Quality Improvement And Seed Yield Of Two Garlic Cultivars *(Allium Sativam L.)* By Seaweed Extract And Mycorrhizae

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BSTRACT

The present work was carried out at a private farm in sharnoob village, Damanhur city, Behira governorate, Egypt, during successive seasons of 2015/2016 and 2016/2017. The present study aimed to investigate the effect of some bio- stimulants (seaweed extract and mycorrhiza fungi) application on the vegetative growth, yield and its component of two garlic cultivars (Balady and Sids 40). Eight treatments of bio- stimulants were used; i.e., T1=Foliar application with tap water (control),T2=Foliar application with seaweed extract at rate 3ml/L,T3=soaking with seaweed extract at rate3ml/L,T4= soaking and foliar application with seaweed extract at rate 3ml/L,T5=Inoculums mycorrhizal in soil and covered in soil, T6= Foliar application with seaweed extract at rate3ml/L + inoculums mycorrhizal in soil and covered in soil, T7=soaking with seaweed extract at rate 3ml/L +inoculums mycorrhizal in soil and covered in soil and T8=soaking and foliar application with seaweed extract at rate 3ml/L + inoculums mycorrhizal in soil and covered in soil. The results indicated that significant difference between the two tested cultivars, where Sids 40 cultivar had thick nick diameter, bulb diameter cm, bulb fresh weight g/ plant, total yield / faddan, N%, P% and K% contents of bulbs in both season. The best results also were given when T3, T5 and T7 treatments application on the most tested characters. The interaction between two garlic cultivars and bio- stimulants treatments show significant effect on all the studied garlic characters. In general,T3=soaking with seaweed extract, T5= inoculums mycorrizal in soil and covered in soil and T7= soaking with seaweed extra at rate 3ml/L +inoculums mycorrhizal in soil and covered in soil can be recommended for achieving better vegetative growth and higher bulb yield of the garlic plants, particularly, Sids 40 cultivar.

Key words: garlic *(Allium Sativum L.)*, bio- stimulants, seaweed extract and mycorrhizal fungi.

INTRODUCTION

Garlic (*Allium Sativum* L.) is one of the main vegetable crops grown in Egypt for local consumption and exploration. Furthermore, it is cultivated for its flavor and medicinal properties with the latter steadily

arising worldwide (Collin, 2004). Increasing garlic yield and improving bulb quality are essential aims for growers. They are both affected with any factor that influence plant growth and development (EL-Morsy, 2004).

Bio- fertilizers play vital role for increasing the number of microorganisms and accelerate certain microbial process in the rhizosphere of inoculated soil plants which can change the available forms of nutrients into plants (Gupta et al. 1998). Bio-fertilizers are generally capable of inducing beneficial effect on compatible host based on altering the rhizospher flora by seed or soil inoculation with certain organism (Abdelkader *et al*., 2014). The significant effect of bio-fertilizers may be due to the effect of different strain groups and nutrients mobilizing microorganism which increased levels of extractable minerals (El-Karmany et al., 2000 and Khater (2001).

The application of seaweed extract for different crops was a great importance because of its contain high levels of organic matter, micro elements vitamins and fatty acids and also seaweed contain growth promoting substances i.e. cytokinins, auxin and abscisic acid which stimulate plant growth and yield and enhance plant tolerance to environmental stress (Zhang et al., 2003), increase nutrient acquisition (Turan and Kose, 2004) and enhance antioxidant properties (Vernieri *et al.,* 2005). Seaweeds have been reported as a products for improveing seeds germination, seedlings development (Zhang and Ervin 2008), and enhance plant growth and yield (Hong et al,2007; Zabape et al,2008 and Khan et al., 2009), Seaweeds have been also reported to produce beneficial effects on garlic (Fawzy *et al.,* 2012). Inoculation of garlic plants with different bio-fertilizers significantly increased all plant growth parameters of garlic (Midan, 2007 and Gouda, 2008).

Arbuscular mycorrhizal fungi (AMF) are soil fungi that form mutualistic relationships with plant roots (David 2008). Arbuscular mycorrhizal fungi can increase the activities of soil enzymes such as phosphatase and dehydrogenase (Vazquez et al., 2000). Phosphatase and dehydrogenase enzymes

play key metabolic roles in mycorrhizal function (Lopez Guiterrez et. al., 2004). It is interest to mention that bacteria, which are most abundant in soils, play a specially role in root- AM fungus interactions. This so- called mycorrhiza – helper bacteria which promote plant growth and nutrient uptake (Nour and Ebtsam 2015).

The major objective of the present study aims to investigate the effect of some source of bio-stimulants application (seaweeds extract and mycorrhizal fungi) on vegetative growth, yield and quality character of two garlic cultivars yield.

MATERIALS AND METHODS

The present investigation was carried out at a private farm in Sharnoob village , Damnhour city, Behira Governorate, Egypt, during the two growing seasons of 2015/2016 and 2016/2017 to study the effect of some bio-stimulants, seaweeds extracts(Algreen) and effect of mycorrhizal fungi on vegetative growth, yield and quality using two garlic cultivars Balady and Sids 40. Table1 shows some physical and chemical properties of the experiment soil before planting.

Experimental design was split plot design in a randomized complete blocks design with three replicates. Each replicate had 16 treatments. Garlic cultivars were the main plot and the treatments of bio-stimulants were randomly allocated in the sub plots. The experimental unit area was 22.5 m^2 with 3 rows (0.75m in width and 10 m length). Garlic cloves were selected uniform in shape and size at distance 10cm apart. Planting date was on October 2^{ed} and 10^{th} during the first and the second seasons, respectively. The experiment included 8 treatments from bio-stimulants as follows:

T1=Foliar application with tap water (control)

T2=Foliar application with seaweed extract at rate 3ml/L

T3=soaking with seaweed extract at rate3ml/L

T4= soaking and foliar application with seaweed extract at rate

3ml/L

T5=Inoculums mycorrhizal in soil and covered in soil

T6= Foliar application with seaweed extract at rate3ml/L +

inoculum mycorrhizal in soil and covered in soil

T7=soaking with seaweed extract at rate 3ml/L +inoculum

mycorrhizal in soil and covered in soil

T8=soaking and foliar application with seaweed extract at rate

3ml/L + inoculum mycorrhizal in soil and covered in soil

Spraying treatments were started after one month from planting date and repeated every 30 days for 3 times through the growth season. Soaking treatments were applied for 12 hour before planting.

A commercial seaweeds extract product was used. Seaweeds extract contains N (6%), Mg (6%), S(9.6%), Born(0.5%) Mo (0.26%) alganic acid (4%), some organic matter and plant hormones. Inoculums of Glomus macro carpium and Glomus intraradiaces. The first specie was obtained from department of plant nutrition at Gottingen-University Germany; the second species were supplied from department of plant pathology at Hanover University- Germany Both species activated in the soil microbiology lab – soil and agriculture chemistry Dept. - Faculty of agriculture-Saba Basha-Alexandria University – Alexandria Egypt.

10 ml =500 A-mycorrhizal spores per hill. Chopped roots and mycorrhiza spores were placed below the cloves.

The agriculture practices were done according to the recommendation of Ministry of Agriculture, Egypt.

The data recorded:

Vegetative characters:

Ten plants per treatment in each replicate were randomly taken at the end of the vegetative growth, 110 days after planting date, to determine plant height (cm), number of leaves / plant, leaves fresh weight (g/plant) and leaves dry matter (%).

Bulbs yield and its components:

At harvesting 150 days from planting all plants for each replicates were harvested and the total yield/fed. was calculated. A random sample of 10 bulbs derived from each cultivar were taken from each sub plot to determine some bulbs traits i.e., nick diameter (cm), number of cloves/bulbs, bulb diameter (cm) bulb fresh weight (g/plant) and bulb dry matter (%). Moreover an additional sample of dry bulbs was used for chemical determination of N, P and K (%) bulb content. The nitrogen was determined according to Jackson son (1973). Phosphorus was determined according to the method of Murphy and Reily (1962). While, potassium was measured using Flam photometer as described by Wiled et al, (1985).

Statistical analysis

Collected data of the experiments were statistically analyzed according to Snedecor and Cochran (1980). Means separation was done using LSD at 5% level of probability.

Table 1: Physical and chemical analysis of the experimental site before starting the experiment.

	Saturated soil extract
pH	7.75
EC,ds/m	1.55
$CaCO_3$,%	2.35%
Soluble anions(meq/l)	
Ca^{++}	5.40
Mg^{++}	5.13
Na^{+}	10.5
K^{+}	0.23
Soluble anions(meq/l)	
HCO3-	8.45
CL-	1.65
SO4--	11.45
Particle size distribution (%)	
Sand	38.6
Silt	21.7
Clay	39.3
Soil texture	Clay Loam

RESULTS AND DISCATION

1-Vegetative growth characters

a- Effect of cultivars:

Data presented in Table (2) showed that the vegetative characters, plant height and leaves fresh weight significantly affected in case of Balady cultivar in the both seasons. However, sids 40 cultivar exhibited higher values for leaves dry matter in the both seasons. Data showed that there were no significant differences between the two cultivars, regarding to number of leaves in the both seasons. Obtained results may be attributed to the genetically variance among the studied garlic cultivars. These results are in harmony with those reported by Abdel –Razzak and El- Sharkawy (2013) and Zaki *et,al.* (2014).

b- Effect of bio-stimulants treatments

The data in Table (2) showed that the vegetative characters were significantly affected with the treatments T3, T5 and T7. They gave the highest means values for all studied traits over garlic cultivars, in both seasons; except T3regarding to leaves fresh weight in the first season. However, there were insignificant differences between T5, T7 and T8 regarding to number of leaves in the first season. Insignificant differences were recorded between T7 and T3 and T8, in number of leaves in the second season. The positive effect of soaking seaweed extract on plant vegetative growth was mainly due to natural content of the mineral nutrients, vitamins, amino acids and enzymes (Kheder and Farid, 2002). In addition, seaweed extract plays an important role in activity of cell division and enlargement which are the basal steps of plant growth due to it auxins content. Saif Eldeen *et al.,* 2014 showed that using seaweeds and chitozan alone or in combination were more effective in increasing vegetative growth characters on glob artichoke plants (plant height, number and dry weight of leaves/ plant) and yield distribution compared with control. Seaweeds have been also reported to produce beneficial effects on garlic (Fawzy *et al.,* 2012) and (Shehata *et al.,* 2012) on cucumber. It is well known that AM fungal root colonization is enhanced in the presence of rhizosphere bacteria, which promote plant growth and nutrient uptake (Hoflich et al., 1994). Biofertilizers contains *Azotobacter sp*., Mycorrhizae (VAM), *Bacillus megatherium* phosphate -dissolving bacteria and silicate -dissolving bacteria could be used instead of chemical fertilizers. Moreover, these bacterial cells increase the availability of nutrients in form which can be easily assimilated by plants (Subba Rao, 1993).

c- Effect of the interactions

There were significant differences in the interaction between the bio-stimulants treatments and the studied cultivars regarding to all studied traits in the both seasons (Table 2). Data showed that T3, T5 and T7 treatments gave rise to the highest means for number of leaves, plant height and leaves dry matter% for both cultivars, Balady and Sids 40, respectively, in the both seasons. Meanwhile, T5 treatment gave the highest means values in Balady regarding to leaves fresh weight in the first season. It is also clear from data in Table 2 that T3 and T5 gave the highest means values regarding to leaves fresh weight in Balady at the second season. The results of this study revealed that foliar spray with bio-stimulants increased vegetative growth parameters. This might be due to the fact that bio-stimulants contain amino acids and some other elements, which enhance the

metabolism processes in plant tissues (Fathy and Farid, 1996). Applying seaweed extract increased the response of different growth parameters responses of Watermelon Abdel-Mawgoud *et al.* (2010). and *et al.* (2012) on Chinese garlic plants. Inoculation of garlic plants with different bio-fertilizers significantly increased all plant growth parameters of garlic. (El-Shabasi *et al*., 2003; El-Seifi *et al*., 2004; Midan, 2007; Gouda, 2008; El-Morsy *et al*., 2009; Mahesh *et al*., 2009 and Mohsen *et al.*, 2011) as well as leaf pigments of garlic (Gouda, 2008). However, the previous studies have proved that seaweeds can, directly or indirectly, influence the physiological activities of the plants (Kamal, and Ghanem 2011 and Shehata *et al.,* 2012). Fawzy, *et al., (*2012), who recommended that all bio-stimulants applied have positive promoting effects on growth of Chinese garlic plants by providing supplemental doses of these bio-stimulants. Also obtained results of the present investigation indicated that, foliar application of amino acid, stimulated most of vegetative growth characters and some chemical compounds which led to producing higher total yield of Sids 40 garlic plants.

Garlic bulb yield, and its components and bulb characteristics

a- Effect of cultivars

The data presented in Table (3) revealed that there were varietals differences in yield and its components. In this concern Balady cultivar showed the highest means values for number of cloves in both seasons, whereas, Sids 40 cultivar surpass Balady cultivar among other studied traits of yield and its components in both seasons. These results might be referred to the genetic variation among garlic cultivars. These results are in according with obtained results by Wafaa(2011) and Abdel- Razzak and El- Sharkawy(2013).

b- Effect of bio-stimulants treatments

All bio- stimulants treatments clearly improved total yield/ faddan, bulbs fresh weight (g/plant), number of cloves /bulbs, bulb diameter (cm) and nick diameter (cm), compared with the control during both seasons (Table3). Data showed that total yield/ faddan, nick diameter, number of cloves, bulb diameter were significantly affected with treatments T3, T5 and T7 in the both seasons However, there were insignificant differences between T3 and T5 or other treatments except T7 regarding to nick diameter in the second season. In addition there were no significant differences between T5 and T7 or T2 regarding to bulb diameter in the second season. The treatments T3 and T7 gave the significant effect on bulb fresh weight in the both seasons. However there were insignificant differences between T5 and T3 in the second season. Meanwhile, the highest means values of bulbs dry weight were recorded by T5 and T7 treatments in the first season. Seaweeds extracts are a new bio-stimulants containing N, P, K, Ca, Mg, S, Zn, Fe, Mn, Cu, Mo, and Co, some growth regulators, polyamines and vitamins was applied to improve nutritional status and vegetative growth (Spinelli *et al*., 2009). Spraying garlic plants with green micro algae extract at 0.2 % was the best treatment for enhancing dry weight of leaves, bulb and total (leaves + bulb) / plant of garlic(Abou El-Khair *et al.*, 2010) . Tarek and Hassan (2014) reported that foliar application of bio-stimulants can be recommended to enhance total yield and bulb quality of garlic. Regarding to inoculum mycorrhizal ,Ghazzi (2006) reported that the AMF-inoculated plants had higher fresh bulb yield and mean bulb weight than uninoculated plants regardless of P level.

c- Effect of the interactions

It is also clear from data in Table (3) treatments T3,T5 and T7 gave the highest mean value in Sids 40 cultivar regarding to total yield /fadden, bulbs diameter in the first season and bulbs fresh weight in the second season. The same treatments gave the highest mean value in Balady cultivars concerning to number of cloves in the both season. Meanwhile T7 treatment gave the best value in Sids 40 cultivar regarding to nick diameter in both season and bulbs fresh weight in the first season. In addition T3 and T7 treatments gave the highest mean value in Sids 40 cultivar regarding to bulb fresh weight in the first season. T2, T3, T4, T6 and T7 treatments gave highest mean value in Sids 40 cultivar concerning to bulb fresh weight in the second season. Root colonization with arbuscular micorrhizal fungi (AMF) have enhanced the uptake of nutrients, especially, N, P, K, and other nutrients and improve plant growth. Smith and Read,(1997) reported that Mycorrhizal inoculation influenced early growth and nutrients uptake of N, P and K at 60-30-50 kg ha-1 NPK fertilizer application level. The application of bio-stimulants as foliar application, could supply the plant organism which promote synthesis of plant organs consequently, it could be summarized that, Sids 40 garlic cultivar plants which received amino acids as foliar spraying gained the heaviest bulbs yield. Similar trend of results, as previously, were reported by several researchers (Paul *et al*., 2001; Sanaa *et al*., 2001; Pourtan, *et al*., 2004; Awad *et al*., 2007; Al-Said and Faten *et al.,* 2010).

Table 2: Effect of bio- stimulants on vegetative growth of two garlic cultivars during both seasons 2015/2016 and 2016/2017.

Treatment	Plant height(cm)			No. of leaves/ plant			Leaves fresh weight(g/plant)			Leaves dry matter (%)		
	Balady	Sids40	Mean	Balady	Sids40	Mean	Balady	Sids40	Mean	Balady	Sids40	Mean
						2015/2016						
T1	90.3d	67.3g	78.3DE	7.0d	7.6cd	7.3E	60.0f	43.3h	51.6E	12.4hi	11.8hi	12.1C
T2	94.0c	72.3f	83.2BC	8.3bcd	8.3bcd	8.3CD	61.6f	51.0g	56.3D	11.2ij	14.5fg	12.8C
T3	101.3ab	77.1e	89.2A	9.3ab	10.3a	9.8A	85.0bc	61.0f	73.0B	20.6b	23.0a	21.8A
T4	90.0d	66.3g	78.2E	8.3bcd	7.6cd	8.0DE	60.0f	50.0g	55.0D	14.1fg	14.5fg	14.3B
T5	103.3a	75.3ef	89.3A	9.6ab	9.3ab	9.5AB	93.3a	61.6f	77.5A	20b	23.2a	21.6A
T6	98.3b	66.6g	82.5C	8.3bcd	7.6cd	8.0DE	83.3c	43.0h	63.2C	10.2j	16.7de	13.4CB
T7	101.0ab	77.0e	89.0A	9.0abc	9.3ab	9.2ABC	86.6b	68.3e	77.5A	20.3b	23.3a	21.8A
T8	97.3bc	64.6g	81.0CD	9.0abc	8.6bc	8.8BCD	80.3d	43.3h	61.8C	15.4ef	13.3gh	14.4B
Mean	96.9A	70.8B		8.6A	8.6A		76.3A	52.7B		15.6B	17.6A	
						2016/2017						
T1	89.3c	68.3f	78.8C	7.0d	7.3cd	7.2D	60.0gh	40.7i	50.3D	13.1gh	13.9fg	13.5D
T2	95.3b	72.3ef	83.8B	8.3abcd	8.3abcd	8.3C	65.0f	61.3g	63.2C	14.5ef	16.1cd	15.3C
T3	101.0a	84.0d	92.5A	9.3a	9.7a	9.5AB	88.0ab	69.3de	78.7A	17.8b	20.1a	18.9A
T4	96.3b	70.0f	83.2B	8.3abcd	7.7bcd	8.0CD	67.0ef	57.7h	62.3C	13.8fg	16.1cd	14.9C
T5	103.3a	83.3d	93.3A	9.7a	9.7a	9.7A	90.7a	70.0d	80.3A	17.9b	20.5a	19.3A
T6	96.0b	74.7e	85.3B	8.3abcd	8.3abcd	8.3C	81.0c	60.7g	70.3B	12.5h	16.7bc	14.5C
T7	104.0a	87.3cd	95.7A	9.0ab	9.7a	9.3AB	87.0b	71.7d	79.3A	17.8b	19.4a	18.6A
T8	95.0b	75.0e	85.0B	8.7abc	8.7abc	8.7BC	80.0c	60.3gh	70.2B	15.4de	17.3bc	16.3B

Values with the same alphabetical letters, within a comparable group of means, do not significantly differ from one another, according to L.S.D test at 0.05 level of probability.

Table 3: Effect of bio- stimulants treatments on yield and its components of two garlic cultivars during both seasons 2015/2016 and 2016/2017

Treatment	Nick diameter(cm)			Number of cloves(Number/Bulbs)			Bulb diameter(cm)			Bulbs fresh weight (g/plant)			Total bulb yield ton/fed.		
	Balady	Sids40	Mean	Balady	Sids40	Mean	Balady	Sids40	Mean	Balady	Sids40	Mean	Balady	Sids40	Mean
2015/2016															
T1	1.2d	1.2d	1.2C	31.0d	14.3g	22.7D	4.8g	5.1f	4.9E	58.3h	50.3i	54.3G	8.01g	9.76e	8.88D
T2	1.2d	1.8b	1.5AB	33.3c	15.0fg	24.3C	5.3e	5.6bcd	5.4CD	83.6e	91.0d	87.3C	8.62g	10.05d	9.33C
T3	1.7bc	1.6c	1.6A	46.7a	19.3e	33.0A	5.7b	5.9a	5.8A	98c	120.0a	109.0A	8.98a	10.85a	9.91A
T4	1.2d	1.7bc	1.4B	33.3c	14.7g	24.0C	5.6bcd	5.5cd	5.5BC	83.3e	85.3e	84.3D	8.46d	10.41bc	9.43B
T5	1.3d	1.8b	1.6A	46.0a	20.7e	33.3A	5.7b	5.8a	5.7A	93.0cd	117.3b	105.2B	8.82b	10.92a	9.87A
T6	1.3d	1.6c	1.4B	39.3b	16.3f	27.8B	5.1f	5.6bcd	5.3D	71.6g	76.0f	73.8F	8.24f	10.56b	9.40B
T7	1.2d	2.0a	1.6A	46.7a	20.0e	33.3A	5.6bcd	5.8a	5.7A	96.6c	124.0a	110.3A	8.88b	10.89a	9.88A
T8	1.3d	1.6c	1.4B	40.0b	16.3f	28.3B	5.4de	5.7b	5.5BC	74.6fg	85.3e	80.0E	8.54e	10.32c	9.43B
Mean	1.3B	1.6A		39.5A	17.1B		5.4B	5.6A		82.3B	93.6A		8.57B	10.47A	
2016/2017															
T1	1.1d	1.1ed	1.1C	22.6d	11.6f	17.2B	4.8de	5.2cd	5.1C	33.0i	63.3d	48.2E	7.30fg	8.95f	11.12D
T2	1.2d	1.2d	1.2BC	23.0d	12.3f	17.6B	4.6ef	5.7a	5.2BC	36.3hi	71.6c	54.0D	7.36f	9.25d	11.30C
T3	1.1d	1.6bc	1.3AB	33.3a	16.3e	24.8A	5.1cd	5.9a	5.4A	55.0ef	81.6a	68.3AB	7.87a	9.77ab	11.82A
T4	1.0e	1.5c	1.2BC	25.3cd	12.0f	18.6B	4.2g	5.7a	4.9C	41.3gh	70.0c	55.6CD	7.53cd	9.13e	11.33C
T5	1.0e	1.7ab	1.3AB	33.3a	17.6e	25.5A	5.3bc	5.3bc	5.3AB	51.0f	79.0ab	65.0B	7.75ab	9.56bc	11.65B
T6	1.0e	1.3d	1.2BC	27.0c	12.3f	19.6B	4.3fg	5.7a	5.1C	41.3gh	75.0bc	58.1C	7.44de	9.60b	11.52B
T7	1.0e	1.8a	1.4A	31.6ab	17.3e	24.5A	4.9d	5.6ab	5.3AB	60.6d	80.0ab	70.3A	7.92a	9.96a	11.94A
T8	1.1d	1.3d	1.2BC	28.3bc	11.0f	19.6B	4.5ef	4.8de	4.7D	45.0g	60.0de	52.5D	7.65bc	9.45c	11.50B
Mean	1.1B	1.4A		28.1A	13.8B		4.7B	5.5A		45.4B	72.5A		7.10B	9.46A	

Values with the same alphabetical letters, within a comparable group of means, do not significantly differ from one another, according to L.S.D test at 0.05 level of probability.

Chemical contents of garlic bulb

a- Effect of cultivar

The results in Table (4) showed that there were significant differences concerning the effect of two cultivar tested. N%, P%, K% and dry matter% contents of bulbs were significantly affected by Sids 40 cultivar compared by Balady cultivar. These results were true in the two seasons of study. Obtained results may be due to the difference in genotype potential which affects the accumulation of N, P and K in garlic cloves.

b- Effect of bio-stimulants treatments

The percentage of N, P, K, and dry matter content of bulbs were increased as a result of application with all bio-stimulants treatments compared with the control in both seasons. Table (4) illustrated the treatment T7 significantly increased means values for N% in garlic bulbs content in both seasons. Meanwhile, the highest means values for P% were recorded by T3, T5 and T7 treatments in both seasons. T3 and T5 treatments resulted in the highest values of K% content in bulbs in both seasons. Bulbs dry matter % content was significantly affected withT5 and T7 treatments during two growing season and T3 treatment in the second season. The application of seaweeds extract for different crops of a great importance due to its contents of high levels of organic matter, essential macro and micro nutrients and vitamins (Crouch and Van-staden, 1992). Similar trend of results, as previously, were reported by several researchers for several crops, Pise and Sabale (2010) showed that nitrogen content was increased in seaweed treated plants. In the same direction, there was significant effect due to seaweed treatment on nitrogen, phosphorous and potassium in leaves of cucumber plants (Abdulraheem, 2009). Meanwhile, the glob artichoke head concentration of N, P and K were positively and significantly responded to application of seaweeds, chitozan and their combination in the two seasons.

c- Effect of interactions

Data in Table 4, showed that there were significant differences in the interaction between the bio-stimulants treatments and the two studied cultivars. Meanwhile T3, T5 and T7 treatments gave the highest mean value in sids 40cultivar regarding to bulb dry matter% in the both seasons. Meanwhile, the highest mean values of N% content of bulbs were recorded in the treatments of T5 and T7 in the first season and T7 treatments in second season regarding to Sids 40 cultivar. Data showed also that, the highest mean values of P% content of bulbs were at T3, T5 and T7 treatments in Sids 40 cultivar for both season and T5 and T7 treatments with Balady cultivar in the first season. Moreover, the highest mean values of K% were recorded in Sids 40 cultivar regarding to T3 and T5 treatments in both seasons and with T6 and T7 treatments in the second season. In addition, the highest mean values of K% were recorded in Balady cultivar regarding to T3 and T7 treatments in the second season. The obtained results are in accordance with Al-Said and Kamal, 2008 and Faten *et al.,* (2010). With regard of P%, the highest amount of P was recorded by foliar sprayed of chitosan at rate of 3 cm/L. Meanwhile, the lowest amount of P was recorded by control treatment.

Table 4: Effect of bio –stimulate on N%,P% ,K% and dry matter(%) content of bulbs of the two garlic cultivars during both seasons2015 /2016 and2016/2017.

Treatments	Nitrogen%			Phosphorus%			Potassium%			Bulbs dry matter (%)		
	Balady	Sids40	Mean	Balady	Sids40	Mean	Balady	Sids40	Mean	Balady	Sids40	Mean
2015/2016												
T1	2.10i	2.40i	2.25F	0.33e	0.35e	0.34C	1.85g	2.22ef	2.03D	11.1g	15.0e	13.1F
T2	2.66h	2.64h	2.65E	0.33e	0.38cde	0.36C	2.11fg	2.45de	2.28C	11.8g	16.8d	14.3E
T3	3.16fg	4.69cd	3.92D	0.45bcd	0.52ab	0.49A	3.17bc	3.57a	3.37A	19.1bc	21.8a	20.5B
T4	2.84gh	2.90gh	2.87E	0.33e	0.39cde	0.36C	2.37def	2.13efg	2.25C	16.9d	17.0d	16.9C
T5	3.28f	5.62ab	4.45C	0.49ab	0.54ab	0.51A	3.11bc	3.36ab	3.23AB	20.0b	22.0a	21.0AB
T6	4.36de	4.89c	4.63BC	0.39cde	0.46bcd	0.43B	2.44de	2.44de	2.44C	13.4f	18.1cd	15.7D
T7	5.61ab	5.88a	5.75A	0.51ab	0.55a	0.53A	2.91c	3.16bc	3.03B	20.0b	23.3a	21.6A
T8	5.30b	4.30e	4.80B	0.37e	0.47bc	0.42B	2.57d	2.27def	2.42C	15.4e	17.2d	16.3CD
Mean	3.66B	4.16A		0.40B	0.46A		2.56B	2.70A		15.9B	18.9A	
2016/2017												
T1	2.13h	2.44h	2.28E	0.39d	0.37d	0.38D	1.82fg	1.54g	1.68C	11.3g	13.6f	12.5D
T2	2.67g	2.69g	2.68D	0.44cd	0.46bcd	0.41CD	2.14efg	2.46cdef	2.30B	12.3g	17.7cd	15.1C
T3	3.28f	4.37e	3.83C	0.57abc	0.67a	0.62A	2.90abcd	3.36a	3.13A	18.3bcd	24.0a	21.1A
T4	2.87g	2.97fg	2.92D	0.41d	0.50bcd	0.46BCD	2.14efg	2.52cdef	2.33B	14.3ef	17.3d	15.8C
T5	3.30f	5.72ab	4.51B	0.50bcd	0.59ab	0.55AB	2.64bcde	3.24ab	2.94A	18.5bcd	23.6a	21.1A
T6	4.27e	4.79d	4.53B	0.46bcd	0.52bcd	0.49BC	2.06efg	2.72abcde	2.39B	12.4g	18.7bc	15.5C
T7	5.51bc	5.88a	5.69A	0.49bcd	0.61ab	0.55AB	2.72abcde	3.16abc	2.94A	18.2bcd	23.3a	20.7A
T8	5.16c	4.36e	4.76B	0.47bcd	0.51bcd	0.49BC	2.30def	2.52cdef	2.41B	15.1e	19.4b	17.2B
Mean	3.64B	4.14A		0.47B	0.53A		2.34B	2.69A		15.1B	19.7A	

Values with the same alphabetical letters, within a comparable group of means, do not significantly differ from one another, using Duncan's multiple range test at 0.05 level of probability.

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الملخص العربي

تحسين الجودة و محصول التقاوي لصنفين من الثوم بمستخلصات الأعشاب البحرية و الميكوريزا

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أجريت هذه الدراسة خلال الموسمين الشتويين 2016/2015 – 2017/2016 على التوالي في مزرعة خاصة في منطقة شرنوب بمدينة دمنهور بمحافظة البحيرة بهدف دراسة تأثير إضافة بعض المنشطات الحيوية(الكنترول(بدون معاملة)، الرش بمستخلص الطحالب البحرية، نقع الفصوص في مستخلص الطحالب البحرية قبل الزراعة، النقع و الرش بمستخلص الطحالب البحرية، تلقيح التربة بالميكوريزا قبل الزراعة إضافة الميكوريزا للتربة مع الرش بمستخلص الطحالب البحرية، النقع في مستخلص الطحالب البحرية مع تلقيح التربة بالميكوريزا والنقع والرش بمستخلص الطحالب البحرية مع تلقيح التربة بالميكوريزا) على النمو الخضري والمحصول ومكوناته لصنفي الثوم البلدي وسدس 40. وقد أوضحت النتائج وجود فروق معنوية بين الصنفين المختبرين حيث تفوق الصنف سدس 40 في متوسط إنتاج المحصول للفدان وبعض الصفات مثل قطر العنق وقطر البصلة ووزن البصلة والنسبة المئوية لمحتوى البصلة من عناصر النتروجين الفسفور والبوتاسيوم والمادة الجافة خلال موسمي الزراعة. كذلك أفادت النتائج أن تطبيق المعاملات نقع الفصوص قبل الزراعة في مستخلص الطحالب البحرية أو إضافة الميكوريزا للتربة أو النقع في مستخلص الطحالب البحرية مع إضافة الميكوريزا للتربة قبل الزراعة إلى زيادة معنوية على صفات النمو الخضري ومحصول الثوم للفدان و محتواه من النتروجين% والفسفور% والبوتاسيوم%. كما كان تأثير التداخل بين الصنفين ومعاملات إضافة المنشطات الحيوية معنويا على صفات النمو الخضري والمحصول خلال موسمي الزراعة. ولذلك نوصى بناء على النتائج المتحصل عليها وتحت ظروف هذه التجربة بزراعة الصنف سدس 40 مع تطبيق المعاملات نقع الفصوص فى مستخلص الطحالب البحرية أو تلقيح التربة بالميكوريزا أو نقع الفصوص قبل الزراعة في مستخلص الطحالب البحرية مع تلقيح التربة بالميكوريزا حيث أعطت أعلى النتائج لصفات المحصول في كلا الموسمين.