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Improving The Productivity and Quality of The Cucumber Crop Grown Under Greenhouse Conditions Using Some Stimulants and Spraying Amino Acids

Shehata, S. A.*; H. A. Hassan*; A. A. Tawfik and Mervat F. Farag*****
*** Vegetable Dept. Fac. Agric., Cairo. Univ., Egypt**
****Hort. Res. Inst., ARC, Egypt**
***** Giza Agricultural High School, Giza, Egypt**

ABSTRACT

Two field experiments were carried out during the two successive early autumn seasons of 2012/2013 and 2014/2015 to study the effect of the both amino acids as foliar application (0 and 2 g/l) and some stimulants ,i.e., microbial inoculants, humic acid, effective microorganisms (EM) and yeast strains (*Saccharomyces cerevisiae*, 110) as soil application on early and total fruit yield, its components and fruit quality. Spraying cucumber plants with amino acids increased significantly early yield and total yield in the first season only and average fruit weight in the second season only while TSS was significantly increased in both seasons. Also, microbial inoculants gave the highest number of fruits/m^2, average fruit weight; early and total yield /m^2 and TSS in both seasons except average fruit weight in the second season only comparing with the other stimulants. Microbial inoculants gave the lowest value of nitrate concentration of fruits comparing with the other stimulants. The combination effect of stimulants and amino acids seems to increase early and total fruit yield and its components and fruit quality. In this connection using microbial inoculants or EM and amino acids gave the highest values of early and total fruit yield and its components and fruit quality.

INTRODUCTION

Cucumber (*Cucumis sativus*) is among the most important vegetable crops grown in Egypt for local consumption and exportation. Increasing the productivity of cucumber fruits with high quality is considered an important aim that could be archived through using the foliar application of amino acid and soil fertilizer with some stimulants materials. Amino acids are a well-known stimulant which has positive effects on plant growth, yield and significantly mitigates the injuries caused by abiotic stresses. Also, amino acids an essential quantity is well known as a means have positive effects on plant growth, yield and quality of different crops. Amino acids are fundamental ingredients in the process of protein synthesis; formation of plant tissue and chlorophyll synthesis (Kowalczyk and Zielony, 2008). El-Shabasi *et al*. (2005) found that treatments of amino acids significantly improved fruits yield and its components of cucumber. Abo Sedera *et al*. (2010) found that strawberry plants sprayed with amino acids at 1.0 g/l exhibited the highest significant values of total yield, average fruit weight and its components.

The effect of amino acids on decreasing nitrate concentrations in onion and lettuce has been reported by (Gunes *et al*., 1994 & 1996). In the same respect, bio-stimulants able to promote vegetative growth, mineral nutrient uptake and improve the productivity of many plants (Fayad, 2005; Fathy *et al.*, 2008; Hassan *et al.*, 2008.Amal *et al.*, 2010; Sarhan *et al.*, 2011, Hernández *et al.*, 2013, Hassan *et al.*, 2013 and Shafeek *et al.*, 2014). The use of biostimulants has also been affected earliness (Botta *et al*., 2009, Marfà *et al*., 2009) and fruit quality (Masny *et al*., 2004, Sarli *et al*., 2009, Abdel-Mawgoud, 2010). Free-living soil bacteria beneficial to plant growth are usually referred to as plant growth promoting rhizobacteria (PGPR), capable of promoting plant growth by colonizing the plant root (Kloepper and Schroth, 1978; Kloepper *et al*.,1989; Cleyet *et al*. ,2001**).** Effective Microorganisms (EM) is a mixture of beneficial and effective Micro-organism that can be used by two ways; watering into the soil or foliar spray. EM contains selected species of microorganisms, including predominant populations of lactic acid bacteria, yeasts, smaller numbers of photosynthetic bacteria, actinomycetes and other types of organisms. Yeast treatment plays a beneficial role in improving the formation of flower initiation due to its effect on carbohydrates accumulation. Also, a stimulatory effect on cell division and enlargement, protein and nucleic acid synthesis and chlorophyll formation (Swelam,, 2012). Yeast is a natural bio-substance suggested to have stimulating, nutritional and protective functions when used on vegetables. Many studies indicated that yeast is one of the richest sources of high quality protein, especially the essential amino acids like lysine and tryptophan, essential minerals as calcium and trace elements as cobalt and iron. Yeast is the best source of the B-complex vitamins and a valuable source of bio-constituents especially cytokinins (Amer, 2004). Also Mahmoud *et al*. (2013) found that yeast extracts improved pea vegetative growth, green pods yield and pod quality with using the highest level of yeast extract (2%). Foliar application of yeast increased yield and quality of lettuce (Fawzy, 2007), eggplant (El-Tohamy *et al*., 2008) and cucumber (Shehata *et al*., 2012). Foliar sprays of these substances also promote growth and increases yield and quality in a number of plant species (Brownell *et al*., 1987; Yildirim, 2007; Karakurt *et al*., 2009 and Halime *et al*., 2011). Zaky *et al*. (2006) found that the total yield and average pod fresh weight were increased by application of humic acid as a foliar fertilizer at a rate of 1 g/l. Different reports indicated that HA treatments improved some fruit characteristics of various plants including cucumber, tomato, eggplant and pepper (Karakurt *et al*., 2009; Arancon *et al*., 2006 and Yildirim, 2007). Mahmoud *et al.* (2009) showed that cucumber plants sprayed with humic acid (0, 1, and 2 g/l) or seaweed

extract (0, 2, and 3 ml/l) led to positive significant differences in fruits number, early and total yield as well as fruit weight, fruit length, yield per plant, fruit dry weight and TSS as compared to untreated plants.

The main objective of this investigation was to evaluate the impact of amino acids as foliar application and using some stimulants i.e., microbial inoculants, humic acid, EM and yeast strains (*Saccharomyces cerevisiae*, 110) as soil application on yield, yield components and quality of cucumber under greenhouse.

MATERIALS AND METHODS

Two experiments were carried out in plastic greenhouses (8.5 × 40 m, 2.7 height) at the Faculty Agriculture Farm, Cairo University, during 2012/3013 and 2014/2015 successive early autumn seasons to study the effect of amino acids as foliar application and some stimulants ,i.e., Microbial inoculants, humic acid, EM and yeast strains (*Saccharomyces cerevisiae*, 110) as soil application on yield, yield components and quality on cucumber (*Cucumis sativus* L.) cv. Safa 62 in organic fertilizer as natural rocks; phosphate and potassium rock as well as compost under sand culture condition whereas the soil has been replaced with sand because of soil diseases. The sand culture were performed randomly collected at 5 samples and subjected to EC 1.2 and 1.8 (dS/m) and pH 7.84 and 5.95 at two seasons respectively.

Seeds of cucumber were sown in the nursery on 13thSeptember and September 7th in both seasons, respectively and seedlings were transplanted in the greenhouse on 28th and 22th of September in both seasons, respectively. The plastic greenhouse was 40 m long and 8.5 m wide (340 m^2) and divided into 5 beds, each 1 m wide and 40 m long. Seedlings were planted on two sides of each bed and 50 cm apart. All treatments were distributed at random. All experimental unites received identical amounts of nitrogen (22 kg N/100 m^2) provided from compost (1.49 and 1.34% N in the first and second years, respectively), phosphate (9 kg P_2O_5/100m^2) provided from the natural rock phosphate (20% P_2O_5) and potassium (25kg K_2O/100 m^2) provided from the natural rock potassium (10% K_2O) banded on rows during soil preparation before planting. The drip irrigation system and agricultural practices were followed as recommended. The physical and chemical properties of the soil under study determined at the Soil and Water Research Institute, ARC.

This experiment included ten treatments which were the combinations between amino acids (0 and 2 g/l) and four stimulants treatments (microbial inoculants, humic acid, effective microorganisms (EM) and yeast strains (*Saccharomyces cerevisiae*, 110) in addition to sprayed with tap water (control). A split plot design with three replicates was used in this experiment were amino acids treatments were arranged in main plots while, some stimulants were randomly distributed in sub plots. The area of each plot was 5 m^2 (5 m long and 1 m width) with 20 plants.

The treatments were as follows:

1. Foliar spray with amino acid
a. Amino acids at 2 g/l
b. Spray with tap water (control)

Amino acids were spraying with a rate of 2 gm/l at each time (once every 7 days) started from transplanting until end of the season.

1. stimulant treatments:
1. Microbial inoculants (7.5 g/100m^2)
2. Humic substance (250g/100 m^2)
3. Effective Microorganisms (EM) (1.5 l / 100 m^2)
4. Yeast (3.6 l /100 m^2)
5. Sprat with tap water (control)

Regarding the use of stimulants (microbial inoculants, humic substance, EM and yeast) were applied in the soil around plants three times (once every 15 days) started from transplanting.

Microbial inoculants: mixed inocula from nitrogen fixing bacteria" *Azotobacter sp*", phosphate dissolving bacteria " *Bacillus megaterium* " and potassium dissolving bacteria " *Bacillus circulans*" by the rate of 7.5 g/100 m^2, each inoculum has 10^8/g bacterial cells obtained from Agriculture Research Center, Central Lab Of Organic Agriculture; ARC; Egypt.

Humic substance: The composition of humic acid (K-humate content of 85.0% humic acids) was applied around plants with a rate (250g/100 m^2).

The Effective Microorganisms (EM): Stock solution has been produced and available at the Ministry of Agriculture, Egypt. The EM is composed of about 80 different beneficial microorganism species (Hu and Qi, 2013).

Among the different microorganism species contained in the EM are the lactic acid bacteria, photosynthetic bacteria, yeasts, and fungi with a rate of (1.5 l / 100 m^2).

Yeast: *Saccharomyces cerevisiae* was applied around plants with a rate of 3.6 l /100 m^2 at each time. Obtained from Biofertilization Production Unit; Soils, Water and Environment Research Institute; ARC; Egypt.

Data recorded were as follows

1- Yield and its components

a. Early yield:

Fruit of first three harvests from each treatment were weighted calculated the early yield (kg/m^2). The first harvest date was on 1st November and October 28th in both seasons at 36 and 37 day after transplanting, respectively and the time between harvests 3 and 4 days in both seasons, respectively.

b. Total yield

Determined for all pickings and calculated as total fresh weight of fruits (kg/m^2).

c. Fruit characteristics:

1. Total number of fruits/plant
2. Average fruit weight (g)

2- Quality of cucumber fruits

a. Total soluble solids percentage (TSS):

Was determined by using a hand refractometer.

b. Nitrate concentration:

Nitrate concentration of fruits was determined at 90 days after transplanting (DAT). Fruits were Oven-dried at 70°C until constant weight (James,1995). The fruit-nitrate concentration (ppm) was estimated following the Salicylic acid method (Cataldo *et al*., 1975). All chemical determinations were calculated on dry weight basis.

3- Statistical analysis

Data were statistically analyzed according to Snedecor and Cochran (1991). The Fishers protected least significant difference (LSD) at P≤0.05 was employed to separate the treatment means.

RESULTS AND DISSCUSION

1- Yield and its components.

(a) Effect of amino acids foliar application.

Data presented in Tables 1 and 2 showed that cucumber plants sprayed with amino acids significantly affected average fruits weight in the second season only, however, the highest value in average fruits weight were recorded from plant sprayed with amino acids while the lowest value was recorded from control. Concerning the effect of number of fruits/m^2, there were no significant in this respect differences between amino acids and untreated control in the two seasons. Regarding the effect of amino acids on early and total yield data revealed that plants sprayed with amino acids was significantly effective for increasing early and total yield in the first season only. The lowest values of early and total yield were obtained from control (spray with tap water).

Amino acids in essential quantities are well known as a means have positive effects on plant growth of different crops. Similar effect and findings about amino acids were indicated by Abo Sedera *et al*. (2010) on strawberry and El-Desouky *et al*. (2011) on tomato.

(b) Effect of some stimulant treatments.

Data presented in Tables 1 and 2 shows that cucumber plants treated with microbial inoculants, humic acid, EM and yeast strains (*Saccharomyces cerevisiae*, 110) significantly affected number of fruit / m^2, average fruit weight, early and total yield /m^2 during the two seasons of growth compared with the untreated control treatment during the both seasons of study.

Table(1) Effect of using some stimulants and spraying amino acids on yield and its components of cucumber in 2012/2013 season.

Treatments		Average fruit weight (g)	Number of fruit/m^2	Early yield (kg/m^2)	Total yield (kg/m^2)
amino acids	stimulants				
0 (conrol)		75.32	124.4	1.427	8.973
2 g/l		76.18	129.4	1.781	10.160
LSD at 5%		NS	NS	0.305	0.992
	Microbial	78.12	137.6	2.142	10.620
	Humic acid	76.03	126.4	1.815	9.190
	EM	76.45	133.9	1.925	10.510
	Yeast	74.82	125.2	1.232	9.140
	Untreated (control)	73.31	111.3	0.907	8.273
LSD at 5%		2.97	7.6	0.579	0.665
	Interaction amino acids × stimulants				
	Microbial	77.47	134.3	1.943	9.910
	Humic acid	75.91	128.4	1.543	9.743
0 (conrol)	EM	76.02	128.9	1.853	8.590
	Yeast	74.82	123.8	0.913	8.627
	Untreated (control)	72.39	106.7	0.880	7.993
	Microbial	78.78	146.8	2.340	11.50
	Humic acid	76.16	126.7	1.777	9.797
2 g/l	EM	76.89	138.9	2.307	11.310
	Yeast	74.82	118.6	1.550	9.653
	Untreated (control)	74.23	115.9	0.933	8.553
LSD at 5%		4.19	10.70	0.819	0.942

Microbial: Microbial inoculants; mixture of nitrogen fixing bacteria" *Azotobacter sp*", phosphate dissolving bacteria " *Bacillus megaterium* " and potassium dissolving bacteria " *Bacillus circulans*" EM: Effective Microorganisms
Yeast: Yeast extract

Table (2) Effect of using some stimulants and spraying amino acids on yield and its components of cucumber in 2014/2015 season.

Treatments		Average fruit weight (g)	Number of fruit/m^2	Early yield (kg/m^2)	Total yield (kg/m^2)
amino acids	**stimulants**				
0 (conrol)		71.36	115.6	1.293	8.480
2 g/l		77.06	118.9	1.472	9.582
LSD at 5%		3.20	NS	NS	NS
	Microbial	75.52	126.4	1.737	9.955
	Humic acid	73.88	123.1	1.523	9.058
	EM	75.39	123.2	1.675	9.878
	Yeast	73.19	117.9	1.092	8.642
	Untreated (control)	73.07	95.8	0.885	7.622
LSD at 5%		NS	5.3	0.488	0.701
		Interaction amino acids × stimulants			
	Microbial	74.50	131.5	1.687	9.110
	Humic acid	70.01	117.0	1.353	8.567
0 (conrol)	EM	73.39	121.3	1.630	9.063
	Yeast	69.99	116.8	0.960	8.250
	Untreated (control)	68.90	91.4	0.833	7.410
	Microbial	77.75	135.7	1.843	10.800
	Humic acid	77.23	114.8	1.663	9.550
2 g/l	EM	77.38	129.5	1.693	10.690
	Yeast	76.54	114.5	1.223	9.033
	Untreated (control)	76.39	100.1	0.937	7.833
LSD at 5%		5.09	7.4	0.690	0.991

Microbial: Microbial inoculants; mixture of nitrogen fixing bacteria" *Azotobacter sp*", phosphate dissolving bacteria " *Bacillus megaterium* " and potassium dissolving bacteria " *Bacillus circulans*" EM: Effective Microorganisms
Yeast: Yeast extract

From the above-mentioned results, it can be noticed that microbial inoculants gave the highest number of fruit / m^2, average fruit weight, early and total yield /m^2 comparing with the other stimulants, while the lowest value number of fruit / m^2 were recorded from untreated control, Early and total yield /m^2 during the two seasons of growth was obtained by control treatment (without treated). stimulant treatments naturally activate the microorganisms found in the soil restoring the soil's natural fertility and protecting it against drought and soil diseases and therefore number of fruit / m^2 , average fruit weight ,early and total yield /m^2 (Han *et al*., 2006). EM contains has a stimulatory effect on number of fruit / m^2, Early and total yield /m^2 (Swelam, 2012). Humic substances are generated through organic matter decomposition and employed as soil fertilizers in order to improve soil structure and soil microorganisms. Foliar sprays of these substances also promote growth in a number of plant species (Brownell *et al*., 1987; Yildirim, 2007; Karakurt *et al*., 2009 and Halime *et al*., 2011) at least partially through increasing nutrient uptake, serving as a source of mineral plant nutrients and regulator of their release (Chen and Aviad, 1990; Atiyeh *et al*., 2002). Zaky *et al*. (2006) Growth of tomato, cucumber and bean plants tended to be increased by treatments of humic acids (Atiyeh, *et al*., 2002, Turkmen, *et al*., 2004 and Zaky *et al*., 2006). Different reports indicated that HA treatments improved growth and some fruit characteristics of various plants including cucumber, tomato, eggplant and pepper. The results showed that spraying humic acid or seaweed extract led to positive significant differences in fruits number, early and total yield as well as fruit weight, fruit length, yield per plant, fruit dry weight, fruit chlorophyll content as compared to untreated plants (Mahmoud *et al*., 2009). Also, Mahmoud *et al*. (2013) found that yeast extracts improved pea vegetative growth. Foliar application of yeast increased yield and quality of lettuce (Fawzy, 2007), eggplant (El-Tohamy *et al*., 2008) and cucumber (Shehata *et al*., 2012)

(c) Effect of the interaction.

The combination between foliar application of amino acids and some stimulants , i.e., Microbial inoculants, humic acid, EM and yeast strains (*Saccharomyces cerevisiae*, 110) significantly affected number of fruit / m^2, average fruit weight, early and total yield /m^2 compared with the control treatment (without treated) during the both seasons of study. Foliar application amino acids show that combined with microbial inoculants increased most of number of fruit / m^2, average fruit weight, early and total yield /m^2 Tables 1 and 2. In this respect, foliar application amino acids show that combined with microbial inoculants gave the highest values of number of fruit / m^2, average fruit weight, early and total yield /m^2 comparing with other interaction treatments. These results were true in the two seasons of experiment. These results may be due to the role of nitrogen on synthesis of chlorophyll,

enzymes and proteins which in turn increases the vegetative growth. Many investigators obtained data support the recent results Mahmoud *et al*. (2013) found that the highest values of number of fruit / m^2, average fruit weight, early and total yield /m^2 were obtained from using stimulant treatments as compared with untreated plants of pea. Foliar application of yeast increased growth of lettuce (Fawzy, 2007), eggplant (El-Tohamy *et al*., 2008) and cucumber (Shehata *et al*., 2012).

2- Fruits quality

a. Total soluble solids percentage (TSS):

(1) Effect of amino acids foliar application.

Data presented in Table (3) show those amino acids foliar application significantly affected on total soluble solids percentage during the two seasons of growth. The highest values of total soluble solids percentage during the two seasons of growth were obtained by amino acids, while the lowest values were obtained by application of control treatment (foliar spray with tap water). Similar effect and findings about amino acids were indicated by Abo Sedera *et al*. (2010) on strawberry and El-Desouky *et al*. (2011) on tomato .

(2) Effect of some stimulant treatments.

Data presented in Table (3) show that treatment of cucumber plants with microbial inoculants, humic acid, EM and yeast strains (*Saccharomyces cerevisiae*, 110) significantly affected total soluble solids percentage during the two seasons of growth compared with the control treatment (without treated) during the both seasons of study .

From the above-mentioned results, it can be noticed that microbial inoculants gave the highest total soluble solids percentage comparing with the other stimulants, while the lowest total soluble solids percentage during the two seasons of growth was obtained by control treatment (without treated). EM contains has a stimulatory effect on total soluble solids percentage (Swelam, 2012). The results showed that spraying humic acid or seaweed extract led to positive significant differences in total soluble solids percentage as compared to untreated plants (Mahmoud *et al*., 2009).

(3) Effect of the interaction.

The combination between foliar application amino acids foliar application amino acids and some stimulants i.e., Microbial inoculants, humic acid, EM and yeast strains (*Saccharomyces cerevisiae*, 110) affected total soluble solids percentage compared with the control treatment (without treated) during the both seasons of study. Foliar application amino acids show that combined with microbial inoculants increased total soluble solids percentage in Table (3). In this respect foliar application amino acids show that combined with microbial inoculants gave the highest values of total soluble solids percentage comparing with other interaction treatments. These results were true in the two seasons of experiment. Many investigators obtained data support the recent results Mahmoud *et al*. (2013) found that the highest values of total soluble solids percentage were obtained from using stimulant treatments as compared with untreated plants of pea. Foliar application of yeast increased growth of eggplant (El-Tohamy *et al*., 2008) and cucumber (Shehata *et al*., 2012).

b. Nitrate concentration:

(1) Effect of amino acids foliar application.

Data presented in Table (3) show those amino acids foliar application non significantly affected nitrate concentration of fruits during the two seasons of growth. Similar effect and findings about amino acids were indicated by Abo Sedera *et al*. (2010) on strawberry and El-Desouky *et al*. (2011) on tomato .

(2) Effect of some stimulant treatments.

Data presented in Table (3) show that treatment of cucumber plants with microbial inoculants, humic acid, EM and yeast strains (*Saccharomyces cerevisiae*, 110) significantly affected nitrate concentration of fruits during the two seasons of growth compared with the control treatment (without treated) during the both seasons of study .From the above-mentioned results, it can be noticed that microbial inoculants gave the lowest value of nitrate concentration of fruits comparing with the other stimulants, while the highest value of nitrate concentration of fruits during the two seasons of growth was obtained by control treatment (without treated). Foliar sprays of these substances also promote growth in a number of plant species (Brownell *et al*., 1987; Yildirim, 2007; Karakurt *et al*., 2009 and Halime *et al*., 2011) at least partially through increasing nutrient uptake, serving as a source of mineral plant nutrients and regulator of their release (Chen and Aviad, 1990; Atiyeh *et al*., 2002).

(3) Effect of the interaction.

Data in Table (3) showed that the combination between foliar application of amino acids and some stimulants ,i.e., Microbial inoculants, humic acid, EM and yeast strains (*Saccharomyces cerevisiae*, 110) significantly affected nitrate concentration of fruits compared with the control treatment (without treated) during the both seasons of study. Foliar application amino acids show that combined with microbial inoculants decreased most of value of nitrate concentration of fruits. In this respect, foliar application amino acids show that combined with microbial inoculants gave the lowest value of nitrate concentration of fruits comparing with other interaction treatments. These results were true in the two seasons of experiment. Many investigators obtained data support the recent results Mahmoud *et al*. (2013) found the lowest value of nitrate concentration of fruits were obtained from using stimulant treatments as compared with untreated plants of pea. Foliar application of yeast increased yield and quality of lettuce (Fawzy, 2007), eggplant (El-Tohamy *et al*., 2008) and cucumber (Shehata *et al*., 2012).

Table (3) Effect of using some stimulants and spraying amino acids on quality of cucumber fruits nitrate concentration (ppm) and TSS of fruits at 90 DAT in 2012-2013 and 2014-2015 seasons.

Treatments		Season (2012-2013)		Season (2014-2015)	
amino acids	stimulants	Nitrate (ppm)	TSS	Nitrate (ppm)	TSS
0 (control)		1.425	3.99	1.071	3.96
2 g/l		1.544	4.30	1.177	4.19
LSD at 5%		NS	0.16	NS	0.09
	Microbial	1.127	4.57	0.840	4.32
	Humic acid	1.475	4.22	1.010	410
	EM	1.400	4.35	1.062	4.26
	Yeast	1.593	3.81	1.270	3.97
	Untreated (control)	1.827	3.78	1.440	3.72
LSD at 5%		0.039	0.16	0.186	0.13
	Interaction amino acids × stimulants				
	Microbial	0.953	4.37	0.700	4.10
	Humic acid	1.457	4.02	0.910	4.01
0 (control)	EM	1.373	4.19	0.977	4.05
	Yeast	1.493	3.82	1.213	3.87
	Untreated (control)	1.640	3.62	1.557	3.60
	Microbial	1.300	4.77	0.980	4.54
	Humic acid	1.493	4.33	1.110	4.29
2 g/l	EM	1.427	4.55	1.147	4.38
	Yeast	1.640	3.96	1.327	3.88
	Untreated (control)	1.640	3.82	1.323	3.73
LSD at 5%		0.055	0.23	0.263	0.18

Microbial: Microbial inoculants; mixture of nitrogen fixing bacteria" *Azotobacter* sp", phosphate dissolving bacteria " *Bacillus megaterium* " and potassium dissolving bacteria "*Bacillus circulans*" EM: Effective Microorganisms Yeast: Yeast extract

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تحسين إنتاجية وجودة محصول الخيار النامي تحت ظروف الصوب باستخدام بعض المنشطات والرش بالأحماض الأمينية

سعيد عبدالله شحاته* ، حسن علي حسن* , أحمد عبد المنعم توفيق و مرفت فراج فرج*****

*** قسم الخضر،كلية الزراعة ، جامعة القاهرة ، مصر**

**** معهد بحوث البساتين , مركز البحوث الزراعية , مصر**

*****مدرسة الجيزة الثانوية الزراعية ، مصر**

أجريت تجربتان حقليتان خلال موسمين في العروة الخريفية المبكرة 2012 / 2013 و2014 / 2015 لدراسة تأثير كل من الأحماض الأمينية رش ورقي (0 , 2 جم/لتر) وبعض المنشطات مثل التلقيح البكتيري، حامض الهيوميك، EM، وسلالات الخميرة (*Saccharomyces cerevisiae*, 110) كتسميد أرضي علي محصول الثمار المبكر والكلي، ومكوناته وجودة الثمرة. رش نباتات الخيار بالأحماض الأمينية أدي إلي تأثيراً معنوياً في زيادة المحصول المبكر والمحصول الكلي في الموسم الأول فقط ومتوسط وزن الثمرة في الموسم الثاني فقط بينما كان التأثير معنوياً في TSS كلا الموسمين. أيضاً التلقيح البكتيري أعطي أعلي عدد ثمار /م2، متوسط وزن الثمرة، المحصول المبكر والمحصول الكلي ما عدا متوسط وزن الثمرة في الموسم الثاني مقارنة بالمنشطات الأخري. التلقيح البكتيري أعطي أقل قيمة لتركيز النترات في الثمار مقارنة بالمنشطات الأخري. تأثير التفاعل بين المنشطات والرش بالأحماض الأمينية يظهر زيادة محصول الثمار المبكر والكلي، ومكوناته وجودة الثمرة. تجمل الدراسة أن استخدام التلقيح البكتيري أو EM مع الرش بالأحماض الأمينية أعطت أعلي قيم لمحصول الثمار المبكر والكلي، ومكوناته وجودة الثمار.