٣] قسم الكيمياء الحيوية، كلية الزراعة، جامعة بني سويف، مصر.

من أهم العناصر التي تحسن من نمو النبات وإنتاجيته وتطوره هو تكامل الإمداد بالعناصر الغذائية ومحفزات النمو بالكميات والنسب المناسبة. أجريت تجربتان حقليتان خلال موسمي ٢٠٢١/٢٠٢٢ و٢٠٢٢/٢٠٢٣ بالمزرعة الشرقية لقسم محاصيل الخضر – كلية الزراعة – جامعة القاهرة، الجيزة، مصر لدراسة تأثير الرش الورقي بـ ٦ معاملات من محفزات النمو (حامض الهيوميك، الأحماض الأمينية، ومستخلص الطحالب، وخليط العناصر الصغرى، ومستخلص المورينجا، وحمض الأسكوربيك) على النمو والإنتاجية والتركيب الكيميائي والقدرة التخزينية لنباتات البصل (صنف جيزة ٢٠). نفذت هذه التجربة بتصميم القطاعات الكاملة العشوائية في ثلاث مكررات. أشارت النتائج إلى أن الرش الورقي بجميع محفزات النمو أدى إلى تحسن معنوي في ارتفاع نبات البصل وعدد الأوراق وقطر البصلة وقطر العنق والمحصول الكلي ونسبة المواد الصلبة الذائبة بعد شهر من التخزين ونشاط الأنزيمات المضادة للأكسدة وحمض الأسكوربيك والفينول الكلي. وفي كلا الموسمين بالمقارنة مع معاملة الكنترول وجد أن الرش بحامض الهيوميك وحامض الاسكوربيك أعطى أعلى محصول كلي للفدان. وقد لوحظت أعلى القيم لمتوسط وزن البصلة عند الرش الورقي بحامض الهيوميك والأحماض الأمينية في كلا الموسمين. استخدام حامض الهيوميك في كلا الموسمين أو استخدام معاملات الأحماض الأمينية والعناصر الصغرى في الموسم الأول أدى إلى انخفاض معنوي في النسبة المئوية للفقد في الوزن مقارنة بالكنترول.

الكلمات المفتاحية: البصل، حامض الهيوميك، الاحماض الامينية، مستخلص الطحالب، مستخلص المورينجا، المحصول، حفظ الجودة، الانزيمات المضادة للاكسدة.