J.Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 4 (10): 1117 - 1137, 2013

PERFORMANCE OF FREE LIVING N_2-FIXERS BACTERIA, COMPOST TEA AND MINERAL NITROGEN APPLICATIONS ON SOME SOIL PROPERTIES, PRODUCTIVITY AND QUALITY OF ONION CROP (Giza red vr.).

El-Gizawy, E. S. A.* and L. S. M. Geries**

*** Agric. Microbiology Dept., Soils, Water and Environment Res. Inst. ARC, Egypt.**

**** Onion Res. Dept., Field Crops Res. Inst., ARC, Egypt.**

ABSTRACT

A field experiment was carried out at the Experimental Farm of Sakha Agricultural Research Station in Kafr El-Sheikh Governorate at North Nile Delta Region. The experiments were conducted to study the response of onion to nitrogen fertilizer levels under different bio-organic fertilizers (compost tea and N_2-fixing bacteria) as well as their interaction, on some soil properties and the growth and onion bulbs yield and its quality during the two successive winter seasons of 2009/2010 and 2010/2011. A split-split plot design with three replicates was used in this study. The main plots were designated to the three mineral nitrogen fertilizer levels (60, 90 and 120 kg N fad.$^{-1}$), whereas foliar spraying treatments with compost tea at the same dose, 20 L fad.$^{-1}$ (spraying with water; foliar spraying at 40 days after transplanting (DAT); foliar spraying at 40 and 60 DAT; foliar spraying at 40, 60 and 80 DAT and soil application, 30 DAT at rate of 30 L fad.$^{-1}$) were randomly distributed in sub plots. While uninoculation and inoculation with di-nitrogen fixing bacteria (*Azotobacter Chroococum* and *Azospirilium Brasilense*) were randomly distributed in the sub-sub plots.

The obtained results could be summarized as follow:

The highest increase in soil available nutrients (N, P and K), organic matter percentages and total bacterial counts were increased significantly and recorded in the plots treated with compost tea as soil application batches and/or inoculation at nitrogen fertilizers level 90 kg N fed^{-1} ($N_2B_4C_2$) while the lowest were recorded in the uninoculated plots treated with N fertilizers at 60 kg N fed^{-1} without both compost tea and bacterial inoculation. With inoculation and mineral nitrogen applications, soil salinity and pH were decreased in compost tea treatment under soil application as compared with others compost tea applications. The experimental results confirmed that the combination of compost tea, inoculation by di-nitrogen fixing bacteria and mineral nitrogen fertilizers could improve soil fertility.

Growth and onion bulbs yield and their quality were highest due to application of compost tea on thrice than twice batches at the same dose and other treatments. The effect of bio-fertilizer in plant height, leaves dry weight/plant, bulb dry weight, plant dry weight, bulb diameter and bulb weight as well as bulb quality was evident in both seasons. In general, inoculation with *Azotobacter chroococcum* and *Azospirilium brasilense* positively increased all the previous characters. Based on the results of the current study, the combinations of medium dose of mineral N and compost tea or biofertilizers could be considered as an integrated nutrient management to improve soil bio-physical properties and the growth and yield of onion plants. It also confirmed that compost tea can be used as organic substrate additives in plant cultivation and substitute for chemical nitrogen fertilizers.

Keywords: *Azotobacter Chroococcum*, *Azospirillium brasilense*, compost tea, soil properties and onion yield and quality.

INTRODUCTION

Production of horticultural crops has undergone significant changes in recent years due to development of innovative technologies including integrated nutrient management practices involving biofertilizers, which include phosphate-solubilizing bacteria, symbiotic and non-symbiotic N_2-fixing bacteria and arbuscular mycorrhizal (AM) fungi. The use of biofertilizers in enhancing plant growth and yield has gained momentum in recent years because of higher cost and hazardous effect of chemical fertilizers. Microbial inoculants are promising components for integrated solutions to agro-environmental problems because inoculants possess the capacity to promote plant growth, enhance nutrient availability and uptake, and support the health of plants (Dobbelaere *et al.*, 2001; Kloepper *et al.*, 2004; Han and Lee, 2005; Weller, 2007and Adesemoye *et al.*, 2008). Nitrogen-fixing bacteria were found to enhance the growth and production of onion plants significantly (Geries, 2007; Ahmed, 2009 and Sridevi and Ramakrishnan, 2010), besides improving the microbiological activity in the rhizosphere (Kohler *et al.,* 2008).

The use of microbe-enriched compost tea for nutrient mobilization is becoming popular, and new systems are being developed to meet the requirements of different crops and cropping systems. Several studies have reported benefits from the use of compost and compost tea as organic substrate additives in plant cultivation and in the suppression of soil-borne diseases. It has been reported that compost tea obtained from agro-wastes were able to enhance the growth and yield of okra when sprayed weekly at full strength (Siddiqui *et al.*, 2008, 2009).

Inorganic fertilizers have significant effects on world crop production and are essential components of today’s agriculture. Estimates show that agricultural production is raised by 50% as a result of chemical fertilizers and 60% of the population owes its nutritional survival to nitrogen (N) fertilizers (Fixon and West, 2002). However, of the total applied N, less than 50% is recovered in the soil–plant system, while the remainder is lost to the environment (Abbasi *et al.,* 2003). Hence, growing concerns about the negative impact of inorganic fertilizers on the environment and their future cost make it expedient to integrate a greater use of organic materials in cultivation practices to enhance crop yields. There are intensive efforts worldwide to use organic manures to provide the same amount of food with less fossil fuel-based inorganic fertilizers.

Integrating nutrient management with organic manures and inorganic fertilizers has been reported to increase yields and chemical constituents in onion (Geries, 2007 and Nyangani, 2010); Plantago arenaria (Kolodziej, 2006). The conjunctive use of organic nutrient sources with inorganic fertilizers was shown to improve the efficiency of inorganic fertilizer, increase crop yield, reduce inputs of chemical fertilizers and minimize environmental risks (Siddiqui *et al.*, 2011).

Onion (*Allium cepa* L) is extremely important vegetable crop in Egypt, which is cultivated in a large scale not only for internal consumption but also as highest foreign exchange earner among the fruits and vegetables. The total area planted in 2007/2008 was 102,703 fad. (1 faddan = 4200 m^2) and produced 1,259,007 tons with an average yield of 12.6 t $fad.^{-1}$†. The average of exports reached 340,000 tons‡.

The information on role of mineral nitrogen, compost tea and biofertilizers and their combinations on some soil properties and production of onion are very scanty. Therefore, there is an urgent need to study the influence of mineral, organics, biofertilizers and their combinations to improve soil fertility and onion productivity and its quality under the conditions of Kafr El-Sheikh Governorate.

MATERIALS AND METHODS

Experimental treatments

A field experiment was carried out during the two successive winter seasons of 2009/2010 and 2010/2011 at the Experimental Farm of Sakha Agricultral Research Station in Kafr El-Sheikh Governorate at North Nile Delta Region (30^0 51 in latitude and 31^0 05 in longitude). The soil of the experimental fields and compost tea analysis were shown in Table (1).

Compost tea preparation: ten kilograms of Controlled Microbial Compost (CMC) was brewing in 350 l free chlorine water for 36 hrs. in brewing system for compost tea production in Sakha Agriculture Station –Bacterial Lab according to the method, which described by El-Gizawy (2005).

Bio-fertilizer preparation: for *Azotobacter chroococcum*, Jensens medium (Allen, 1953) was used. It contains in g/l: decstrose 2.0, $MgSO_4.7H_2O$ 0.2, K_2HPO_4 0.5, $FeCL_3.6H_2O$ traces, Casein 0.2 (Dissolve 0.2 g Casien in 10 ml 0.1 N NaOH) pH 6.5-6.6. for *Azospirillum brasilense*, semi-solid malate medium (Dobereiner et al 1978) was used. It contains in g/l, Dl-Malic acid 5.0, KOH 4.0, K_2HPO_4 0.5, $FeSO_4.7H_2O$ 0.5, $MnSO_4.H_2O$ 0.01, $CaCl_2$ 0.02, Na_2MoO_4 0.002, (Bromothymole blue 0.5% alcoholic solution) 2.0 ml, agar 1.75 and pH 6.8.

Five hundred ml conical flasks containing 150 ml of Jensen medium and malate medium for *Azotobacter* and *Azospirillum*, respectively were sterilized and inoculated with full knob of 5-days specific selective agar old culture media of each bacterial genus. Inoculated flasks were shaking incubated (150 rpm) at 28±2 ºC for 7 days. Total count of each bacterial genus was determined and its concentration was adjusted to 10^7cell ml^{-1} using distilled water. Four weeks old healthy seedlings were dipped in liquid biofertilizers (*Azospirillum b*. at 2 L and *Azotobacter ch*. at 2 L) and transplanted in main field on the time.

The experimental design was split-split-plot with three replicates. The main plots included three mineral nitrogen levels (N) i.e., 60, 90 and 120 kg N $fad.^{-1}$. While compost tea (B) were allocated in sub– plots; B_0: foliar spray with water (Control); B_1: foliar spray, 40 days after transplanting (DAT), at a rate of 20 L $fad.^{-1}$; B_2: foliar spray, 40 and 60 DAT, at a rate of 20 L $fad.^{-1}$; B_3: foliar

†(Central Administration of Agricultural Statistics)

‡ (General Organization for Export and Import Control)

spray, 40, 60 and 80 DAT, at a rate of 20 L fad.$^{-1}$ as well as B_4: soil application, 30 DAT, at a rate of 30 L fad.$^{-1}$. Inoculation treatments (C); uninoculated and co-inoculation with *Azotobacter spp.* and *Azospirilium spp.* as biofertilizer were allocated in sub-sub-plots. The plot area was 10.5 m^2 (3.5 m length and 3 m width) included five ridges with 60 cm apart between ridges. Uniformed seedling was transplanted after hardening on the sides of ridges 10 cm apart.

Table (1): Physiochemical properties of compost tea and the study of the soil under growing seasons.

Nutrients/heavy metals	Unit	Compost tea	Soil	
			2009/2010	2010/2011
Particle size distribution				
Coarse sand	%		2.4	2.1
Fine sand	%		21.9	22.2
Silt	%		22.2	24.4
Clay	%		53.5	51.3
Textural class	-	-	**Clayey**	
Smell (odor)		Good smell	-	-
Color		Dark	-	-
Total Solid materials	g l^{-1}	1.15	-	-
Organic matter	%	-	1.62	1.68
pH*		5.01	7.93	7.81
EC**	dSm^{-1}	1.63	1.83	2.11
Total Nitrogen	mg l^{-1}	7300	-	-
Ammonium Nitrogen	mg l^{-1}	2010	-	-
Nitrate Nitrogen	mg l^{-1}	3300	-	-
Available nitrogen	mg kg^{-1} soil	-	18.2	20.3
Total phosphorus	mg l^{-1}	4500	-	-
Available phosphorous	mg kg^{-1} soil	-	7.0	7.5
Total Potassium	mg l^{-1}	6200	-	-
Available potassium	mg kg^{-1} soil	-	209	227
Calcium carbonate	%	-	3.51	2.56
Available Fe	mg kg^{-1} soil	-	8.4	9.6
Available Zn	mg kg^{-1} soil	-	8.01	7.22
Available Mn	mg kg^{-1} soil	-	11.71	12.61
Total Bacterial Counts (CFU/g)	Cell ml^{-1}	102 x10^7	-	-
Total Actinomycetes Counts	Cell ml^{-1}	93 x10^5	-	-
Total Fungus Counts	Cell ml^{-1}	81 x10^3	-	-
Feacal Coliform	Cell ml^{-1}	Nil	-	-
Escherichia coli	Cell ml^{-1}	Nil	-	-
Salmonella & Shigella	Cell ml^{-1}	Nil	-	-

* **And ** :EC and pH measurements in soil paste extract and direct measurements (1:5d) in compost tea at 25^{0}C.***

The onion seed was sown in the nursery on October 5th in both seasons. Transplanting took place on December 28th and 13rd in the first and second seasons, respectively. Phosphorus fertilizer was applied in the form of calcium super phosphate (15.5% P_2O_5) at the rate of 45 kg P_2O_5fad.$^{-1}$ during land preparation. Nitrogen fertilizer as ammonium nitrate (33.5% N) at the above mentioned levels was added in the two equal doses (after 30 and 60 DAT). All cultivation practices were done according to the common practices in onion growing.

Data recorded:

A- Soil parameter measurements:

Soil samples (0-30 cm) were taken before sowing and after harvesting and chemically analyzed for the main soil characteristics such as total soluble salts (TSS) were measured as ECe (dS/m) electrical conductivity apparatus in the saturated soil past extract. pH, and organic matter were determined according to Page et al (1982). Available nitrogen was extracted by K_2SO_4 (1%) and determined by micro-Kjeldahl methods. Available phosphorus was extracted with 0.5 N sodium bicarbonate and determined by spectrophotometer according to Olsen methods, available potassium was extracted by ammonium acetat1 N and determined photometrical according to Page et al (1982). Total bacterial count was determined according to the methods which described by (Allen 1953).

B- Growth and yield parameter measurements:

B-1- Plant growth measurements:

A representative samples, each five plants were randomly taken from the 2nd row of each plot at 120 DAT to estimated plant height (cm), number of leaves/plant, bulb diameter (cm) as well as fresh and dry weights of leaves/plant, bulb and whole plant (g).

B-2- Onion bulbs yield and its quality:

At harvesting time, all the remaining bulbs in each plot were uprooted and bulbs yield of onion expressed as: average bulb weight (g), marketable bulbs yield (t fad^{-1}), culls bulb weight (t fad^{-1}) and total bulbs yield (t fad^{-1}). In the same time, sample of 5 bulbs were randomly taken for recording the bulb quality properties, i.e. bulb diameter (cm), total soluble solids (TSS%) and dry matter content (%).

Statistical analysis:

All data collected were subjected to statistical analysis as described by Snedecor and Cochran (1980) and the means were compared using L.S.D. test at 5% significance level. Treatments means were compared according to Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Effect of the interaction between N-fertilizer level, compost tea and bio-fertilizer on:

Soil pH

Soil pH is one of the most important parameters which reflect the overall changes in soil chemical properties. It is obvious from Table (2) that the soil of all experimental plot units is characterized by slightly alkaline trend, where the pH value is always around 7.81 to 7.50. Data showed that the soil pH tended to decrease due to application of compost tea in soil (B_4 treatments). However, there was no clear trend, for the applied different treatments, on the pH values of the studied soils. On the other hand, the soil pH, after the two seasons, tended to slightly decreased with increasing the mineral N fertilizer rates combined with co-inoculation and compost tea treatments.

Table (2):Some soil properties measurements after onion crop harvesting as influenced by mineral nitrogen level, compost tea and bio fertilizers applications in 2009/2010 and 2010/2011 seasons.

N-level	Compost tea	Bio-fertilizers	ECe dSm^{-1} (Soil paste)		pH (Soil paste)		OM%		Total Bacterial Counts (cfu/d g soil)	
			2009/10	2010/11	2009/10	2010/11	2009/10	2010/11	2009/10	2010/11
A_1	B_0	C_1	1.84	1.91	7.81	7.73	1.61	1.60	$42x\ 10^{5}$	$13.4x10^{6}$
		C_2	1.78	1.79	7.71	7.68	1.63	1.62	$39x10^{5}$	$15.5x10^{7}$
	B_1	C_1	1.81	1.85	7.68	7.71	1.65	1.63	$72x10^{6}$	$12.3x10^{6}$
		C_2	1.74	1.80	7.71	7.67	1.67	1.65	$28x10^{7}$	$14.1x10^{7}$
	B_2	C_1	1.76	1.81	7.66	7.71	1.62	1.64	$34x10^{5}$	$67x10^{5}$
		C2	1.74	1.80	7.61	7.70	1.61	1.65	$59x10^{7}$	$81x10^{7}$
	B_3	C_1	1.80	1.83	7.68	7.66	1.61	1.63	$82x10^{5}$	$90x10^{5}$
		C_2	1.72	1.74	7.71	7.67	1.62	1.61	$11.5x10^{7}$	$12.6x10^{7}$
	B_4	C_1	1.70	1.74	7.52	7.61	1.72	1.64	$14.3x10^{8}$	$19x10^{6}$
		C_2	1.65	1.64	7.50	7.58	1.77	1.66	$19.6x10^{8}$	$22x10^{8}$
A_2	B_0	C_1	1.72	1.81	7.77	7.71	1.63	1.62	$23x10^{6}$	$14.6x10^{6}$
		C_2	1.70	1.80	7.76	7.75	1.66	1.63	$74x10^{7}$	$81x10^{6}$
	B_1	C_1	1.81	1.74	7.73	7.74	1.64	1.62	$51x10^{6}$	$12.3x10^{6}$
		C_2	1.80	1.73	7.73	7.72	1.66	1.62	$62x10^{6}$	$19x10^{7}$
	B_2	C_1	1.83	1. 81	7.77	7.73	1.65	1.64	$43x10^{5}$	$13.5x10^{4}$
		C_2	1.75	1.78	7.72	7.71	1.64	1.63	$61x10^{7}$	$21.4x10^{5}$
	B_3	C_1	1.71	1.72	7.73	7.74	1.63	1.62	$81x10^{6}$	$19.2x10^{6}$
		C_2	1.70	1.71	7.71	7.72	1.66	1.65	$71x10^{7}$	$41x10^{6}$
	B_4	C_1	1.84	1.69	7.59	7.62	1.75	1.74	$62x10^{6}$	$52x10^{6}$
		C_2	1.78	1.66	7.61	7.56	1.77	1.72	$12.6x10^{8}$	$19.5x10^{7}$
A_3	B_0	C_1	1.72	1.72	7.49	7.57	1.72	1.65	$13.2x10^{5}$	$12.5x10^{5}$
		C_2	1.70	1.69	7.62	7.71	1.81	1.72	$14.2x10^{6}$	$12.6x10^{7}$
	B_1	C_1	1.81	1.73	7.63	7.77	1.82	1.87	$35x10^{5}$	$45x10^{5}$
		C_2	1.80	1.71	7.67	7.72	1.76	1.76	$17.5x10^{6}$	$12.7x10^{6}$
	B_2	C_1	1.83	1.77	7.56	7.72	1.69	1.63	$21.4x10^{5}$	$13.5x10^{5}$
		C_2	1.75	1.75	7.67	7.82	1.72	1.70	$56x10^{6}$	$73x10^{6}$
	B_3	C_1	1.71	1.72	7.56	7.62	1.69	1.73	$72x10^{5}$	$45x10^{6}$
		C_2	1.70	1.66	7.63	7.71	1.72	1.75	$64x10^{6}$	$23.5x10^{6}$
	B_4	C_1	1.72	1.63	7.59	7.58	1.84	1.88	$55x10^{6}$	$62x10^{6}$
		C_2	1.70	1.60	7.58	7.61	1.91	1.90	$33x10^{8}$	$46x10^{8}$
LSD at 0.05			**N.S.**	**N.S.**	**N.S.**	**N.S.**	**0.051**	**0.036**	**$14.4x10^{3}$**	**$23.2x10^{4}$**

N1: 60, N2: 90 and N3: 120 Kg N fad.-1 – B0: Without compost tea, B1: Foliar at 40 DAT, B2: Foliar at 40 and 60 DAT, B3: Foliar at 40, 60 and 80 DAT and B4: Soil application at30 DAT – C1: Uninoculated and C2: Inoculated by free living (z+s).

These findings were in agreement with those reported by Nasef *et al.* (2009) who found that the application of compost, compost tea and bio-fertilizer combined with different rates of mineral N fertilizer, in general, decreased the soil pH in both seasons of the experiment. These findings could be explained as a result of organic acids like amino acid, glycine, cystien and humic acid of the compost tea which would have caused this decrease in soil pH. These study results were also, in harmony with those reported by Shaban and Omar (2006) who found that the formation of hydrocarbonic acids in the rhizosphere of maize root, due to biofertilizer treatment, led to decreasing in soil pH.

Soil salinity

Table 2 shows no-significant effect of different mineral nitrogen level, compost tea and bio fertilizers applications in 2009/2010 and 2010/2011 seasons on soil salinity. Generally trend of soil salinity changes was the same in both seasons; however, the soil salinity decreased with increasing the N- fertilizer rates with all combinations. With inoculation and mineral nitrogen applications, soil salinity was decreased in compost tea treatment under soil application as compared with other compost tea applications. The higher decreases in soil salinity were with co-inoculation with *Azotobacter and Azospirilium* than un-inoculation under all treatments. This may be due to inoculation enhanced root growth and uptake salts from the rhizosphere which decreased soil salts (phytoremediation). These findings were in agreement with those obtained by Abdurrahman *et al.* (2004), Porass, *et al.* (2010) and Hussein and Hassan (2011). These results could be explained as a reflection of the activity of microorganisms to reduce salinity and simultaneously improving characterization of soil structure; increasing drainable porosity and aggregate stability, and consequently enhanced leaching process through irrigation fractions. Generally the obtained decreases in soil salinity may be due to the high organic matter of them (Table 2), which, it was enhanced physical properties of this soil, and consequently improved soil leaching.

Organic matter percentages

The significant effect of different mineral nitrogen level, compost tea and bio fertilizers applications in 2009/2010 and 2010/2011 seasons on soil organic matter was shown in (Table 2). With inoculation and mineral nitrogen applications, soil organic matter was increased in compost tea treatment under soil application as compared with other compost tea applications. The higher increases in soil organic matter were with co-inoculation with *Azotobacter and Azospirilium* than un-inoculation under all treatments. These increases were attributed to high organic materials content and microbial populations of compost tea (Table 1).

Total Bacterial Count:

The total bacterial count (CFU/d g soil) fluctuated from 13.2 X 10^5 to 33 X 10^8 and from 13.5 X 10^4 to 46 X10^8 during 2009/2010 and 2010/2011 seasons, respectively. These results indicated that the total bacterial count in soil treated with compost tea and inoculation (B_4C_2 treatments) were higher than that those untreated plots ($B_{0,1,2\ and\ 3}C_1$ treatments). Counts of total bacteria in soil contained with compost tea progressively increased with inoculation and mineral nitrogen applications (Table 2). The highest increases in counts of total bacteria were with co-inoculation with *Azotobacter and Azospirilium* than un-inoculation under all treatments. These increases were attributed to high total bacteria count of compost tea and nutrients (Table 1). Total bacteria count increased with compost tea and biofertilizer treatments may be due to compost tea include a lot of macro and micro elements such as N, P, K, Fe, Zn, Cu, Mn and Mo and humic acids that affects on soil fertility, and consequently increased them.

Soil available N, P and K contents

Generally data in Table (3) show that the increase in the availability of phosphorus and potassium was increased with soil application of compost tea and inoculation treatment at the two seasons of study (B_4C_2), especially at the second level of mineral nitrogen (90 kg N fad.$^{-1}$). While the soil availability of nitrogen was increased according to continuous additions of mineral nitrogen fertilizers.

Table (3): Available N, P and K (mg kg^{-1} soil) in the experimental soil after onion crop harvesting as influenced by mineral nitrogen levels, compost tea and biofertilizer applications in 2009/2010 and 2010/2011 seasons.

N-level	Compost tea	Bio-fertilizers	Nitrogen (mg kg^{-1} soil)		Phosphorus (mg kg^{-1} soil)		Potassium (mg kg^{-1} soil)	
			2009/10	2010/11	2009/10	2010/11	2009/10	2010/11
A_1	B_0	C_1	18.4	18.6	7.9	8.1	218	209
		C_2	23.1	19.4	7.9	8.3	220	213
	B_1	C_1	23.0	20.0	7.6	8.1	200	204
		C_2	24.3	22.6	8.1	8.3	218	220
	B_2	C_1	28.1	25.1	8.2	7.6	209	211
		C2	28.7	30.2	9.2	8.0	231	209
	B_3	C_1	33.2	30.6	8.3	8.3	207	204
		C_2	34.1	38.1	9.1	8.2	221	209
	B_4	C_1	44.5	43.0	9.1	9.1	251	244
		C_2	46.8	44.6	9.6	9.4	260	271
A_2	B_0	C_1	38.1	36.2	8.7	8.1	204	213
		C_2	40.6	35.5	7.9	8.3	209	224
	B_1	C_1	39.6	36.7	7.1	8.0	212	220
		C_2	38.1	36.2	9.1	8.4	208	228
	B_2	C_1	42.2	36.4	8.4	7.6	210	214
		C_2	39.1	38.0	9.1	7.9	218	234
	B_3	C_1	46.7	32.1	9.2	8.1	216	221
		C_2	36.1	43.0	8.8	8.3	220	231
	B_4	C_1	51.6	46.7	9.4	10.6	248	251
		C_2	55.8	52.4	9.8	11.1	266	264
A_3	B_0	C_1	51.0	53.6	7.2	8.2	198	204
		C_2	51.1	54.1	7.3	8.6	204	209
	B_1	C_1	52.6	56.7	8.0	7.8	206	211
		C_2	53.0	60.1	8.1	9.2	214	224
	B_2	C_1	61.3	60.3	8.3	8.3	220	231
		C_2	62.1	61.0	9.1	9.0	217	224
	B_3	C_1	59.8	58.2	8.9	8.6	208	231
		C_2	60.2	60.3	9.2	8.4	221	234
	B_4	C_1	64.8	62.1	10.6	10.0	238	248
		C_2	65.0	63.4	11.0	10.8	249	274
LSD at 0.05			**23.85**	**31.53**	**3.12**	**2.83**	**51.24**	**62.12**

N_1: 60, N_2: 90 and N_3: 120 Kg N fad.$^{-1}$ – B_0: Without compost tea, B_1: Foliar at 40 DAT, B_2: Foliar at 40 and 60 DAT, B_3: Foliar at 40, 60 and 80 DAT and B_4: Soil application at30 DAT – C_1: Uninoculated and C_2: Inoculated by free living (z+s).

In this connection, Jayathilake *et al.* (2006) found similar results in onion plants. In all treatments, the mean values of soil available NPK were increased due to the application of compost tea to soil (B_4 treatments) as compared to foliar application in both seasons of study.

Effect of different nitrogen fertilizer on growth and yield of onion plants.

Plant growth measurements:

It is clear that applying of 90 kg N fad.$^{-1}$ (N_2) significantly increased plant height, number of leaves, bulb diameter as well as fresh and dry weight of bulbs, leaves/ plant and whole plant of onion at 120 days after transplanting (DAT) without significant difference with 120 kg N fad.$^{-1}$ (N_3) on most studied characters. Therefore, bulb and plant dry weight significantly increased with N applied, especially in the plots treated with N_2 treatment in the two seasons (Tables 4 and 5).

4

5

The highest values of plant growth measurements under higher rate of nitrogen reflect the role of nitrogen in enhancing biochemical process, which in turn enhanced the vegetative growth of onion plants. The same results were recorded by Geries (2007) and Geries *et al.* (2012) are supported the obtained results.

Onion bulbs yield and its quality:

Data cited in Tables (6 and 7) show that the nitrogen fertilizer at 90 kg Nfad.$^{-1}$ (N_2) resulted in the heaviest bulb weight, marketable yield fad.$^{-1}$, total yield fad.$^{-1}$ and highest bulbs diameter. 120 kg N fad^{-1} (N_3) gave the lowest values of culls yield fad.$^{-1}$, TSS and dry matter percentage, if compared with applying 60 and 90 kg N fad.$^{-1}$(N_1 and N_2) in the two seasons. The reduction in TSS and dry matter with 90 and 120 kg N fad.$^{-1}$ may be explained as the dilute effect, which accompanied the increment in the growth and weight of whole onion bulb, consequently, decreased the T.S.S and dry matter content. So it is clear from these results that an increase in N application beyond 90 kg N fad.$^{-1}$ is merely an increase in the cost of production. The trends of the obtained results are in good accordance with that reported by many investigators such as Shaheen *et al.,* (2011). Also, many researchers reported bulb yields improvement in response to N fertilization (Geries, 2007; Marey 2009; Abdissa *et al.*, 2011; Geries *et al.* 2012 and Morsy *et al.* 2012).

Table (6): Effect of different nitrogen rates, compost tea, bio fertilizer and their interactions on bulb yield and quality of onion in 2009/2010 season.

Treatment	Yield				Quality		
	Average bulb weight (g)	Marketable yield (t fad.$^{-1}$)	Culls yield (t fad.$^{-1}$)	Total yield (t fad.$^{-1}$)	Bulb diameter (cm)	TSS (%)	Dry matter (%)
N-Level (N):							
60	74.10 **c**	11.35 **c**	1.97 **a**	13.32 **c**	5.31 **c**	12.77 **a**	15.55 **a**
90	108.57 **a**	15.67 **a**	1.77 **b**	17.45 **a**	7.05 **a**	12.10 **b**	14.58 **b**
120	104.26 **b**	15.44 **b**	1.10 **c**	16.54 **b**	6.65 **b**	11.86 **c**	13.12 **c**
F-test	**	**	**	**	**	**	**
Comp. Tea (B):							
Control	72.67 **e**	11.67 **e**	1.81 **a**	13.48 **e**	5.77 **d**	11.47 **d**	12.59 **e**
Foliar at 40 DAT	97.55 **c**	14.62 **c**	1.51 **b**	16.13 **c**	6.42 **b**	12.10 **c**	14.22 **c**
Foliar at 40 and 60 DAT	105.17 **b**	14.79 **b**	1.57 **b**	16.36 **b**	6.55 **b**	12.48 **b**	15.68 **b**
Foliar at 40, 60 and 80DAT	110.97 **a**	15.39 **a**	1.72 **a**	17.12 **a**	6.76 **a**	13.32 **a**	16.46 **a**
Soil application at 30 DAT	92.30 **d**	14.30 **d**	1.46 **b**	15.76 **d**	6.21 **c**	11.85 **d**	13.14 **d**
F-test	**	**	**	**	**	**	**
Bio-fertilizer (C):							
Uninoculated	89.57	13.62	1.71	15.34	6.17	11.93	13.56
Inoculated with (z+s)	101.89	14.69	1.52	16.20	6.51	12.56	15.28
F-test	**	**	**	**	**	**	**
Interaction:							
Nx B	**	**	N.S	**	**	NS	**
Nx C	*	**	N.S	*	N.S	N.S	**
B x C	**	*	N.S	**	N.S	N.S	**
N x B xC	**	**	N.S	**	N.S	NS	N.S

***, ** and NS indicated P<0.05, P<0.01 and not significant, respectively. Means within the same column for each factor designed by the same letter are not significantly different at 5% level according to Duncan's multiple range test.**

Table (7): Effect of different nitrogen rates, compost tea, bio fertilizer and their interactions on bulb yield and quality of onion in 2010/2011 season.

Treatment	Yield				Quality		
	Average bulb weight(g)	Marketable yield (t fad.$^{-1}$)	Culls yield (t fad.$^{-1}$)	Total yield (t fad.$^{-1}$)	Bulb diameter (cm)	TSS (%)	Dry matter (%)
N-Level (N):							
60	68.64 **c**	9.52 **b**	2.50	12.02 **b**	4.61 **b**	12.88 **a**	16.26 **a**
90	104.64 **a**	12.60 **a**	2.27	14.88 **a**	6.60 **a**	12.24 **b**	15.42 **b**
120	98.87 **b**	12.62**a**	2.11	14.73 **a**	6.54 **a**	12.10 **b**	13.56 **c**
F-test	**	**	N.S	**	**	**	**
Comp. Tea (B):							
Control	67.43 **e**	10.48 **e**	2.75 **a**	13.23 **d**	5.40 **d**	11.66 **d**	13.49 **e**
Foliar at 40 DAT	94.87 **c**	11.76 **c**	2.14 **b**	13.91 **bc**	5.98 **bc**	12.46 **bc**	15.19 **c**
Foliar at 40 and 60 DAT	100.33 **b**	12.09 **b**	2.06 **b**	14.16 **ab**	6.13 **ab**	12.66 **b**	15.76 **b**
Foliar at 40, 60 and 80DAT	106.30 **a**	12.38 **a**	1.95 **b**	14.33 **a**	6.36 **a**	13.05 **a**	16.91 **a**
Soil application at 30 DAT	84.65 **d**	11.18 **d**	2.56 **a**	13.73 **c**	5.71 **c**	12.23 **c**	14.05 **d**
F-test	**	**	**	**	**	**	**
Bio-fertilizer (C):							
Uninoculated	86.46	11.19	2.49	13.69	5.73	12.00	14.25
Inoculated with (z+s)	93.97	11.96	2.09	14.05	6.10	12.81	15.91
F-test	**	**	**	**	**	**	**
Interaction:							
Nx B	**	**	N.S	**	*	NS	**
Nx C	*	**	N.S	**	N.S	Ns	**
B x C	*	**	N.S	**	N.S	Ns	**
N x B xC	**	**	N.S	**	N.S	NS	NS

***, ** and NS indicated P<0.05, P<0.01 and not significant, respectively. Means within the same column for each factor designed by the same letter are not significantly different at 5% level according to Duncan's multiple range test.**

Effect of compost tea under mineral nitrogen levels on growth and yield of onion crop:

Plant growth measurements:

Onion growth significantly improved with application of compost tea and bio-fertilizer when it used alone (Tables 4 and 5). Application of compost tea and bio-fertilizer produced an almost equal growth as that of N - inorganic fertilization in terms of plant height, number of leaves, bulb diameter and fresh and dry weight of bulbs, leaves/ plant and whole plant of onion plants at 120 DAT. This fact was true in both seasons. Onion growth was higher under the application of compost tea on thrice (B_3) than twice batches at the same dose compared to control treatment (B_0). Application of B_3 (foliar spraying with compost at 40, 60 and 80 DAT) increased bulb and plant dry weight by (31.59 and 32.05%) and (40.10 and 30.29%) during both seasons, respectively.

The application of compost tea as foliar treatments on onion plants was higher in onion growth than compost tea applied as soil application. The highest growth of onion plants was obtained in the plots treated by compost tea under B_3 treatment compared with other organic fertilization in both seasons. Inoculation with di-nitrogen fixing bacteria (*Azotobacter* and *Azospirilium*) significantly improved growth of the onion plants compared with uninoculation treatment (Tables 4 and 5). Considering inoculation treatment increased bulb dry weight and plant than uninoculation treatment by (18.57 and 12.20%) and (19.20 and 11.72%) during 2009/2010 and 2010/2011 seasons, respectively. This data indicated that inoculation had the highest effect on onion growth. These increases may be due to the effect of nitrogen, which produced by inoculated bacteria in addition to cytokinens, GA_3 and IAA, which increase vegetative growth. These results were coinciding with those of Khalid *et al.* (2006) and Gharib *et al.* (2008). They all showed that compost tea increased vegetative growth and essential oil content of *Ocimum basilicum* and *marjoram* plants, respectively. The beneficial effect of compost tea on herb dry matter may be due to both supply nutrients and microbial functions (as useful microorganisms increase the time stomata stay open, then reducing loss from the leaf surface). It can provide chelated microelements and make them easier for plants to absorb and increasing soil aeration and acidity (Ebid *et al.*, 2008). This decrease of compost tea applied as soil application on onion growth due to soil components (i.e., organic matter, Al- and Fe-hydr oxides, variable charge clays, ect.), which probably interacted with the humic and fulvic acids and phenolic compounds that in compost tea contents. In case compost tea as foliar, there are increasing permeability of cellular membranes in plants to vitamins within the cell (Kaya *et al.*, 2005), which increased plant growth. And also, when compost teas are applied to foliage, there may be direct effects on the pathogen and indirect effects through improvement in plant resistance (Litterick *et al.*, 2004), which probably increased plant growth. Jayathilake *et al.* (2006) was obtained highest onion bulb yield (22.4%) with the application of *Azospirillum* + vermicompost + chemical fertilizers.

Onion bulbs yield and its quality:

It is clear from the present data in Tables (6 and 7) that foliar nutrients with compost tea significantly affected onion bulb yield and quality in the two seasons. Application of compost tea and bio-fertilizer when it used alone was effective in increasing the onion bulb yield in both seasons. Maximum average bulb weight, marketable and total bulbs yield (t $fad.^{-1}$), bulb diameter, TSS % and dry matter % were achieved by foliar spraying with compost tea at 40, 60 and 80 DAT (B_3).On the other hand, the lowest values were obtained from spraying with water (B_0), while it gave the highest values of culls yield $fad.^{-1}$ in the two seasons. Application of B_3 increased marketable yield, total yield and TSS % by (31.88 and 18.13 %), (27.00 and 8.32%) and (16.13 and 11.92 %) during 2009/2010and 2010/2011 seasons, respectively.

Effect of the interaction between N-fertilizer levels and compost tea:

According to the data in Table (8), it is clear that the combination between 90 kg N $fad.^{-1}$ and compost tea at 40, 60 and 80 DAT (N_2B_3) resulted in the highest values of plant height, plant dry weight, average bulb weight, marketable yield as well as total yield and bulb diameter, while the highest value of dry mater % was recorded when fertilized with 60 kg N $fad.^{-1}$. (N_1B_3).

Table (8): Effect of the interactions between N-fertilizer level, and compost tea on onion growth, onion bulbs and yield in 2009/2010 and 2010/2011 seasons.

Season	N-Level	Compost tea	Plant height (cm)	Plant dry weight (g)	Average bulb weight (g)	Marketable yield (t fad.$^{-1}$)	Total yield (t fad.$^{-1}$)	Bulb diameter (cm)	Dry mater (%)
2009/2010	N_1	B_0	61.30 i	14.51 j	61.45 l	9.97 j	12.47 k	5.05 j	13.50 e
		B_1	65.83 gh	17.68 h	73.76 j	11.34 i	13.04 j	5.35 i	15.54 c
		B_2	67.17 efg	17.63 h	79.24 h	11.60 h	13.48 i	5.40 i	16.85 ab
		B_3	69.17de	21.39 e	84.78 g	12.31 g	14.44 g	5.63 h	17.42 a
		B_4	64.58 h	15.21i	71.29 k	11.55 hi	13.18 j	5.16 ih	14.45 d
	N_2	B_0	66.58 fgh	19.17 g	76.21 i	11.78 h	14.06 h	6.03 g	12.75 fg
		B_1	75.67 b	22.30 d	109.39 e	16.67 b	18.29 b	7.31 ab	15.24 gh
		B_2	77.68 ab	26.26 b	124.43 b	16.64b	18.28 b	7.38 a	15.56 c
		B_3	78.02 a	28.18 a	126.79 a	17.24 a	18.96 a	7.53 a	16.20 bc
		B_4	72.35 c	19.97 f	107.35 e	16.03 cd	17.64d	7.01 cd	13.18 ef
	N_3	B_0	66.67fgh	19.99 f	80.35 h	13.27f	13.90 h	6.23 fg	11.52 h
		B_1	69.17 de	21.46 e	109.51 e	15.87 d	17.07 e	6.59 e	11.87gh
		B_2	71.23 cd	22.76 d	111.85 d	16.13 c	17.33 e	6.86 d	14.64 d
		B_3	72.42 c	25.61c	121.34 c	16.62 b	17.94c	7.13 bc	15.75 c
		B_4	68.67 ef	20.42 f	98.24 f	15.32 e	16.46 f	6.45 ef	11.80 h
2010/2011	N_1	B_0	54.92 j	15.77 i	52.33 l	8.55 j	11.35 g	4.16 f	14.40 g
		B_1	62.67 de	17.82 gh	68.39 g	9.72 h	12.19 ef	4.69 ef	16.70 c
		B_2	62.00 def	18.25 g	77.68 f	9.89 h	12.19 ef	4.76 e	17.05 b
		B_3	63.00 cd	22.20 d	85.39 e	10.40 g	12.59 e	4.97 e	17.92 a
		B_4	56.27 i	17.19 h	59.39 h	9.01 i	11.75 fg	4.49 ef	15.22 f
	N_2	B_0	57.67 h	19.20 f	72.00 g	10.95 f	13.72 d	5.98 d	14.02 h
		B_1	64.08 bc	22.19 d	113.23 b	13.08 b	15.13 ab	6.71 abc	15.68 e
		B_2	66.92 a	24.37 b	114.00 b	13.29ab	15.34 a	6.82 abc	16.23 d
		B_3	66.67 a	25.57 a	117.99 a	13.54 a	15.45 a	7.20 a	16.62 c
		B_4	61.75 ef	21.21 e	106.00 cd	12.16de	14.73 bc	6.28 cd	14.52 g
	N_3	B_0	59.42 g	19.60 f	77.95 f	11.95 e	14.63 bc	6.07bcd	12.07 k
		B_1	62.87 de	20.98 e	102.97 d	12.49 c	14.40 c	6.54bcd	13.19 i
		B_2	64.83 b	22.67 cd	109.32 c	13.10 b	14.94 abc	6.81abc	14.00 h
		B_3	64.83 b	23.33 c	115.52 ab	13.19 b	14.94 abc	6.90 ab	16.18 d
		B_4	61.33 f	19.79 f	88.56 e	12.36cd	14.72 bc	6.38bcd	12.39 j

Means designed by the same letter are not significantly different at 5% level, using Duncan's multiple range test. N_1: 60, N_2: 90 and N_3: 120 Kg N fad.$^{-1}$ – B_0: without compost tea, B_1: Foliar at 40 DAT, B_2: Foliar at 40 and 60 DAT, B_3: Foliar at 40, 60 and 80 DAT and B_4: Soil application at 30 DAT.

Adding 120 kg N fad.$^{-1}$ with soil application of compost tea at 30 DAT attained the highest mean values of weight loss% at all storage periods in both seasons, except for that at 6 months storage period in the second season (N_3B_4). Siddiqui *et al.* (2011) found that the interaction between compost tea and an inorganic fertilizer has led to an increase in macronutrient content. This increase might be related to the positive effect of compost tea and an inorganic fertilizer in increasing the root surface area per unit of soil volume, water use efficiency and photosynthetic activity, which directly affect physiological processes. These elements improve the yield and growth of onion. Also, the organic sources of nitrogen, as well as their combinations with inorganic sources, have been reported to significantly improve plant height, fresh and dry weight of both above-ground parts and roots, and increase oil yield in basil compared to plots receiving only inorganic N (Sifola and Barbieri, 2006).

Effects of the interaction between N- fertilizer level and bio-fertilizer are shown in Table (9). Plant fresh weight, average bulb weight, marketable and total yield were increased in all plots which received 90 kg N fad.$^{-1}$ with applying biofertilizer in comparison to all other treatments.

Table (9): Plant fresh weight (g), average bulb weight (g), marketable and total yield (t fad.$^{-1}$) and dry mater % as affected by the interactions between N-fertilizer levels and bio-fertilizer in 2009/2010 and 2010/2011 seasons.

N- level (Kg fad.$^{-1}$)	2009/2010		2010/2011	
	Bio-fertilizer			
	Uninoc.	Inoc.	Uninoc.	Inoc.
Plant fresh weight (g)				
60	155.31 f	165.40 e	145.40 e	180.60 d
90	205.96 c	236.21 a	195.12 c	219.03 a
120	194.84 d	221.34 b	194.87 c	208.45 b
Average bulb weight (g)				
60	68.35 f	79.86 e	64.33 e	72.95 d
90	103.04 c	114.62 a	101.53 b	107.76 a
120	97.33 d	111.20 b	93.53 c	104.20 b
Marketable yield (t fad.$^{-1}$)				
60	10.92 e	11.79 d	9.10 f	9.93 e
90	15.15 b	16.20 a	12.12 d	13.09 a
120	14.81 c	16.07 a	12.38 c	12.86 b
Total yield (t fad.$^{-1}$)				
60	12.98 e	13.67 d	11.83 e	12.20 d
90	16.99 b	17.90 a	14.54 c	15.21 a
120	16.05 c	17.03 b	14.71 bc	14.75 b
Dry mater (%)				
60	14.85 c	16.26 a	15.29 c	17.23 a
90	13.39 d	15.78 b	14.29 d	16.54 b
120	12.43 e	13.80 d	13.18 f	13.95 e

Means designed by the same letter are not significantly different at 5% level, using Duncan's multiple range test

Whereas, application of 60 Kg N. fad.-1 recorded the highest values of dry mater % (16.26 and 17.23%) under inoculation treatment in the first and second seasons, respectively. Effects of the interactions between compost tea and bio-fertilizer are shown in Table (10). The maximum plant height and plant dry weight at 120 DAT, average bulb weight, marketable yield and percentage of dry mater were noticed from the treatment included bio-fertilizer application and spraying with compost tea at 40, 60 and 80 DAT followed by foliar application of compost tea at 40 and 60 DAT, while the lowest one was obtained with the combination of control (without both compost tea and inoculation treatment).

Table (10): Plant height (cm), plant dry weight (g), average bulb weight (g), marketable and total yield (t fad.$^{-1}$) and percentage of dry matter as influenced by the interactions between foliar nutrients with compost tea and biofertilizer in 2009/2010 and 2010/2011 seasons.

Season	Compost tea	Bio-fertlizers	Plant height (cm)	Plant dry weight (g)	Average bulb weight (g)	Marketable yield (t fad.$^{-1}$)	Total yield (t fad.$^{-1}$)	Dry mater (%)
2009/2010	B_0	C_1	64.11 **f**	16.45 **i**	66.78 **h**	11.15 **g**	13.17 **h**	12.19 **g**
		C_2	65.59 **e**	19.33 **f**	78.57 **g**	12.19 **f**	13.79 **g**	12.98 **ef**
	B_1	C_1	68.09 **d**	18.86 **g**	88.47 **e**	14.14 **d**	15.70 **e**	13.37 **e**
		C_2	72.36 **b**	22.10 **d**	106.63 **c**	15.11 **c**	16.57 **c**	15.06 **c**
	B_2	C_1	69.92 **c**	19.87 **e**	99.87 **d**	14.18 **d**	15.82 **e**	14.31 **d**
		C_2	74.13 **a**	24.56 **b**	110.48 **b**	15.40 **b**	16.91 **b**	17.06 **b**
	B_3	C_1	71.37 **b**	22.75 **c**	107.92 **c**	14.99 **c**	16.82 **b**	15.15 **c**
		C_2	75.03 **a**	27.38 **a**	114.02 **a**	15.79 **a**	17.41 **a**	17.77**a**
	B_4	C_1	65.92 **e**	17.12 **h**	84.82 **f**	13.68 **e**	15.20 **f**	12.76 **f**
		C_2	71.14 **bc**	19.95 **e**	99.77 **d**	14.93 **c**	16.32 **d**	13.52 **e**
2010/2011	B_0	C_1	56.11 **g**	17.41 **h**	61.75 **g**	10.19 **i**	13.10 **e**	13.09
		C_2	58.56 **f**	18.96 **f**	73.11 **f**	10.78 **g**	13.37 **e**	13.90 **f**
	B_1	C_1	61.02 **e**	19.18 **f**	88.85 **d**	11.52 **f**	13.95 **cd**	14.27 **e**
		C_2	65.39 **b**	21.48 **d**	100.89 **bc**	12.01 **c**	13.86 **d**	16.11 **c**
	B_2	C_1	62.56 **d**	20.24 **e**	97.41 **c**	11.76 **e**	13.95 **cd**	14.44 **de**
		C_2	66.61 **a**	23.29 **b**	103.26 **b**	12.43 **b**	14.37 **ab**	17.08 **b**
	B_3	C_1	63.37 **c**	22.51 **c**	104.17 **b**	11.97 **cd**	14.17 **bc**	15.96 **c**
		C_2	66.17 **a**	24.88 **a**	108.43 **a**	12.79 **a**	14.49 **a**	17.85 **a**
	B_4	C_1	58.16 **f**	18.29 **g**	80.14 **e**	10.56 **h**	13.28 **e**	13.49 **g**
		C_2	61.41 **e**	20.50 **e**	89.16 **d**	11.79 **de**	14.19 **bc**	14.59 **d**

Means designed by the same letter are not significantly different at 5% level, using Duncan's multiple range test.B_0: without compost tea, B_1: Foliar at 40 DAT, B_2: Foliar at 40 and 60 DAT, B_3: Foliar at 40, 60 and 80 AT and B_4: Soil application at30 DAT – C_1: uninoculated and C_2: Inoculated by free living (z+s)

There was a significant effect due to the interaction among N-fertilizer level, compost tea treatment and bio-fertilizer on average bulb weight, marketable yield and total yield in the two seasons. Data in Table 11 show that added of 90 kg N fad^{-1}, compost tea spraying 3 times and inoculation by bacterial di-nitrogen fixers ($N_2B_3C_2$) compared to ($N_2B_0C_1$) led to an increase in average bulb weight (g), marketable yield (t/fed.) and total yield t/fed.) in both 2009/2010 and 2010/2011 seasons were 81.4, 62.32 and 45.5% and 91.2, 31.3 and 15.4%, respectively.

Table (11): Average bulb weight (g), marketable yield (t fad^{-1}) and total yield (t fad^{-1}) as affected by the interaction among N-fertilizer level, compost tea and biofertilizer in 2009/2010 and 2010/2011 seasons.

N-Levels	Compost Tea	Bio-fertlizers	Average bulb weight(g)		Marketable Yield (t fad.-1)		Total Yield (t fad.-1)	
			2009/10	2010/11	2009/10	2010/11	2009/10	2010/11
N_1	B_0	C_1	54.86	51.32	9.77	8.07	12.43	11.00
		C_2	68.05	53.34	10.17	9.03	12.51	11.70
	B_1	C_1	66.63	56.51	10.85	9.40	12.61	12.14
		C_2	80.89	80.28	11.82	10.04	13.47	12.23
	B_2	C_1	76.02	72.70	10.77	9.68	12.75	12.14
		C_2	82.45	82.66	12.43	10.11	14.20	12.23
	B_3	C_1	83.06	83.39	11.96	10.12	14.18	12.51
		C_2	86.49	87.39	12.66	10.68	14.71	12.68
	B_4	C_1	61.16	57.73	11.25	8.21	12.91	11.35
		C_2	81.41	61.06	11.85	9.80	13.45	12.16
N_2	B_0	C_1	70.40	62.73	10.88	10.70	13.28	13.70
		C_2	82.01	81.27	12.68	11.20	14.84	13.73
	B1	C_1	97.79	111.78	16.41	12.74	18.06	14.96
		C_2	120.98	114.69	16.93	13.41	18.52	15.29
	B_2	C_1	121.24	111.92	16.25	12.86	17.94	15.03
		C_2	127.62	116.08	17.04	13.72	18.63	15.66
	B_3	C_1	123.51	116.03	16.83	13.03	18.61	15.09
		C_2	130.08	119.94	17.66	14.05	19.32	15.81
	B_4	C_1	102.27	105.17	15.39	11.29	17.09	13.89
		C_2	112.43	106.83	16.68	13.04	18.19	15.57
N_3	B_0	C_1	75.06	71.20	12.80	11.80	13.80	14.60
		C_2	85.64	84.71	13.73	12.10	14.00	14.67
	B_1	C_1	101.01	98.25	15.15	12.41	16.42	14.75
		C_2	118.02	107.70	16.58	12.58	17.71	14.06
	B_2	C_1	102.34	107.60	15.52	12.73	16.75	14.67
		C_2	121.36	111.04	16.73	13.46	17.92	15.21
	B_3	C_1	117.20	113.10	16.19	12.76	17.67	14.90
		C_2	125.49	117.96	17.06	13.63	18.21	14.98
	B_4	C_1	91.02	77.52	14.39	12.18	15.59	14.61
		C_2	105.46	99.61	16.25	12.54	17.33	14.82
L S D at 0.05			2.755	7.134	0.330	0.346	0.402	0.441

N_1: 60, N_2: 90 and N_3: 120 Kg N $fad.^{-1}$ – B_0: Without compost tea, B_1: Foliar at 40 DAT, B_2: Foliar at 40 and 60 DAT, B_3: Foliar at 40, 60 and 80 DAT and B_4: Soil application at 30 DAT – C_1: Uninoculated and C_2: Inoculated by free living (z+s).

REFERENCES

Abdel-Razzak,H.S. and G.A.El-Sharkawy (2013). Effeect of biofertilizer and humic acid applications on growth, yield, quality and storability of two garlic(Allium sativum L.) cultivars. Asian J. of Crop Sci., (5):48-64.

Abdissa, Y.; T. Tekalign and L. M. Pant (2011). Growth, bulb yield and quality of onion (*Allium cepa* L.) as influenced by nitrogen and phosphorus fertilization on vertisol. I. growth attributes, biomass production and bulb yield. African J. Agric. Res. 6 (14): 3252-3258.

Abdurrahman, H., B. Fatih, M. Fatih and Y. Mustafa (2004). Reclamation of saline-sodic soils with gypsum and MSW compost. J. Compost Sc. & Utilization, 12(2): 175-179.

Adesemoye, A.O.; H.A. Torbert and J.W Kloepper (2008) Enhanced plant nutrient use efficiency with PGPR and AMF in an integrated nutrient management system. Can J Microbiol 54:876–886

Ahmed, M.E.M. (2009). Effect of some bio and mineral fertilization levels on the growth, productivity and storability of onion. Annals Agric. Sci., Ain Shams Univ., Cairo, 54(2), 427-436.

Allen, O. N.(1953). Experiments in Soil Bacteriology Ins. Ed. Burrges. Pub., USA.

Bashan,Y.; G. Holguin and L.E.de-Bashan (2004). *Azospirillum*-plant relationships: physiological, molecular, agricultural, and environmental advances (1997–2003). Can J Microbiol 50:521–577

Dobbelaere, S.; A. Croonenborghs; A. Thys; D. Ptacek and J. Vanderleyden (2001). Responses of agrinomically important crops to inoculation with Azospirillum. Aust. J. Plant Physiol., 28: 871-879.

Dobereiner, J. (1978). Influnce of environmental factors on the occurrence of S. lipoferum in soil roots. Environmental role of N2-fixing blue green algae and asymbiotic bacteria Ecol. Bull. (Stockholm), 26: 343-352.

Duncan, B. D. (1955). Multiple rang and multiple F-test Biometrics 11: 1- 42.

Ebid, A.;H. A Ueno and G. N. Asagi (2008). Nitrogen uptake by radish, spinach and "Chingensai" from composted tea leaves, coffee waste and kitchen garbage. Compost Sci & Utilization, 16(3): 152-158.

El-Gizawy, E.S. (2005). The role of compost quality and compost tea to enhance organic agriculture system. Ph.D. Thesis, Soil Science Dept., Fac. of gric. Alex. Univ. Egypt.

Fixon, P.E. and F.B. West (2002). Nitrogen fertilizers: meeting contemporary challenges. Ambio 31 (2), 169–176.

Geries, L.S.M. (2007). Effect of different fertilizer sources on growth and yield of onion (*Allium cepa*, L.). Ph.D. Thesis, Fac. of Agric., Kafrelsheikh Univ., Egypt.

Geries, L.S.M.; A.M.A. Abo-Dahab and S.S. Karam (2012). Response of onion productivity and storability to some sources, rates and time of application of nitrogen fertilizers. Alex. j. Agric.Res.,57(2):153-162.

Gharib, F.A., L.A. Moussa and O.N. Massoud (2008). Effect of compost and bio-fertilizers on growth, yield and essential oil of sweet marjoram (*Majorana hortensis*) plant. Inter. J. of Agric. &Biol., 10(4): 381-387.

Haggag-Wafaa, M. and M. Saber (2007). Suppression of *Alternaria* blighton tomato and onion by foliar spray of aerated and non aerated compost teas. J. Food, Agric. and Environ. 5: 2, 302-309.

Han, H.S.and K.D.Lee (2005). Phosphate and potassium solubilizing bacteria effect on mineral uptake, soil availability, and growth of egg plant. Res J. Agric. Biol. Sci. 1:176–180

Hussein, Kh. and A.F. Hassan (2011). Effect of different levels of humic acids on the nutrient content, plant growth and soil properties under conditions of salinity. Soil and Water Res., 6(1): 21-29.

Jayathilake , K.S.; I.P. Reddy; D. Srihari and K.R.Reddy (2006). Productivity and soil fertility status as influenced by integrated use of N-fixing biofertilizers, organic manures and inorganic fertilizers in onion. J. Agric. Sci, 2 (1):46-58.

Kaya, M.; M. Atak, K. Mahmood, C.Y. Cefci and S. Ozcan (2005). Effect of pre-sowing seed treatment with zinc and foliar spray of humic acid on yield of common bean (*Phaseolus vulgaris* L.). Int. J. Agric. Biol., 7: 875-878.

Khalid, K.H.A.; S.F. Hendawy, and E. S. El-Gizawy (2006). *Ocimum basilicum L.* production under organic farming. Res. J. Agric. Biol. Sci., 2(1): 25- 32.

Kloepper, J.W.; C.M. Ryu and S. Zhang (2004). Induced systemic resistance and promotion of plant growth by *Bacillus spp*. Phytopathol. 94:1259–1266

Kohler, J.; J.A. Hernandez; F. Caravaca and A. Roldan (2008). Plant growth promoting rhizobacteria and arbuscular mycorrhizal fungi modify alleviation biochemical mechanisms in water-stressed plants. Function Plant Biol 35:141–151

Kolodziej, B.(2006). Effect of mineral fertilization on ribwort plantain (*Plantago lanceolataL*.) yielding. Acta Agrophys. 8, 637–647.

Lee, J.(2010). Effect of application methods of organic fertilizer on growth, soil chemical properties and microbial densities in organic bulb onion production. Scientia Horticulturae 124: 299–305.

Litterick, A.M.; L. Harrier; P. Wallace; C.A., Watson and M.Wood (2004).The role of uncomposted materials, composts, manures and compost extracts in reducing pest and disease incidence and severity in sustainable temperate agricultural and horticultural crop production—areview. Crit. Rev. Plant Sci. 23, 453–479.

Marey, R.A. (2009). Post-harvest attributes of onion bulbs as affected by NPK fertilization under Souther Egypt condition. Egypt. J. Appl. Sci., 24(9): 239-250.

Morsy, M.G.; R.A. Marey; S.S. Karam and A.M.A. Abo-Dahab (2012). Productivity and storability of onion as influenced by the different levels of NPK fertilization. Agric. Res. Kafer El-Sheikh Univ., 38(1):171-187.

Nasef, M.A., Kh. A. Shaban and F. Abd El-Hamide-Amal (2009). Effect of compost, compost tea and biofertilizer application on some chemical soil properties and rice productivity under saline soil condition. J. Agric. Mansoura Univ., 34(4): 2609-2623.

Nyangani,E.T.(2010). Effect of combined application of organic manure and chemical fertilizers on soil properties and crop yield: Revew. Nigerian J. of Sci., Techno. and Environ.Education (NIJOSTEE), 3(1): 0331-9873

Page, M. A.; R. H. Millex an D. R. Keeny (1982). Methods of Soil Analysis. Part 2. Academic press, New York.

Porass, M.N., S. Gerges Jaklin, M. Sallam Amany and M.B. Adel (2010). Interactive effect of nitrogen fertilizer,bio-fertilizer and humic acid under saline conditions on yield, yield components and seed quality of sesame (Sesamum indicum L). Egypt. J. Appl. Sci., 25(2B): 89-114.

Shaheen, A.M.; Fatma A. Rizk, A.M. M. El- Tanahy and E. H. abd El-Samad (2011). Vegetative growth and chemical parameters of onion as influenced by potassium as major and stimufol as minor fertilizers. Australian J. Basic and Applied Sc., 5(11):518-525.

Shaban, Kh. A. and M.N. Omar (2006). Improvement of maize yield and some soil properties by using nitrogen mineral and PGPR group fertilization in newly cultivated saline soils. Egypt. J. Sci., 46(3): 329-342.

Siddiqui, Y.; S. Meon; R. Ismail and M.Rahmani (2009). Bio-potential of compost tea from agro-waste to suppress Choanephora cucurbitarum L. the causal pathogen of wet rot of okra. Biol. Control 49, 38–44.

Siddiqui, Y.; S. Meon; R. Ismail; M. Rahmani and A. Ali (2008). Bio-efficiency of compost extracts on the wet rot incidence, morphological and physiological growth of okra (Abelmoschus esculentus [(L.) Moench]). Sci. Horti. 117, 9–14.

Siddiqui, Y.; S. Meon; R.Ismail and Y.Naidu (2011). The conjunctive use of compost tea and inorganic fertiliser on the growth, yield and terpenoid content of *Centella asiatica (L.)* urban. Sci. Horti. 130, 289–295

Sifola, M.I. and G. Barbieri (2006). Growth, yield and essential oil content of three cultivars of basil grown under different levels of nitrogen in the field .Scientia Horticulturae, 108: 408–413.

Snedecor, G.V. and W.G. Cochran (1980). Statistical methods, 12th Ed. Iowa State Univ. Press, Amer. Iowa, USA.

Sridevi, S.and K. Ramakrishnan (2010). Effects of combined inoculation of AM fungi and *Azospirillum* on the growth and yield of onion *(Allium cepa L.) . J. Phyto, 2(1): 88-90*.

Weller, D.M.(2007). *Pseudomonas* biocontrol agents of soilborne pathogens: looking back over 30 years. Phytopathology 97: 250–256

تقييم إضافة بكتريا تثبيت الأزوت الجوى الحرة المعيشة وشاى الكومبوست ومستويات تسميد نيتروجين معدنى على بعض خواص التربة وإنتاجية وجودة محصول البصل صنف جيزة أحمر

عيد سليمان على الجيزاوى[١] و لبيب صبحي ميخائيل جريس[٢]

[١]قسم بحوث الميكروبيولوجيا الزراعية – معهد بحوث الأراضى والمياة والبيئة – مركز البحوث الزراعية – مصر

[٢] قسم بحوث البصل- معهد بحوث المحاصيل الحقلية- مركز البحوث الزراعية– مصر.

أجرى هذا البحث التطبيقى خلال الموسمين الشتويين ٢٠١٠/٢٠٠٩ و ٢٠١٠/ ٢٠١١ بالمزرعة البحثية لمحطة البحوث الزراعية بسخا – محافظة كفرالشيخ وذلك لدراسة تأثير إستخدام شاى الكومبوست بمواعيد إضافة مختلفة و معدلات مختلفة من التسميد النيتروجينى المعدنى والحيوى على بعض خواص التربة والقدرة الإنتاجية وجودة محصول البصل صنف جيزه أحمر.تم استخدام تصميم القطع المنشقة مرتين فى ثلاث مكررات حيث وزعت معاملات التسميد النيتروجينى المعدنى بثلاث معدلات (٦٠، ٩٠ ،١٢٠ كجم نيتروجين

/فدان) على القطع الرئيسية ، ومواعيد الرش بشاى الكومبوست بمعدل٢٠لتر/فدان في كل مرة (الرش الورقى بالماء العادي للمقارنة - الرش الورقى عند ٤٠يوم من الشتل ، الرش الورقى عند ٦٠،٤٠ يوم، الرش الورقى عند ٨٠،٦٠،٤٠ يوم من الشتل ،واضافة شاي الكمبوست الي التربة بمعدل ٣٠لتر/فدان عند ٣٠يوم من الشتل) على القطع الشقية الأولى أما التسميد الحيوى (شتلات غير ملقحة - شتلات ملقحة بخليط من بكتريا الازوتوباكتروالأزوسبريللام) فقد وزعت عشوائيا على القطع الشقية الثانية.

ويمكن تلخيص أهم النتائج فيما يلى:

- تحققت أعلى زيادة معنوية فى يسر العناصر الغذائية الكبرى المتاحة (نيتروجين – فوسفور - بوتاسيوم) والنسبة المئوية للمادة العضوية والعدد الكلى للبكتريا فى التربة بعد الحصاد خلال موسمى التجربة فى القطاعات الأرضية التى عوملت أرضيا بشاى الكومبوست بمعدل ٣٠ لتر للفدان بعد ٣٠ يوم من الشتل وخاصة مع التلقيح بمخلوط بكتريا الأزوتبكتر كروكوكم وبكتريا الأزوسبيريللام براسيلانس وذلك عند مستوى ٩٠ كجم نيتروجين معدنى للفدان ($N_2B_4C_2$) . بينما سجلت أقل قيم فى صفات التربة السابقة الذكر عند عدم إستخدام شاى كومبوست وعدم التلقيح البكتيرى وذلك عند مستوى ٦٠ كجم نيتروجين للفدان ($N_1B_0C_1$) وبذلك يمكن القول أن الإستخدام المتكامل بين شاى الكومبوست والتلقيح ببكتريا تثبيت الأزوت الجوى الحرة المعيشة والتسميد المعدنى المتوسط يحدث تحسن واضح فى خصوبة التربة .
- أشارت النتائج الى الحصول علي أعلى القيم من صفات النمو الخضرى والمحصول وجودة الأبصال والقدرة التخزينية للأبصال تم الحصول عليها عند الرش الورقي بشاي الكومبست ثلاث مرات بعد٤٠،٦٠،٨٠ يوم من الشتل. فى حين تم الحصول على اقل القيم من صفات النمو الخضرى والمحصول وجودة الأبصال عند الرش بالماء، وذلك فى كلا الموسمين. أيضا كان هناك تأثيراً معنوياً واضحا للتسميد الحيوى بالموسمين، حيث أدى تلقيح شتلات البصل بالأزوتوباكتروالأيزوسبريليم إلى زيادة فى ارتفاع النبات، الوزن الغض و الجاف لكل من الاوراق والابصال والنبات و قطر ووزن البصلة، وكذلك متوسط وزن البصلة ،المحصول الصالح للتسويق والكلي مع اقل محصول نقضة/فدان وتحسين القدرة التخزينية للأبصال.
- عموما ومن الناحية الاقتصادية وتحت ظروف هذة الدراسة يمكن أن نوصى بالرش الورقى بشاى الكومبوست ثلاث مرات بمعدل ٢٠ لتر/فدان في كل مرة وتسميد نباتات البصل (صنف جيزة أحمر) بمعدل ٩٠ كجم نيتروجين (معدنى)/فدان مع تلقيح شتلات البصل بالأزوتوباكتر والأزوسبيريليم لزيادة إنتاجية محصول البصل وتقليل التلوث البيئى نتيجة لتقليل استخدام النيتروجين فى الصورة المعدنية و من هذة النتائج المحققة يمكن إستخدام شاى الكومبوست كبديل لجزء كبير من الأسمدة المعدنية وبالتالى تقليل تكاليف الإنتاج وتحسين الجودة والحد من التلوث البيئى .

قام بتحكيم البحث

أ.د / زكريا مسعد الصيرفى	**كلية الزراعة – جامعة المنصورة**
أ.د / رمضان اسماعيل كنانى	**مركز البحوث الزراعية**

Table (4): Effect of different nitrogen rates, compost tea, bio fertilizer and their interactions on some onion growth characters at 120 DAT in 2009/2010 season.

Treatment	Plant height (cm)	No. of Green leaves /plant	Bulb diameter (cm)	Leaves fresh Weight /plant (g)	Bulb fresh weight (g)	Plant fresh weight (g)	Leaves dry weight /plant (g)	Bulb dry weight (g)	Plant dry weight (g)
N-Level (N):									
60	65.61 **c**	7.16 **b**	3.97 **b**	81.91 **c**	78.44 **c**	160.35 **c**	4.48 **c**	12.81 **b**	17.28 **c**
90	74.06 **a**	8.67 **a**	4.33 **a**	98.40 **a**	122.69 **a**	221.09 **a**	6.47 **a**	16.71 **a**	23.17 **a**
120	69.63 **b**	8.80 **a**	4.25 **a**	90.41 **b**	117.68 **b**	208.09 **b**	5.82 **b**	16.23 **a**	22.05 **b**
F-test	**	**	**	**	**	**	**	**	**
Compost Tea (B):									
Control	64.85 **d**	7.38 **c**	3.98 **d**	76.67 **e**	85.70 **e**	162.37 **e**	4.31 **e**	13.58 **e**	17.89 **e**
Foliar at 40 DAT	70.22 **b**	8.30 **ab**	4.10 **c**	89.21 **c**	105.78**c**	194.98 **c**	5.85 **c**	14.90 **c**	20.48 **c**
Foliar at 40 and 60 DAT	72.03 **a**	8.52 **a**b	4.30 **b**	95.38 **b**	120.52**b**	215.89 **b**	6.35 **b**	15.87 **b**	22.22 **b**
Foliar at 40 , 60 and 80 DAT	73.20 **a**	8.71 **a**	4.63 **a**	105.87**a**	128.00**a**	233.88 **a**	7.19 **a**	17.87 **a**	25.06 **a**
Soil application at 30 DAT	68.53 **c**	8.12 **b**	3.91 **d**	84.06 **d**	91.37 **d**	175.43 **d**	4.52 **d**	14.02 **d**	18.53 **d**
F-test	**	**	**	**	**	**	**	**	**
Bio-fertilizer (C):									
Uninoculated	67.88	7.95	3.94	84.19	101.18	185.37	5.06	13.95	19.01
Inoculated with (z+s)	71.65	8.46	4.42	96.29	111.36	207.65	6.12	16.54	22.66
F-test	**	**	**	**	**	**	**	**	**
Interaction:									
Nx B	**	N.S	N.S	N.S	N.S	N.S	N.S	N.S	**
Nx C	N.S	N.S	N.S	N.S	N.S	**	N.S	N.S	N.S
B x C	**	N.S	N.S	N.S	N.S	N.S	N.S	N.S	**
N x B Xc	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

***, ** and NS indicated P<0.05, P<0.01 and not significant, respectively. Means within the same column for each factor designed by the same letter are not significantly different at 5% level according to Duncan's multiple range test.**

Table (5): Effect of different nitrogen rates, compost tea, bio fertilizer and their interactions on some onion growth characters at 120 DAT in 2010/2011 season.

Treatment	Plant height (cm)	No. of green leaves /plant	Bulb diameter (cm)	Leaves fresh Weight /plant (g)	Bulb fresh weight (g)	Plant fresh weight (g)	Leaves dry weight /plant (g)	Bulb dry weight (g)	Plant dry weight (g)
N-Level (N):									
60	59.77 **c**	7.28 **b**	3.28 **b**	86.11 **b**	76.89 **b**	163.00 **b**	4.66 **b**	13.59 **c**	18.24 **c**
90	63.42 **a**	8.59 **a**	4.21 **a**	98.96 **a**	108.12 **a**	207.08 **a**	6.58 **a**	15.93 **a**	22.51 **a**
120	62.62 **b**	8.31 **a**	4.34 **a**	94.46 **ab**	107.19 **a**	201.66 **a**	6.45 **a**	14.82 **b**	21.27 **b**
F-test	**	**	*	*	**	**	**	**	**
Comp. Tea (B):									
Control	57.34 **d**	7.32 **d**	3.57 **c**	86.18 **c**	90.17 **c**	176.35 **c**	5.18 **d**	13.01 **e**	18.19 **e**
Foliar at 40 DAT	63.21 **b**	7.91 **c**	4.02 **b**	92.98 **bc**	95.42**abc**	188.40 **bc**	5.97 **bc**	14.36 **c**	20.33 **c**
Foliar at 40 and 60 DAT	64.58 **a**	8.72 **b**	4.13 **ab**	96.16 **ab**	102.14**ab**	198.31 **ab**	6.16 **ab**	15.60 **b**	21.76 **b**
Foliar at 40 , 60 and 80 DAT	64.77 **a**	9.17 **a**	4.31 **a**	101.06 **a**	106.23 **a**	207.30 **a**	6.51 **a**	17.18 **a**	23.70 **a**
Soil application at 30 DAT	59.78 **c**	7.19 **d**	3.70 **c**	89.50b **c**	93.03 **bc**	182.53 **c**	5.66 **c**	13.73 **d**	19.40 **d**
F-test	**	**	**	**	*	**	**	**	**
Bio-fertilizer (C):									
Uninoculated	60.24	7.60	3.76	85.90	92.56	178.46	5.60	13.93	19.53
Inoculated with (z+s)	63.63	8.52	4.13	100.45	102.24	202.69	6.19	15.63	21.82
F-test	**	**	**	**	**	**	**	**	**
Interaction:									
Nx B	**	N.S	N.S	N.S	N.S	N.S	N.S	N.S	**
Nx C	N.S	N.S	N.S	N.S	N.S	*	N.S	N.S	N.S
B x C	**	N.S	N.S	N.S	N.S	N.S	N.S	N.S	*
N x B xC	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

***, ** and NS indicated P<0.05, P<0.01 and not significant, respectively. Means within the same column for each factor designed by the same letter are not significantly different at 5% level according to Duncan's multiple range test**