Journal of Agricultural Science; Vol. 4, No. 11; 2012
ISSN 1916-9752 E-ISSN 1916-9760
Published by Canadian Center of Science and Education

Influence of Foliar Application by EM "Effective Microorganisms", Amino Acids and Yeast on Growth, Yield and Quality of Two Cultivars of Onion Plants under Newly Reclaimed Soil

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Received: June 21, 2012 Accepted: July 17, 2012 Online Published: October 12, 2012

doi:10.5539/jas.v4n11p26 URL: http://dx.doi.org/ doi:10.5539/jas.v4n11p26

This research was funded by the key project of IGSNRR, CAS, grant number: 2012SJ003

Abstract

Two field experiments were carried out in two successive seasons of 2009/2010 and 2010/2011 in newly reclaimed soil at Wady Elmollak, Ismailia Governorate, Egypt to study response of two varieties of onion plant "Giza 20 and Super X" of foliar spraying of EM "Effective microorganisms", amino acids and yeast on growth, and its quality as well as chemical composition. Results showed that Giza 20 cv gave the highest amount of vegetative growth "plant height and fresh weight of leaves" in the two seasons. Whilst, Super X cv. gave the highest amount of fresh weight of bulbs and whole plants. Moreover, using Super X cv gave the highest yield and quality on onion. Furthermore, Giza 20 cv. gave the highest amount of T.S.S, N, P and K% as well as some trace elements compared with Super X cv. With regard to foliar application treatments, the results indicated that, using EM, amino acids and yeast had positive promoting effects by providing supplemental doses of these components on growth, yield and its quality as well as all chemical composition compared with control plants. It may be concluded that using yeast at rates of 3 gm./L gives the highest growth parameters. However, using EM at rates of 3 cm/ L gives the highest yield and its quality of onion plants. Generally, it can be found that, using Super X cv. with foliar spraying of EM give the highest amount of growth, yield and quality of onion plants.

Keywords: onion, EM "effective microorganism", amino acids, yeast, cultivars, growth, yield, chemical composition

1. Introduction

Onion (*Allium cepa* L.) is an important bulb crop grown worldwide. It is an important crop in all condiment and used of flavouring the food, both at mature and immature bulb stages besides being used as salad and pickles. To lesser extent, it is used by processing industry for dehydration in the form of onion flakes and powder, which are in great demand in the world market. The great advances in techniques and methods of production of this crop in Egypt during the last decade perhaps open enormous pathways for exportation. Thus, the present work has involved studies on foliar application onion with EM (effective microorganisms) amino green and yeast because it is well known that this kind of treatments for obtaining clean and safe product.

Farmers have adopted the strategy of increasing crop yields by applying large amounts of chemical fertilizers and pesticides. At present, however, the negative effects of heavy applications of chemical inputs, in terms of production, environment, and quality deterioration are becoming apparent (Nishio, 1996). The ultimate goal of sustainable agriculture is to develop farming systems that are productive, profitable, energy-conserving, environmentally-sound, conserving of natural resources such as soil and water, and that ensure food safety and quality.

The cultivars genotype plays an important role of growth, yield and quality on onion plants (Mostafa, 1998; Daiz, 1994; Mohanty, 2001; Rahmanet al., 2002; Leilahet al., 2003; Gomaa, 2006; Haydar et al., 2007).

Microbial fertilizer is one way that organic farmers are able to increase yield and quality of crops without a large investment of money and labor (Pham, 2004). Moreover, microbial fertilizer can clean the environment and encourage the productive capacity of land by reducing the amount of chemical fertilizer consumption (Pham, 2004).

Various effective microorganisms and physiological active substances are contained in EM. Therefore, it must be effective to improve the quality and productivity of soil and to increase the vegetable production (Higa, 1991). In general, the vegetable crops require many nutrients for short period of cultivation. It seems that EM is a good supply source of nutrients in vegetable crops, because EM can make a favorable condition for the growth of crops, promoting the mobilization of non-soluble and activating the beneficial microorganisms in soil (Higa,. 1991, 2000; Hussain et al., 2002). Application of EM is known to enhance crop growth and yield in many vegetable crops (Kengo & Hui-lian, 2000; Sheng & Lian, 2002; Javaid, 2006, 2009; Khaliq et al., 2006; Daiss et al., 2008; Javaid & Nasir, 2010).

The requirement of amino acids in essential quantities is well known as a means to increase yield and overall quality of corps (Sanaa, et al., 2001; Slviero et al., 2001; Attoa et al., 2002; El- Shabasi et al., 2005; Awad et al., 2007; Fawzy, 2007; Al-Said & Kamal, 2008; Faten et al., 2010; Fawzy et al, 2010; Shaheen et al., 2010).

Dry yeast is a natural bio-substance suggested to be of useful stimulatory, nutritional and protective functions when it is applied on to vegetable plants during stressful condition due to its hormones, sugars, amino and nucleic acids, vitamins and minerals. The dry bread yeast (*Saccharomyces cerevisiae*) is a kind of the used biofertilizers in soil fertilization or in foliar application on the shoots of vegetable crops (El-Ghamriny et al., 1999). This is because it's content of many nutrient elements and being productive compounds of semi growth regulator compounds like auxins, gibberellins and cytokinins (Glick, 1995). Glick recorded that the yeast was capable of increasing the simulative growth compounds like gibberellins, auxins and cytokinins that act in improving plant cell division and growth. Foliar application of yeast was found to increase growth, yield and quality of many vegetable crops (Abou El-Nasr et al., 2001; Gomaa et al., 2005, Mona et al., 2005; El-Tohamy & El-Greadly, 2007; El-Tohamy et al., 2008, Fawzy, 2007; Hussain & Khalaf, 2007; Fawzy et al., 2010; Ghoname et al., 2010).

The aim of present study was to evaluate the efficiency of foliar application of EM, active yeast extract and amino acids on improving onion growth, productivity and bulbs quality.

2. Material and Methods

Two successive field experiments were carried out on onion (*Allium cepa,* L.) in newly reclaimed soil at Wady Elmollak, Ismailia Governorate, Egypt during 2009/2010 and 2010/2011 seasons to study response of two varieties of onion plant growth, yield and quality to foliar nutrients. Seeds of onion cvs. Giza 20 and Super X were sown in the nursery on 15th and 7th of October in 2009 and 2010 seasons, respectively. All required agricultural managements for seedling production were carried out. Seedling was transplanted in the field after 45 days.

The experimental design was split plot with three replicates. Varieties of onion accepted the main plot and treatments of foliar nutrients were randomly allocated in the sub plots. Each experiment included twenty treatments representing the interaction between two varieties of onion i.e., Giza 20 and Super X with ten rates of foliar nutrients as follows:

* Control (Spray with tap water).

* Foliar spray of EM = Effective microorganism, at three rates (1 cm/L, 2 cm/L and 3 cm/L).

EM solution consists of useful micro-organisms and it safe for plants and soil. EM consists of photosynthesis bacteria, lactic acid bacteria and yeast. An EM effective microorganism is bio-fertilizer was got from Ministry of Egyptian Agriculture.

* Foliar spray of amino green II compound at three rates (1 cm/L, 2 cm/L and 3 cm/L.)

Amino green compound contains (w/v) total organic acids plus amino acids 15 %, iron (Fe), 2.9 %, Zinc (Zn) 1.4 % and Manganese (Mn) 0.7 %. Free amino acids, proline, Hydroxyl proline, Glysine, Alanine, Faline, Methionine, Escoliosin, Lyosine, Cyctin, Finel Alanin, Syrin, Glotomic) Arjenin, Hydroxy, Lysing and Hystiden. (Compound contain organic and amino acids and trace elements was got at from Dishner company for chemicals and trading, Giza- Egypt).

* Active dry yeast was used at three rates (1 gm. /L., 2 gm. /L., and 3 gm. /L)

The analysis of dry yeast was protein (47.2 %), Arginine (2.6 %), Glycin (2.6 %), Histidine (1.4 %), Esoloysine (2.9 %), Leucine (3.5 %), Lycine (3.8 %), Mehioninecystine (0.6 %), Phenyl-alanine (3 %), Tryptophan (0.5 %) and vitamin B (2.9 %) (N. R. P. 1977), Goyal and Khuller (1992), Yatskovskaya et al. (1992), Ahmed et al. (1997) and Khedr and Farid (2002) reported that yeast preparation contained carbohydrates, sugars, hormones, macro and micro elements in suitable balance.

Plants were sprayed with dry yeast, amino green compound and EM solution every week after month of transplanting for two month.

Data recorded:

A. Vegetative growth: five plants from each plot were chosen randomly 120 days after transplanting for measuring the following characters:

1. Plant height (cm).
2. Leaves number/ plant.
3. Bulb diameter (cm).
4. Neck diameter (cm).
5. Bulbing ratio
6. Fresh weight of plant and its organs (leaves and bulbs).

B. Yield: total yield of onion was recorded per feddan.

C. Bulb quality: weight and diameter of bulbs at harvesting were recorded.

Total soluble solids (T.S.S) were assayed according to A.O.A.C (1990). Total nitrogen and phosphorus contents were determined using Kieldahl method and colorimetric method using spectrophotometer (SPECTRONIC 20D, Milton Roy Co. Ltd., USA), according to the procedure described by Cottenie (1980). Potassium content was measured using flame photometer method (JENWAY, PFP-7, ELE Instrument Co. Ltd., UK) as described by Chapman and Pratt (1982).

Copper, Zinc, Iron and Magnesium were determined using the Atomic Absorption Spectrophotometer (Philips) according the methods described by Chapman and Pratt (1961).

The obtained data were subjected to the analysis of variance procedure and mean were compared using the L.S.D. method at 5 % level of significance according to Gomez and Gomez (1984).

3. Results and Discussion

3.1 Vegetative Growth

3.1.1 Effect of Varieties

Vegetative characters of onion plant expressed as plant height, leaf numbers, fresh weight of leaves, bulbs and total plant were statistically affected by varieties of onion plants (Table 1). The differences resulting by the varieties reached the level of significant at all vegetative growth characters in the two seasons of study except for number of leaves in the second seasons. In addition, the highest values in vegetative growth were obtained by the Giza 20 cv. except for fresh weight of bulb. On the other hand, the lowest values of plant growth (plant height, leaf number and fresh weight of leaves) were recorded by Super X cv. The observed differences in vegetative growth of cultivars are mainly due to the genotype of each cultivar. The observed differences in vegetative growth of cultivars are mainly due to the genotype of each cultivar. This result was in harmony with previous findings (Daiz, 1994; Mohanty, 2001; Rahman et al., 2002; Haydar et al., 2007).

Table 1. Effect of two varieties of onion on vegetative growth characters in the 2009/2010 and 2010/2011 seasons

Varieties	Plant height(cm)	Leaf No./plant	Fresh weight(gm.)			Plant height (cm)	Leaf No./plant	Fresh weight(gm.)		
			Leaves	Bulbs	Total		Bulbs	Leaves	Bulbs	Total
Giza 20	51.23	9.40	32.87	100.60	133.49	42.16	6.59	31.88	108.34	140.22
Super X	42.16	6.82	13.34	123.42	136.45	41.23	6.73	13.00	132.28	145.28
L.S.D at 0.05	0.66	0.56	1.71	7.65	0.08	0.23	NS	4.45	11.49	0.03

3.1.2 Effect of Foliar Application

Data in Table 2 shows clearly that foliar application of EM, amino green and yeast have a significant effect on the vegetative growth characterizes of onion plant in the two seasons of study. The increments were gradually and consistently with increasing the levels of yeast 1 gm. to 3 gm. /L. Generally, it could be concluded that, the highest values of plant height, number of leaves and fresh weight of onion plants were recorded by using yeast at rates of 3 gm. /L. compared with other treatments. On the contrary, the lowest values of vegetative growth of onion plants recorded by control plants (foliar spray with water). These findings were true in both seasons. These increments with using yeast as a foliar spray might be attributed to the effect of yeast extract in increasing levels of endogenous hormones in treated plants which could be interpreted to cell elongation and cell division (Khedr and Faried, 2002). Also, these results may be due to the physiological roles of vitamins and amino acids in the yeast extract which increased the metabolic processes rate and levels of indigenous hormones, i.e. LAA and GA_3 (Chailakhyn, 1957; N.R.P., 1977).

Table 2. Effect of foliar application of EM" Effective microorganisms", amino green (AG) and yeast on vegetative growth characters of onion plants in the 2009/2010 and 2010/2011 seasons

Treatments	Plant height(cm)	Leaf No./plant	Fresh weight(gm.)			Plant Height (cm)	Leaf No./plant	Fresh weight(gm.)		
			Leaves	Bulbs	Total			Leaves	Bulbs	Total
Control	36.08	6.25	8.19	45.08	53.27	35.83	5.27	10.30	50.95	61.25
EM 1	45.37	7.67	21.80	101.93	123.73	42.38	6.50	22.34	108.42	130.76
EM2	49.37	9.08	26.28	129.14	155.73	45.58	7.17	21.43	139.47	160.90
EM 3	47.78	8.83	31.49	159.33	187.82	40.72	7.50	32.63	162.74	195.37
AG 1	45.33	7.50	18.06	91.26	109.32	42.00	6.17	19.73	98.67	118.40
AG 2	49.25	8.25	22.88	111.86	134.74	45.33	6.08	23.09	120.65	143.74
AG 3	46.16	8.08	27.59	106.27	133.86	36.05	6.83	28.42	116.32	144.74
Yeast 1	48.48	7.33	18.26	90.46	108.72	40.87	6.42	19.10	98.86	117.96
Yeast 2	48.42	8.25	24.35	130.16	154.52	42.00	6.83	24.33	140.67	165.00
Yeast 3	50.60	9.83	32.28	156.08	188.36	45.58	7.83	32.99	166.35	199.34
L.S.D at0.05	2.95	1.84	7.72	30.93	34.72	3.04	1.08	9.32	30.92	22.34

3.1.3 Effect of the Interaction

The interaction effect within varieties of onion plants and foliar application treatments on vegetative characters of onion plant expressed as plant height leaves number, fresh weight of leaves, bulbs and total plant of onion plants shown in Table 3. There were significant differences in the all vegetative growth parameters in the first season except for number of leave parameter. Whilst, there were no significant effect in the all vegetative growth parameters in the second season except for total fresh weight of whole onion plant. Moreover, the highest plant height was recorded by Giza 20 cv. and foliar spray with yeast at a rate of 1 gm. /L in the first season and by Giza 20 cv. with foliar spray of yeast at rates of 3 gm. / L in the second one. On the contrary, the lowest value of plant height was found by Giza 20 cv. with foliar spray of water in the first season and by Super X cv. with control treatment (foliar spray with water) in the second season. With regard of number of leaves, data in Table 3 show that, the highest amount number of leaves was recorded by using Giza 20 cv with foliar spray of yeast at a rate of 3 gm. /L in the first season and by Super X cv and foliar spray of EM at rates of 3 cm/L in the second season. On the other hand, the lowest amount of number of leaves was found by Super X cv. and foliar spray of water in the first season and with Giza 20 cv. and foliar spray with water in the second season, respectively. However, the highest fresh weight of leaves was recorded by Giza 20 cv. with foliar spray of yeast at rates of 3 gm. /L in the first season, whilst, by using Giza 20 cv with foliar spray of AG at rates of 3 cm/L in the second one. On the contrary, the lowest values were recorded by Super X cv. with foliar spray of water. These findings were true in both seasons. Moreover, data in Table 3 demonstrated that, the highest fresh weight of bulb and whole plants were recorded by using Super X cv. with foliar spray of EM at rates of 3cm/L. On the other hand, the lowest values were found by Giza 20 cv. with foliar spray with water. These findings were true in both growing seasons.

Table 3. Effect of the interaction between varieties and foliar application of EM-Effective microorganisms, amino green (AG) and yeast on vegetative growth characters of onion plants in the 2009/2010 and 2010/2011 seasons

Varieties	Treatments	Plant height(cm)	Leaf No./plant	Fresh weight(gm)			Plant height(cm)	Leaf No./plant	Fresh weight(gm)		
				Leaves	Bulbs	Total			Leaves	Bulbs	Total
Giza 20	Control	35.83	7.00	10.01	27.93	37.93	36.33	4.87	11.61	28.46	40.07
	EM 1	47.68	8.33	31.78	102.76	134.55	43.05	6.67	31.13	107.43	138.56
	EM2	52.57	11.00	35.69	89.75	125.44	46.62	6.83	25.03	100.42	125.45
	EM 3	54.83	9.33	40.08	113.53	153.61	40.72	7.67	41.55	119.82	161.37
	AG 1	48.15	9.67	24.97	73.88	98.84	42.50	6.17	25.77	82.34	108.11
	AG 2	52.42	10.50	34.14	102.40	136.55	46.08	5.83	33.52	110.98	144.50
	AG 3	55.50	9.50	45.96	151.40	196.99	36.82	6.83	45.22	161.03	206.25
	Yeast 1	56.08	8.33	26.61	88.99	115.60	40.87	6.50	26.31	97.21	123.52
	Yeast 2	54.17	9.50	35.36	125.34	160.70	42.67	7.00	35.08	135.34	170.42
	Yeast 3	55.03	11.83	44.34	130.37	174.72	46.16	7.50	43.54	140.37	183.91
Super X	Control	36.33	5.50	6.37	62.24	68.60	35.33	5.67	8.98	73.44	82.42
	EM 1	43.05	7.00	11.81	101.10	112.91	41.72	6.33	13.54	109.40	122.94
	EM2	46.42	7.17	16.86	168.52	185.38	44.75	7.50	17.84	178.52	196.36
	EM 3	40.72	8.33	22.89	199.13	222.02	40.72	8.00	24.44	205.67	230.11
	AG 1	42.50	6.33	11.16	108.63	119.74	41.50	6.17	13.69	115.00	128.69
	AG 2	46.08	6.00	11.61	121.32	132.93	45.08	6.33	12.66	130.32	142.98
	AG 3	36.82	6.67	9.23	61.51	70.73	36.48	6.83	11.62	71.61	83.23
	Yeast 1	40.87	6.33	9.91	91.93	101.84	40.87	6.33	11.88	100.50	112.38
	Yeast 2	42.67	7.00	13.34	134.99	148.33	41.33	6.67	13.37	146.00	159.37
	Yeast 3	46.17	7.83	20.21	181.79	202.00	44.50	7.50	21.73	192.32	214.05
L.S.D. at 0.05		4.18	NS	10.92	43.79	49.11	NS	NS	NS	34.73	38.76

3.2 Yield and Its Quality

3.2.1 Effect of Varieties

Data in Table (4) illustrated that, there were significant differences in the bulb quality (bulb diameter, neck diameter, bulbing ratio and bulb weight) and total yield between the different varieties of onion plants. Moreover, the highest bulb diameter, bulb weight and total yield of onion were produced by Super X cv. On the contrary, the lowest bulb diameter, bulb weight and yield of onion plants were recorded by using Giza 20 cv. These findings held good in both two experimental seasons. With regarding of neck diameter and bulbing ratio of onion. Results in Table (4) show that, the highest neck diameter and bulbing ratio of onion bulb were recorded by Giza 20 cv. and the lowest value of neck diameter and bulbing ratio found by super X cv. These results might be correlated with the gene action of the tested cultivars. These results are agreed with those obtained by Mostafa (1998), Mohanty (2001), Rahman et al. (2002), Leilah et al. (2003), Gomaa (2006), Haydar et al. (2007).

Table 4. Effect of two varieties of onion on the yield and bulb quality in the 2009/2010 and 2010/2011 seasons

Varieties	Bulb diameter	Neck diameter	Bulbing ratio	Bulb weight	Total yield Ton/fed.	Bulb diameter	Neck diameter	Bulbing ratio	Bulb weight	Total yield Ton/fed.
Giza 20	5.72	2.14	0.37	100.60	10.84	5.69	2.28	0.39	108.34	11.03
Super X	6.00	1.18	0.20	123.12	11.91	5.94	1.31	0.23	132.28	12.00
L.S.D at 0.05	0.26	0.15	0.03	7.65	0.27	0.12	0.15	0.30	11.49	0.34

3.2.2 Effect of Foliar Application

Data presented in Table (5) show that, foliar application of EM, amino green, and yeast increased all bulb quality (bulb diameter, neck diameter, bulbing ratio and bulb weight) and total yield of onion compared with control. However, the highest bulb quality (bulb diameter, neck diameter, bulbing ratio and bulb weight) and total yield

of onion plants was recorded by foliar application of EM at rates of 3 gm. /L. in the two seasons of study except for bulb diameter in the two seasons of study and bulb weight in the second season without any significant with foliar spray of EM at rates of 3 gm./L. On the contrary, the lowest bulb quality (bulb diameter, neck diameter, bulbing ratio and bulb weight) and total yield of onion plants was recorded by foliar spray with water (control). The superiority of bulb quality and total yield of onion plants by using EM may be attributed to microorganisms improve crop growth and yield by increasing photosynthesis, producing bioactive substances such as hormones and enzymes, controlling soil diseases and accelerating decomposition of lignin materials in the soil (Higa, 2000; Hussain et al., 2002).

Table 5. Effect of foliar application of EM-Effective microorganisms, amino green (AG) and yeast on the yield and bulb quality of onion plants in the 2009/2010 and 2010/2011 seasons

Treatments	Bulb diameter	Neck diameter	Bulbing ratio	Bulb weight	Total yield Ton/fed.	Bulb diameter	Neck diameter	Bulbing ratio	Bulb weight	Total yield Ton/fed.
Control	4.33	0.99	0.24	45.08	8.08	4.32	1.08	0.27	50.95	8.28
EM 1	5.68	1.63	0.29	101.93	11.20	5.62	1.85	0.31	108.42	11.56
EM2	6.18	1.74	0.30	129.14	12.81	6.09	1.86	0.33	139.47	13.01
EM 3	5.69	2.04	0.36	156.33	17.06	5.39	2.14	0.37	162.74	15.69
AG 1	5.67	1.47	0.27	91.26	8.79	5.56	1.56	0.29	98.67	9.34
AG 2	6.26	1.63	0.26	111.86	12.38	6.22	1.84	0.28	120.65	12.59
AG 3	5.78	1.88	0.31	106.27	11.20	5.99	1.95	0.32	116.32	11.47
Yeast 1	5.67	1.63	0.29	90.46	8.77	5.51	1.84	0.31	98.86	9.08
Yeast 2	6.48	1.77	0.28	130.16	10.17	6.45	1.92	0.32	140.67	10.49
Yeast 3	6.83	1.83	0.28	156.08	13.29	7.02	1.95	0.30	166.35	13.63
L.S.D at0.05	0.68	0.25	0.04	30.93	2.46	0.77	0.27	0.04	30.92	1.86

3.2.3 Effect of the Interaction

The interaction effect within varieties of onion plants and foliar application treatments on bulb quality (bulb diameter, neck diameter, bulbing ratio and bulb weight) and total yield are shown in Table (6). The obtained data reveals that, the interaction treatments significantly affected all bulb quality and total yield in the two seasons of study. These results held good in the two experimental seasons. Generally, it could be summarized that, the highest amount of bulb diameter was recorded by Super X cv. with foliar application of yeasts at a rate of 3 gm/L. On the contrary, the lowest bulb diameter recorded by Giza 20 cv. with foliar spray with water only (control). The highest neck diameter of bulb recorded by Giza 20 cv. with foliar spray AG at rates of 3 cm/L. On the contrary, the lowest values of neck diameter of bulb recorded by Super X cv. with foliar spray of water only (control). With regard of bulbing ratio. Data in Table (6) show that the highest bulbing ratio recorded when using Giza 20 cv. receiving foliar spray with EM at rates of 2 cm/L. On the contrary, the lowest amount of bulbing ratio recorded by using Super X cv. receiving foliar spray of water only (control) in the first season and by Super X cv. receiving foliar spray of AG at rates of 1 or 2 cm/L in the second one. With regard of bulb weight, data in Table (6) show that the highest bulb weight and total yield of onion plants were recorded by Super X cv with foliar spray of EM at a rate of 3 cm/ L. Whilst, the lowest amount of bulb weight and total yield of onion plants were found by using Giza 20 cv and foliar spray with water. These results held good in the two seasons of study.

Table 6. Effect of the interaction between varieties and foliar application of EM-Effective microorganisms, amino green (AG) and yeast on the yield and its quality of onion plants in the 2009/2010 and 2010/2011 seasons

Varieties	Treatments	Bulb diameter	Neck diameter	Bulbing ratio	Bulb weight	Total yield Ton/fed	Bulb diameter	Neck diameter	Bulbing ratio	Bulb weight	Total yield Ton/fed.
Giza 20	Control	3.67	1.20	0.33	27.93	6.65	3.73	1.30	0.35	28.46	6.82
	EM 1	5.53	2.17	0.39	102.76	10.23	5.57	2.37	0.40	107.43	10.40
	EM2	5.20	2.25	0.43	89.75	12.25	5.23	2.25	0.45	100.42	12.40
	EM 3	6.47	2.17	0.34	113.53	13.59	6.27	2.30	0.35	119.82	13.89
	AG 1	5.15	1.97	0.38	73.88	9.11	5.10	2.05	0.39	82.34	9.34
	AG 2	6.12	2.25	0.37	102.40	14.86	5.93	2.57	0.38	110.48	14.74
	AG 3	4.78	2.68	0.39	151.03	10.64	6.93	2.82	0.41	161.03	10.86
	Yeast 1	5.57	2.08	0.37	88.99	9.22	5.46	2.22	0.39	97.21	9.92
	Yeast 2	6.42	2.27	0.36	125.34	10.08	6.48	2.50	0.37	135.34	10.40
	Yeast 3	6.25	2.35	0.38	130.37	11.70	6.30	2.47	0.39	140.37	11.99
Super X	Control	5.00	0.78	0.16	62.24	9.52	4.91	0.85	0.19	73.44	9.73
	EM 1	5.83	1.10	0.19	101.10	12.17	5.67	1.34	0.22	109.40	12.73
	EM2	7.15	1.23	0.17	168.52	13.37	6.94	1.97	0.20	178.52	13.62
	EM 3	4.92	1.92	0.39	199.13	19.53	4.52	1.98	0.39	205.67	17.48
	AG 1	6.18	0.97	0.16	108.63	8.47	6.02	1.07	0.18	115.00	9.33
	AG 2	6.40	1.00	0.16	121.32	9.89	6.51	1.12	0.18	130.32	10.44
	AG 3	4.78	1.08	0.23	61.51	11.76	5.13	1.08	0.24	71.61	12.08
	Yeast 1	5.77	1.17	0.20	91.93	8.33	5.56	1.47	0.23	100.50	8.74
	Yeast 2	6.55	1.27	0.20	134.99	10.27	4.42	1.33	0.22	146.00	10.57
	Yeast 3	7.40	1.32	0.18	181.79	14.82	7.73	1.43	0.21	192.32	15.26
L.S.D. at 0.05		0.96	0.36	0.36	43.75	3.48	1.1	0.38	0.06	34.73	2.63

3.3 Chemical Contents

3.3.1 Effect of Varieties

Chemical contents of onion plant expressed as T.S.S, N, P and K% were statistically affected by varieties of onion plants (Figure 1). The differences resulting by the varieties reached the level of significant at all vegetative growth characters in the two seasons of study except for N % in the two seasons of study. Furthermore, the highest values in as T.S.S, N, P and K% were obtained by the Giza 20 cv. On the other hand, the lowest values were recorded by Super X cv. These results were true in the two seasons of study. These results were coincided with those reported by Gomaa (2006) and Haydaret al. (2007).

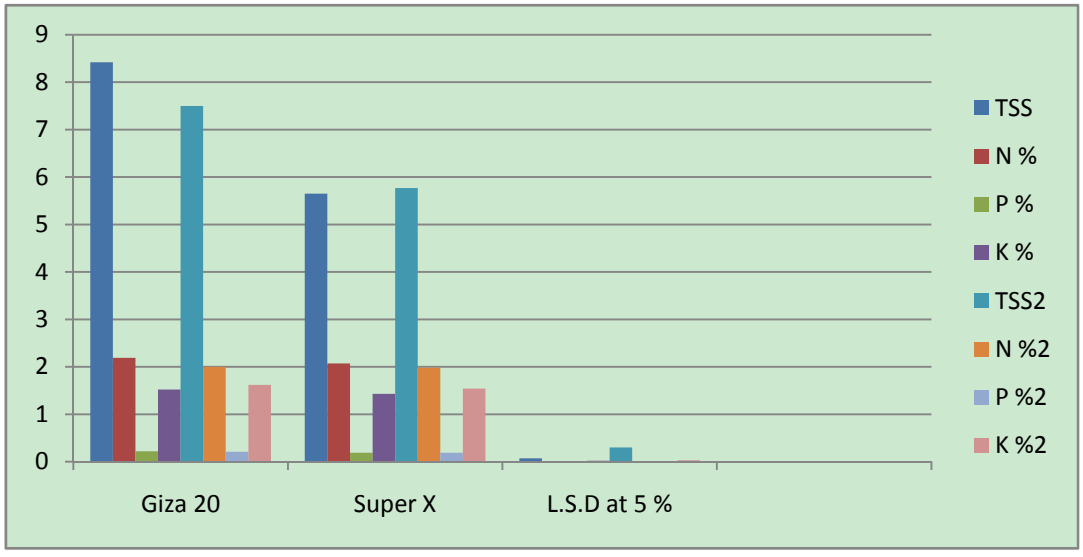

Figure 1. Effect of two varieties of onion on the T.S.S, N, P and K% in the 2009/2010 and 2010/2011 seasons

3.3.2 Effect of Foliar Application

Data in Table (7) show clearly that foliar application of EM, amino green and yeast had a significant effect on the chemical content characterizes of onion tissues in the two seasons of study. Generally, it could be concluded that, the highest values of T.S.S was recorded by using yeast at rates of 3 gm. /L. compared with other treatments. On the contrary, the lowest value of T.S.S was recorded by control plants (foliar spray with water). These findings were true in both seasons. With regards of N, P and K %, results in Table (7) demonstrated that, the highest values of N, P and K% were recorded by using foliar application of AG with different rates compared of other treatments. On the other hand, the lowest value of N, P and K % were recorded by control plants (foliar spray with water). These findings were true in both seasons of study.

Table 7. Effect of foliar application of EM-Effective microorganisms", amino green (AG) and yeast on T.S.S, N,P and K% of onion tissues in the 2009/2010 and 2010/2011 seasons

Treatments	T.S.S	N %	P %	K %	T.S.S	N %	P %	K %
Control	6.47	1.79	0.15	1.25	6.03	1.70	0.14	1.35
EM 1	6.88	1.90	0.19	1.32	6.50	1.77	0.18	1.42
EM2	7.03	2.08	0.22	1.39	6.67	1.97	0.21	1.47
EM 3	7.40	2.30	0.23	1.46	6.75	1.79	0.22	1.61
AG 1	6.83	2.70	0.18	1.48	6.38	2.27	0.17	1.58
AG 2	7.13	2.18	0.20	1.59	6.67	2.04	0.20	1.66
AG 3	7.02	2.28	0.32	1.68	6.92	2.16	0.22	1.79
Yeast 1	7.00	2.06	0.21	1.49	6.57	1.93	0.21	1.57
Yeast 2	7.13	2.17	0.23	1.54	6.85	2.13	0.22	1.65
Yeast 3	7.42	2.22	0.24	1.59	7.05	2.12	0.23	1.69
L.S.D at0.05	0.22	0.06	0.01	0.04	0.26	0.12	0.01	0.04

This superiority might be due to that amino green compound contains many amino acids as well as some growth regulators and vitamins which stimulate and enhance the metabolism processes in plant tissues. Whereas, the previous studies have proved that, amino acids, can directly or indirectly influenc the physiological activities of the plants (Ei-Shabase et al., 2005; Awad et al., 2007; Al-Said & Kamal, 2008; Faten et al., 2010; Shaheen et al., 2010).

3.3.3 Effect of the Interaction

The interaction effect within varieties of onion plants and foliar application treatments on T.S.S, N, P and K % are shown in Table 8. The obtained data reveals that, the interaction treatments significantly affected T.S.S, P% in the two seasons of study and K% in the second season only. These results held good in the two experimental seasons. Generally, it could be summarized that, the highest amount of T.S.S, N, P and K % were recorded by using Giza 20 cv. with foliar application of EM and AG compared with foliar spray of yeast and control treatment (foliar spray of water). On the contrary, the lowest T.S.S, N, P and K % were recorded by Super X cv. with foliar spray with water only (control).

Table 8. Effect of the interaction between varieties and foliar application of EM "Effective microorganisms", amino green (AG) and yeast on the T.S.S, N,P and K% of onion tissues in the 2009/2010 and 2010/2011 seasons

Varieties	Treatments	T.S.S	N %	P %	K %	T.S.S	N %	P %	K %
	Control	7.60	1.84	0.17	1.31	6.67	1.76	0.15	1.41
	EM 1	8.23	1.95	0.21	1.39	7.43	1.81	0.20	1.48
	EM2	8.63	2.09	0.26	1.43	7.80	1.95	0.24	1.51
Giza 20	EM 3	9.23	2.40	0.25	1.48	7.87	2.34	0.24	1.59
	AG 1	8.13	2.21	0.18	1.53	7.17	1.76	0.18	1.62
	AG 2	8.33	2.26	0.21	1.63	7.47	2.08	0.20	1.69
	AG 3	8.37	2.34	0.23	1.76	7.83	2.13	0.23	1.87
	Yeast 1	8.37	2.14	0.22	1.51	7.37	1.93	0.21	1.59
	Yeast 2	8.50	2.15	0.24	1.57	7.63	2.13	0.23	1.69
	Yeast 3	8.77	2.20	0.25	1.63	7.80	2.13	0.24	1.79
	Control	5.33	1.74	0.13	1.19	5.40	1.65	0.12	1.29
	EM 1	5.53	1.85	0.16	1.24	5.57	1.74	0.16	1.35
	EM2	5.43	2.07	0.18	1.35	5.53	1.98	0.18	1.44
	EM 3	5.57	2.20	0.20	1.43	5.63	2.20	0.20	1.63
	AG 1	5.53	1.93	0.17	1.43	5.60	1.83	0.17	1.55
	AG 2	5.93	2.10	0.20	1.54	5.87	2.00	0.19	1.62
Super X	AG 3	5.67	2.23	0.22	1.60	6.00	2.19	0.21	1.70
	Yeast 1	5.63	1.97	0.20	1.46	5.77	1.94	0.20	1.55
	Yeast 2	5.77	2.19	0.21	1.50	6.07	2.13	0.21	1.61
	Yeast 3	8.07	2.30	0.23	1.54	6.30	2.10	0.22	1.63
L.S.D. at 0.05		0.30	NS	0.02	NS	0.37	NS	0.02	0.06

3.4 Trace Element Content

3.4.1 Effect of Varieties

Trace element content of onion tissues expressed as Fe, Cu, Zn and Mn were affected by varieties of onion plants (Figure 2). The differences resulting by the varieties reached the level of significant at Fe, Cu and Zn in the first season and Zn and Mn in the second one. Moreover, the highest values of all trace elements content were obtained by the Giza 20 cv. except for Mn in the first season and Fe in the second season, the highest amount was recorded by Super X cv. On the other hand, the lowest values were recorded by Super X cv. except for Mn and Fe ppm in the first and second seasons, respectively. The lowest values were found by Giza 20 cv. These results were true in the true seasons of study. These results were coincided with those reported by Gomaa (2006) and Haydar et al. (2007).

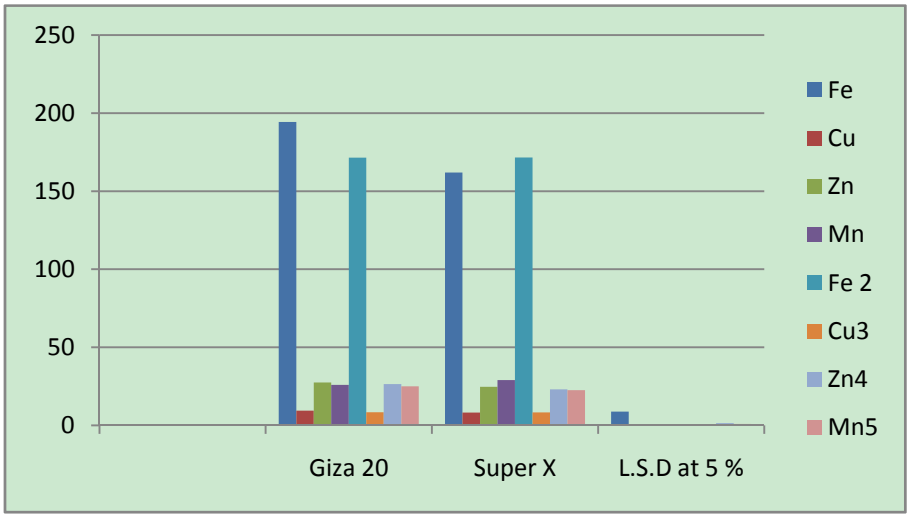

Figure 2. Effect of two varieties of onion on the Fe, Cu, Zn and Mn ppm in the 2009/2010 and 2010/2011 seasons

3.4.2 Effect of Foliar Application

Data in Table (9) show clearly that foliar application of EM, amino green and yeast had a significant effect on the trace elements content of onion tissues in the two seasons of study except for Mn ppm in the first season failed to significant effect. Generally, it could be concluded that, the highest values of trace elements content (Fe, Zn and Mn) were recorded by using foliar application of AG at rates of 3 cm/L. compared with other treatments. Whilst, the highest amount of Cu ppm was recorded by foliar spray of yeast at a rate of 3 bm./L. These results were true in the two seasons of study. On the contrary, the lowest value of all trace element measures were recorded by control plants (foliar spray with water). These findings were true in both seasons. These results may be due to the content of macro and micro elements of the dry yeast and amino green compound. El-Fouly 1983 reported that, foliar application of microelements is highly recommended under Egyptian conditions. In view of the fact the soil pH exceeds 7.5 and sometimes even 8.5 some areas show high $CaCO_3$ contents which among other factors; make soil application of micronutrients more costly and unpractical. The trends of obtained results are in good accordance of the previous investigators such as (Ei-Shabase et al., 2005; Awad et al., 2007; Al-Said & Kamal, 2008; Faten et al., 2010).

Table 9. Effect of foliar application of EM "Effective microorganisms", amino green (AG) and yeast on Fe, Cu, Zn and Mn ppm of onion tissues in the 2009/2010 and 2010/2011 seasons

Treatments	Fe	Cu	Zn	Mn	Fe	Cu	Zn	Mn
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Control	137.65	7.98	23.90	20.41	143.67	7.50	22.88	19.87
EM 1	154.75	8.60	25.32	22.78	150.77	7.92	24.30	21.71
EM2	166.30	8.80	26.01	24.06	157.06	8.56	24.95	22.97
EM 3	173.83	9.17	26.86	25.65	167.67	8.71	25.91	24.55
AG 1	171.72	8.61	26.11	24.72	167.78	8.07	25.29	23.70
AG 2	186.67	8.77	27.42	22.47	180.67	8.48	26.39	23.94
AG 3	215.83	8.93	28.21	28.08	200.00	8.61	26.97	27.17
Yeast 1	180.12	8.68	24.89	24.40	177.16	8.23	22.37	23.63
Yeast 2	194.00	9.22	25.70	26.59	184.00	8.53	23.11	25.25
Yeast 3	200.50	9.59	26.62	25.61	186.69	9.05	25.74	24.83
L.S.D at 0.05	11.82	0.28	0.83	NS	7.42	0.21	2.05	2.35

3.4.3 Effect of the Interaction

The interaction effect within varieties of onion plants and foliar application treatments on trace element contents (Fe, Cu, Zn and Mn) are shown in Table 10. The obtained data reveals that, the interaction treatments had no significantly affected of all trace element content except for Fe in the first season. These results held good in the two experimental seasons. Generally, it could be summarized that, the highest amount of Fe ppm was recorded by using Giza 20 cv. with foliar application of AG at a rate of 3 cm/L in the first season and by Super X cv. with foliar spray of AG at a rate of 3cm/L in the second one. With regard of Cu ppm, the highest amount of Cu ppm was recorded by using Giza 20 cv. with foliar application of yeast at a rate of 3 gm. /L in the first season and by Super X cv with foliar spray of yeast at a rate of 3gm. /L in the second season. Meanwhile, the highest amount of Zn and Mn ppm were recorded by using Giza 20 cv. with foliar spray of AG at a rate of 3 cm/L. These findings were true in both seasons. On the contrary, the lowest amounts of all trace elements were recorded by Super X cv. with foliar spray with water only (control) except for Fe and Cu in the second season, the lowest amount was found by Giza 20 cv. with foliar spray with water only (control).

Table 10. Effect of the interaction between varieties and foliar application of EM "Effective microorganisms", amino green (AG) and yeast on the Fe, Cu, Zn and Mn ppm of onion tissues in the 2009/2010 and 2010/2011 seasons

Varieties	Treatments	Fe ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Cu ppm	Zn ppm	Mn ppm
	Control	141.69	8.44	25.43	21.23	143.70	7.35	24.39	20.77
	EM 1	169.10	9.39	26.80	23.78	150.55	8.02	25.85	22.44
	EM2	184.93	9.38	27.21	24.89	156.67	8.61	26.24	23.76
	EM 3	189.33	9.72	28.14	26.97	168.33	8.75	27.17	25.87
Giza 20	AG 1	184.33	9.26	27.22	25.80	168.00	8.07	26.65	24.91
	AG 2	200.33	9.25	28.47	26.77	181.33	8.49	27.48	25.74
	AG 3	244.33	9.38	29.22	28.58	196.00	8.61	27.66	27.84
	Yeast 1	192.67	9.33	26.62	25.17	177.21	8.32	25.79	24.28
	Yeast 2	213.00	10.10	27.48	27.87	184.67	8.54	26.59	26.35
	Yeast 3	223.00	10.29	28.14	28.26	188.38	9.00	26.92	27.73
	Control	133.60	7.51	22.36	19.59	143.63	7.65	21.36	18.98
	EM 1	140.39	7.81	23.84	21.79	150.99	7.82	22.75	20.97
	EM2	158.33	8.21	24.82	23.22	157.45	8.51	23.65	22.19
	EM 3	159.33	8.61	25.59	24.32	167.00	8.68	24.95	23.22
Super X	AG 1	159.11	7.95	24.99	23.63	167.55	8.07	23.93	22.99
	AG 2	173.00	8.29	26.37	78.17	180.00	8.40	25.30	22.15
	AG 3	187.33	8.48	27.20	27.59	204.00	8.61	26.28	26.48
	Yeast 1	167.58	8.03	23.15	23.63	177.11	8.15	18.96	22.98
	Yeast 2	175.00	8.34	23.15	25.30	183.33	8.51	19.63	24.16
	Yeast 3	178.00	8.88	23.92	22.97	185.00	9.09	24.55	21.94
L.S.D. at 0.05		10.72	NS	NS	NS	NS	NS	NS	NS

4. Conclusion

It can be recommended that all applied bio-stimulants have a positive and growth promoting effects on two cultivar of onion plants by providing supplemental doses of bio-stimulants "yeast, EM and amino acids".

Generally, it can be concluded that, using Super X cv. with foliar spraying of EM gives highest amount of growth, yield and quality of onion plants.

Acknowledgment

The authors would express their thanks for all fruitful efforts presented and supported by Postdoctoral Program for African Researchers of China-Africa Science and Technology Partnership Program (CASTEP).

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