J. Product. & Dev., 15(3):335- 354 (2010)

EFFECT OF FOLIAR SPRAY WITH HUMIC ACID AND GREEN MICROALGAE EXTRACT ON GROWTH AND PRODUCTIVITY OF GARLIC PLANT GROWN IN SANDY SOIL

E.E. Abou El-Khair[1], I.A.S. Al-Esaily[1] and H.E.M. Ismail[2]
[1]Hort. Research Institute, Agriculture Research Center, Giza, Egypt.
[2]Hort. Department, Faculty of Agriculture, Zagazig University, Egypt.

ABSTRACT:

The present work was carried out in vegetable private farm at El-Kassasein Distract, Ismailia governorate during two successive winter seasons of 2008/2009 and 2009/2010, to evaluate the effect of foliar spray with both humic acid (HA) at 0, 0.1and 0.2 % and green microalgae extract (GMAE) of Scenedesmus sp. at 0, 0.1 and 0.2 % as well as their interactions on nutrient content and uptake as well as photosynthetic pigments. Consequently, growth and yield of garlic (sids-40) under sandy soil conditions using drip irrigation system.

Spraying garlic plants with HA at 0.2 % or with GMAE at 0.2 % recorded the maximum values of N,P and K uptake in bulb and N,P and K total uptake, chlorophyll a, b, total (a+b) and carotenoids, total dry weight, average bulb weight , yield of grades 1 and 2 and total yield/fed. without significant differences by spraying with GMAE at 0.1 % with respect yield and its components.

The interaction between spraying of garlic plants with HA at 0.2 % and GMAE at 0.1% was the best interaction treatment for enhancing N,P and K total uptake, total dry weight, while average bulb weight , yield of grades 1 and 2 and total yield/fed. were increased with the interaction between HA at 0.2 % and GMAE at 0.1 or 0.2 % .

***Conclusively**, from foregoing results of this study, it could be concluded that spraying of garlic plants with HA at 0.2 % and GMAE at 0.2% increased mineral uptake, plant growth and total yield of garlic under sandy soil conditions.*

Keywords : Garlic, humic acid, green microalgae extract, NPK uptake and total yield.

INTRODUCTION

Garlic (*Allium sativum* L.) is the second most important crop cultivated and used among *Alliums* after onion. It is consumed as fresh as well as dried in the spice form and as an ingredient to flavour the various dishes all over the world. It is also medicinally important.

Application of humic acids (HA) has several benefits and agriculturists all over the world are accepting HA as an integral part of their fertilizer program. It can be applied directly to the plant foliage in liquid form or to the soil in the form of granules alone or as fertilizer mixture. Humic acid is one of the major components of humus. Humates are natural organic substances, high in HA and containing most of known trace minerals necessary to the development of plant life (Senn, 1991).

Foliar application of HA (25 % active HA) consistently enhanced antioxidants such as α- tocopheral, β-carotene, superoxide dismutases, and ascorbic acid concentrations in turfgrass species (Zhang, 1997). These antioxidants may play a role in the regulation of plant.

Humic acid enhanced plant growth, increased yield , improved grade and marketability of garlic (Xin, 2006), and caused an improve in plant vegetative growth of onion (Erik *et al*., 2000; El-Desuiki, 2004) Also, HA increased dry weight/ plant , total yield , N,P and K contents and uptake in tubers of potato (Ezzat *et al*., 2009 ; Mahmoud and Hafez, 2010). There are few researchers on using HA as foliar application. Foliar spray with HA significantly increased dry weight/ plant and green pod yield of snap bean (Kaya *et al*., 2005 ; El- Bassiony *et al.*, 2010) chlorophyll contents in leaf tissues of faba been (El-Ghamry *et al*., 2009).

Scenedesmus is a genus of algae, specifically of the chlorophyceae. *Scenedesmus* is commonly found in the plankton of fresh water rivers, ponds and lakes, and sometimes in brackish. *Scenedesmus* is a small, nonmotile colonial green algae of cell aligned in a flat plate. The colonies most often have two or four cells, but may have 8,16 or rarely 32 and are occasionally unicellulart.

Fresh water green microalgae contain high percentage of macro and micronutrients bounded in their major biochemical constituents such as carbohydrates and protein (El-Fouly *et al.*, 1992). In the area of agriculture and horticulture in the three genera microalgae from chlorophylla (*Protococcus* , *Chlorella* and *Scenedesmus)* have been shown to stimulate the growth of plant , due to the presence of auxine, cytokinins , gibberellins and related growth regulator substances (Ordog *et al*., 2004; Molnar and Ordog, 2005).

Foliar spray with extract of the green microalgae of *Scenedesmus sp* as a new biofertilizer containing protein (50.56 %), N,P, K, Fe, Zn, Mn and Cu (Shaaban *et al*., 2010) or with green microalgae extract obtained from *Chlorella vulgars* containing protein (35%), fats (7%) , carbohydrates (9%) and different amino acids as well as macro; *i.e*, N, P, K,Ca, Mg, Na and micronutrients; i.e., Fe, Mn, Zn and Cu (Shaaban *et al*., 2001) increased N, P and K concentration and uptake by shoots and dry matter accumulation compared foliar spray with tap water. Also, spraying with green microalgae extract obtained from *Chlorella ellipoida* significantly increased chlorophyll a, b, and total (a+b) and showed

strong positive correlation with increase in fresh weight, green weight and yield components of wheat plant (Abd El-Baky *et al.*, 2008).

Therefore, the objective from this work was to evaluate the effect of foliar spray with humic acid (HA) and green microalgae extract (GMAE) obtained from *Scenedesmus sp.* on nutrient content and uptake as well as photosynthetic pigments. Consequently growth, yield and its components of garlic plant grown in sandy soil using drip irrigation system.

MATERIALS AND METHODS

The present work was carried out in vegetable Private Farm at El-Kassasein Distract, Ismailia governorate during two successive winter seasons of 2008/2009 and 2009/2010 , to evaluate the effect of foliar spray with both humic acid (HA) and green microalgae extract (GMAE) of *Scenedesmus sp.* as well as their interactions on nutrient content and uptake as well as photosynthetic pigments. Consequently growth and yield of garlic (sids-40) under sandy soil conditions using drip irrigation system. The physical and chemical analyses of the soil are presented in Table 1.

This experiment included nine treatments, which were the combinations between three concentrations of humic acid (0, 0.1 and 0.2 %) and three concentrations of green microalgae extract of *Scenedesmus sp.* (0, 0.1 and 0.2 %). These treatments were arranged in a split plot in a complete randomized block design with three replicates. Humic acid concentrations were randomly arranged in the main plots and green microalgae extract concentrations were randomly distributed in the sub plots.

Humic acid (Mega Power-X) which was obtained from Union for Agriculture Development (UAD), Cairo, Egypt contain humic acid 19 %, folvic acid 2 %, free amino acid 5 %, chelated Zn 0.5 %, chelated Fe 0.025 % , chelated Mn 0.5 % and potassium citrate 2 % .

Obtained green microalgae extract from *Scenedesmus sp*. (El-Sayed, 2004) was produced at the Algae Production Station of the National Research Centre (NRC, Giza, Egypt)) within three open ponds ($15m^3$ per each). Major components of the used green microalgae *Scenedesmus sp*. are shown in Table 2.

The cloves of garlic *cv* sids 40 were sown on 1st and 5th October in the 1st and 2nd seasons, respectively. Garlic cloves were selected for uniformity in shape and size sown on both sides of the dripper lines at distance 10 cm a apart.

The experimental unit area was 12.6 m^2. It contains three dripper lines with 7m length each and 60 cm distance between each two drippers lines. One line was used for taking samples to measure the morphological, physiological traits and some chemical constituents and the other two lines were used for yield determinations.

Table 1: The physical and chemical properties of soil during 2008/2009 and 2009/2010 seasons

Characters	Seasons	
Physical properties	**2008/2009**	**2009/2010**
Sand (%)	93.5	92.6
Silt (%)	1.7	1.6
Clay	4.8	5.8
Texture	Sandy	Sandy
Chemical properties		
pH	8.17	8.09
Organic matter(%)	0.03	0.07
Available K (ppm)	61	63
Available P (ppm)	6.4	6.9
Available N (%)	6.7	7.2
Calcium carbonate (%)	0.26	0.23
Available Fe (ppm)	5.13	4.67
Available Zn (ppm)	3.25	3.37
Available Mn (ppm)	2.07	2.18

Table 2. Major constituents of the used green microalgae *Scenedesmus sp*.

Constituents(D.W)	(%)	Macronutrients (%)		Micronutrients (ppm)	
Crude protein	50.56	N	8.09	Fe	2057
Ether extract	7.39	P	2.69	Zn	722
Crude fiber	9.83	K	0.65	Mn	747
Ash	9.18			Cu	93
Moisture	4.51				

Plants were sprayed three times by 15 days intervals, beginning 60 days after planting (60, 75 and 90 days) with both humic acid and green microalgae extract. Each plot received 2 L solutions of each concentrations using spreading agent in all treatments to improve adherence of the spray to the plant foliage for increasing humic acid (HA) and green microalgae extract (GMAE) absorption by the plants. The untreated plants (check) were sprayed with tap water and

spreading agent. One dripper line was left between each two experimental plots without spraying as a gourd row to avoid the overlapping of spraying salutation.

All plots received equal amounts of farmyard manure at rate of 30 m^3/fed. and one third of all commercial fertilizers; i.e., ammonium sulphate (20.5 % N), calcium superphosphate (15.5 % P_2O_5) and potassium sulphate (48 % K_2O) during soil preparation in the center of planting line , then covered by sand. These commercial fertilizers were added at the rates of 500, 450 and 200 kg/fed. respectively. The rest amounts of these fertilizers (two thirds) were splitted into 5 equal portions and added to the soil every 15 days , beginning one month after planting. The normal agricultural practices were carried out as commonly used in the district.

Data Recorded

1. Content, Uptake and Total Uptake of N, P and K

Dried represented samples of bulb and leaves of all tested treatments after 135 days from planting in both seasons were finely ground and wet digested. Then, N, P and K contents were determined according to the methods described by Bremner and Mulvaney (1982), Olsen and Sommers (1982) and Jackson (1970), respectively. The uptake of minerals and total plant uptake were calculated.

2. Photosynthetic Pigments

Disk samples from the fourth upper leaf were obtained after 135 days from planting in both seasons to determine chlorophyll a and b as well as carotenoids according to the method described by Wettestein (1957).

3. Dry weight

Ten plants were randomly taken from each plot after 135 days from planting, and they were divided separately into different organs; *i.e.*, bulb and leaves, then they were oven dried at 70 °C tell constant weight. Dry weight was recorded as leaf and bulb dry weights/ plant (g). In addition, total plant dry weight /plant (bulb +leaves) were calculated.

4. Yield and its Components

At proper maturity stage of bulbs (200 days after planting), bulbs in every plot were harvested and graded into three categories according to the Ministry of Economic for garlic exportation (1963) as follow: grade 1: Bulbs with diameter above 5.5 cm, grade 2: Bulbs with diameter between 4.5- 5.5 cm and grade 3: Bulbs with diameter less than 4.4 cm. Then, each grade was weighed separately at the same harvest day and the following data were calculated as ton/ *fed*: total yield (grade 1+ grade 2 + grade 3). Also, average bulb fresh weight (gm) was recorded.

Statistical Analysis: Collected data were subjected to statistical analysis of variance according to Snedecor and Cochran (1980), and means separation was done using L.S.D. at 5 % level of probability.

RESULTS AND DISCUSSION

1. Contents and Uptake of N,P and K

1.1 Effect of humic acid (HA)

Concerning N,P and K contents, data in Table ٣ show that foliar spray with HA (Mega Power-X) at 0.1 or 0.2 % increased N, P and K contents in bulb and leaves of garlic compared to control (sprayed with tap water) with insignificant differences between the two concentrations of HA in both seasons. On the other hand, spraying with HA had no significant effect on P content in bulb in the 2nd season and K content in leaves in the 1st season.

As for N, P and K uptake and total uptake, presented data in Tables 4 and 5 show that garlic plants which were sprayed with HA at 0.2 % recorded the maximum values of N,P and K uptake in bulb and N,P and K total uptake by plant followed by plants which sprayed with HA at 0.1 %.

Similar increases in the contents of some nutrients by foliar application with HA were obtained by Guvenc *et al*. (1999) who found that spraying lettuce plants with HA or Trisert-CB significantly increased P, K, Na and Mg contents compared to the control treatment.

These results are in accordance with those reported by Ezzat *et al*. (2009) and Mahmoud and Hafez (2010). They found that HA increased N,P and K contents and uptake by potato plants.

1.2 Effect of green microalgae extract (GMAE)

Respecting N, P and K content, the obtained results in Table 3 show that spraying garlic plants with GMAE obtained from *Scenedesmus sp.* at 0.2 % recorded the maximum values of N,P and K content in bulb and leaves with insignificant differences between GMAE at 0.2 and 0.1 % for P content in bulb in both seasons.

As for N, P and K uptake and total uptake , data in Tables 4 and 5 indicate that spraying with GMAE at 0.2 % significantly increased N,P and K uptake in bulb and leaves and N,P and K total uptake by plant compared to control or GMAE treatment at 0.1 % in both seasons.

The increase in N content in shoots may be due to that the high protein content (50.56 % on dry basis of the green microalgae extract of *Scenedesmus sp.)* which split natural plant amino acids involved directly in the metabolism. Plants can uptake N in forms of amino acids without relying on microbial mineralization (Lipson and Nasholm, 2001). Also the increase in N, P and K content in leaves and bulbs may be due to that the used green microalgae

Table 3, 4

Tables 5 and 6

Scenedesmus sp. contained 8.09 % N, 2.69 % P and 0.65 % K on dry weight basis (El-Sayed, 2004). Nutrient uptake increases may be due to nutrients present in the cell extract of green microalgae *(Scenedesmus sp.)* which mostly are in an organic form and can be directly involved in the metabolism.

These results agree with those reported by Shaaban *et al*. (2001) who found that spraying of wheat plants with green microalgae extract increased N,P and K concentration and uptake by shoots and dry matter accumulation compared to foliar spray with tap water.

1.3 Effect of HA x GMAE

It is apparent from data in Tables 6, 7 and 8 that, the interaction between HA at 0.2% and GMAE at 0.2 % was the superior treatment for increasing N,P and K content and uptake of bulb and leaves as well as N,P and K total uptake , followed by the interaction between HA at 0.1% and GMAE at 0.1 % compared to control and other interaction treatments. On the other hand, in most cases, there were no significant differences among interaction treatments; i.e., 0.0 HA x 0.1 % GMAE and 0.0 HA and 0.2% GMAE with control (0.0 HA x 0.0 GMAE) on N, P and K content and uptake in both seasons.

2. Photosynthetic Pigments

2. 1.Effect of HA

It is intelligible from data in Table 9 that the garlic plants which were sprayed with HA at 0.1 and 0.2% significantly increased the concentrations of chlorophyll a, b, total (a+b) and carotenoides in leaf tissue in the 2nd season only compared to plants which unsprayed. Spraying with HA at 0.2 % recorded the maximum values of chlorophyll a, b, total (a+b) and carotenoids. Humic acid enhanced photosynthetic process and development of chlorophyll (Liu *et al*., 1998).

The increase in chlorophyll through foliar spray with HA may be due to that HA content 2 % free amino acids that would help to increase chlorophyll concentration in plant leading to higher degree of photosynthesis.

Similar findings were obtained by El-Ghamry *et al*. (2009). They found that foliar spray with HA increased chlorophyll contents in leaf tissues of faba been.

2.2 Effect of GMAE

It is obvious from data in Table 9 that spraying garlic plants with GMAE at 0.1 and 0.2 % significantly increased the concentrations of chlorophyll a, b and total (a+b) in leaf tissues in the second season and carotenoides in leaf tissues in both seasons compared to plants which unsprayed. Also, spraying with GMAE at 0.2% recorded the maximum values of photosynthetic pigments in leaf tissues.

7 and 8

Tables 9 and 10

These results are in harmony with those reported by Abd El-Baky *et al.* (2008) who found that spraying with green microalgae extract obtained from *Chlorella ellipoida* significantly increased chlorophyll a, b, and total (a+b) in leaf tissues of wheat.

2.3 Effect of HA x GMAE

The obtained data in Table 10 show that the interaction between HA at 0.1 % and GMAE at 0.1 % or the interaction between HA at 0.2 % and GMAE at 0.2 % were the best interaction treatments for increasing concentration of chlorophyll a, b and total (a+b), whereas the interaction between HA at 0.2% and GMAE at 0.2 % was the best interaction treatment for increasing carotenoides in leaf tissues in the second season only.

3. Dry weight

3.1 Effect of HA

The obtained results in Table 11 show that spraying garlic plants with HA at 0.1 or 0.2 % significantly increased dry weight of leaves, bulb and total (leaves + bulb) / plant compared to control (sprayed with tap water). Foliar spray with HA at 0.2 % recorded the maximum values of dry weight of leaves and total (leaves + bulb) with insignificant differences could be detected with HA at 0.1 % with respect to dry weight of leaves and total dry weight. The increases in total dry weight/ plant were about 0.96 and 1.84 gm/plant for spraying with HA at 0.2 % and 0.62 and 1.34 gm/ plant for spraying with HA at 0.1 % over the control in the 1st and 2nd seasons, respectively.

The role of HA in plant growth may be due to that HA stimulated plant growth through increasing cell division, as well as optimizing uptake of nutrients and water (Atiyeh *et al*., 2002 ; Chen *et al*., 2004) . Also, regulate hormone level, improve plant growth and enhance stress tolerance (Piccolo *et al*., 1992).

The increment in growth parameters may be due to that HA is extremely important component because its constituents a stable fraction of carbon, thus regulating the carbon cycle and release of nutrients, including N,P, and S, which decrease the need for inorganic fertilizer for plant growth. Humic acid stimulate plant growth by assimilation of major and minor elements, enzymes activation and /or inhibition, changes in membrane permeability, protein synthesis and finally the activation of biomass production (Ulukan , 2008).

Humic acid is excellent foliar fertilizer carrier and activator. Application of HA as foliar spray can improve the growth of plant foliage, roots and fruits. By increasing plant growth process within in leaves an increase in carbohydrates content of the leaves and stem occurs. These carbohydrates are then transported down the stems into the roots where they are in part released from the root to provide nutrients for various soil microorganisms on the rhizosplane and in the rhizosphere. The microorganisms then release acids and other organic

compounds which increase the availability of plant nutrients. Other microorganisms release hormone like compounds which are taken up by plant roots.

Similar increases in plant growth by application of HA as foliar spray were obtained by Padem *et al*. (1999) on pepper and eggplant , Erik *et al*. (2000) on onion , Kaya *et al*. (2005) and El- Bassiony *et al.* (2010) on snap been.

3.2 Effect of GMAE

It can be seen from data in Table 11 that foliar spray with GMAE at 0.2 % was the best treatment for enhancing dry weight of leaves, bulb and total (leaves + bulb) / plant. The increases in total dry weight/ plant were about 2.16 and 1.74 gm/ plant for spraying with GMAE at 0.2 % over the control (sprayed with tap water) in the 1st and 2nd seasons, respectively.

The three genera microalgae from chlorophylla (*Protococcus*, *Chlorella* and *Scenedesmus)* have been shown to stimulate the growth of plant , due to the presence of auxine, cytokinins, gibberellins and related growth regulator substances (Ordog *et al*., 2004; Molnar and Ordog, 2005).

3.3 Effect of HA x GMAE

It is marked from data in Table 12 that the interaction between HA at 0.2 % and GMAE at 0.2 % was the superior interaction treatment for increasing dry weight of leaves, bulb and total/ plant, followed by the interaction between HA at 0.1 % and GMAE at 0.2 % compared to control and other interaction treatments in both seasons. The increases in total dry weight/ plant were about 2.16 and 3.72 gm/ plant for the interaction between spraying with HA at 0.2 % and GMAE at 0.2 % and 0.78 and 3.14 gm/ plant for the interaction between spraying with HA at 0.1 % and GMAE at 0.2 % over the control (sprayed with tap water) in the 1st and 2nd seasons, respectively.

Amino acids derived from proteolysis of proteins in green microalgae extract and HA contain 2 % amino acids that would have a chelating effect on micronutrients when applied and consequently make the absorption and transportation of micronutrients inside the plant is easier due to its effect on cell membrane permeability. Some of these micronutrients play roles in synthesis of intermediates in the metabolic pathway, through tryptophane to auxin (Ohki, 1978). Consequently auxin lead to increase in vegetative growth and increase in total phenol, calcium content and activity of chatecol oxidase, these materials protect plants against pathogen stress (Chowdhury, 2003).

Tables 11 and 12

4. Yield and Its Components

4.1. Effect of HA

It is visible from data in Table 13 that foliar spray of garlic plants with HA at 0.1 or 0.2 % significantly increased average bulb weight, yield of grades 1 and 2 as well as total yield/fed. compared to control (sprayed with tap water) and HA at 0.2 % recorded maximum values of average bulb weight , yield of grades 1 and 2 as well as total yield/feddan. On the other hand, spraying with HA at different concentrations had no significant effect on yield of grade 1 and yield of grade 3 in the 2nd season and HA at 0.2 % recorded the maximum values of yield of grade 3 in the 2nd season. The increases in total yield/fed. were about 1.269 and 0.711 ton/ fed. for spraying with HA at 0.2 % and 0.721 and 0.675 ton/fed for spraying with HA at 0.1 % over the control (sprayed with tap water) in the 1st and 2nd seasons, respectively.

Foliar spray with HA at 0.1 or 0.2 % was superior in increasing N,P and K content and uptake (Tables 3, 4 and 5), photosynthetic pigments (Table 9). As a reflection to dry weight of shoots (Table 11) and total yield of garlic (Table 13).

Obtained results are in harmony with those reported by El-Desuki (2004) on onion, Xin (2006) on garlic, Ezzat *et al*. (2009) , Mahmoud and Hafez (2010) on potato. They found that application of HA as foliar spraywere improved and increased total yield.

4.2 Effect of GMAE

The obtained results in Table 13 show that plants which sprayed with GMAE at different concentrations (0.1 and 0.2 %) reflected a significant effect on average bulb weight and yield of grades 1 and 2 as well as total yield/fed. compared to the plants which unsprayed and spraying with GMAE at 0.2 % recorded the maximum values of these characters. On the other hand, spraying with GMAE had no significant effect on yield of grade 3 in the 1st season and spraying with 0.2 % recorded the minimum value of yield of grade 3 with insignificant differences with GMAE at 0.1 % in the 2nd season. The increases in total yield/fed. were about 0.778 and 0.676 ton/ fed. for spraying with GMAE at 0.2 % and 0.381 and 0.505 ton/fed. for spraying with GMAE at 0.1 % over the control (sprayed with tap water) in the 1st and 2nd seasons, respectively.

Foliar spray with GMAE of *Scenedesmus sp.* at 0.1 or 0.2 % was superior in increasing N,P and K content and uptake (Tables 3,4 and 5), photosynthetic pigments (Table 9). As a reflection to dry weight of shoots (Table 11) and total yield of garlic (Table 13).

These results are in harmony with those obtained by Abd El-Baky *et al.* (2008). They found that spraying with green microalgae extract obtained from *Chlorella ellipoida* significantly increased green weight and yield component of wheat.

Tables 13 and 14

4.3 Effect of HA x GMAE

It is clear from data in Table 14 that the interaction between HA at 0.2 % and GMAE at 0.2 % was the best interaction treatment for increasing average bulb weight, yield of grades 1 and 2 and total yield/fed. followed by the interaction between spraying with HA at 0.1 % and GMAE at 0.2 %. On the other hand, the interaction between HA and GMAE had no significant effect on yield of grade 3 in the 1st season and the interaction between spraying with HA at 0.2 % and GMAE at 0.2 % recorded the minimum value of yield of grade 3 in the 2nd season. There were no significant differences among the interactions treatments, i.e., 0 HA x 0.1% GMAE and 0 HA x 0.2% GMAE with control (0 HA x 0 GMAE) in the most cases.

The increases in total yield/fed. were about 2.121 and 1.472 ton /fed. for the interaction between spraying with HA at 0.2 % and GMAE at 0.2 % and 0.900 and 1.214 ton/fed for the interaction between spraying with HA at 0.1 % and GMAE at 0.1 % over the control (sprayed with tap water) in the 1st and 2nd seasons, respectively.

Conclusively, from foregoing results of this study, it could be concluded that spraying of garlic plants with HA at 0.2 % and GMAE at 0.2% increased mineral uptake, plant growth and total yield of garlic under sandy soil conditions.

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تأثير الرش الورقى بحمض الهيومك ومستخلص الطحالب الخضراء على نمو وإنتاجية نبات الثوم النامى فى الارض الرملية

السيد السيد أبو الخير[١] ، ابراهيم عبد الله سليم العسيلى [١] ، هانى السيد محمد اسماعيل[٢]

[١] معهد بحوث البساتين- مركز البحوث الزراعية – الجيزة –مصر

2 قسم البساتين- كلية الزراعة – جامعة الزقازيق

أجرى هذا العمل خلال موسمى شتاء ٢٠٠٩/٢٠٠٨ ، ٢٠١٠/٢٠٠٩ وذلك بمزرعة محطة خضر خاصة بمنطقة القصاصين – محافظة الاسماعلية- مصر وذلك لدراسة تأثير الرش الورقى بكل من حمض الهيومك بتركيز (صفر ، ٠.١ ، ٠.٢ %) ومستخلص الطحالب الخضراء بتركيز (صفر ، ٠.١ ، ٠.٢ %) وكذلك التفاعل بينهما على محتوى وامتصاص العناصر وكذلك صبغات التمثيل الضوئى وانعكاس ذلك على النمو والمحصول لنبات الثوم صنف سدس ٤٠ النامى فى ارض رملية وباستخدام نظام الرى بالتنقيط.

أدى رش نبات الثوم بحمض الهيومك بتركيز ٠.٢ % أو مستخلص الطحالب الخضراء بتركيز ٠.٢% لزيادة الممتص من النتروجين والفوسفور والبوتاسيوم بواسطة البصلة والاوراق والممتص الكلى بواسطة النبات ، ومحتوى أنسجة الورقة من كلوروفيل أ، ب، الكلوروفيل الكلى (ا+ب) وكذلك الكاروتينات ، والوزن الجاف الكلى للنبات ، ومتوسط وزن البصلة، ومحصول الدرجة الاولى والثانية ، والمحصول الكلى للفدان وبدون فروق معنوية مع الرش بمستخلص الطحالب الخضراء بتركيز ٠.١ % بخصوص المحصول ومكوناته.

كانت أفضل معاملة تفاعل لزيادة الممتص الكلى من النتروجين والفوسفور والبوتاسيوم بواسطة النبات ، والوزن الجاف الكلى للنبات هى رش نباتات الثوم بحمض الهيومك بتركيز ٠.٢ % والرش بمستخلص الطحالب الخضراء ٠.٢ % ، بينما ازداد متوسط وزن البصلة ، ومحصول الدرجة الأولى والثانية وكذلك المحصول الكلى للفدان بالتفاعل بين الرش بحمض الهيومك بتركيز ٠.٢ % والرش بمستخلص الطحالب الخضراء بتركيز ٠.١ او ٠.٢ % .