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The Effects of The Conjunctive Use of Compost Tea and Inorganic Fertilizers on Radish (*Raphanus sativus*) Nutrient Uptake and Soil Microorganisms

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APPLICATION of organic amendments to soil is an important management strategy for enhancing soil fertility and microorganisms. A pot experiment was conducted under greenhouse conditions to investigate the effect of compost and compost tea(CT), mineral fertilization only complete (N_{100}) and half (N_{50}) recommended doses of nitrogen or combined with two kinds of compost tea (according to extract methods) molasses compost tea (CT1) and molasses compost tea+ ammonium sulphate (CT2) with three application ratios (v:v) (1:25, 1:50 and 1:75) on NPK uptake of leaf and root of radish (Raphanus sativus), soil nutrient status after harvest, and soil microbial populations. Application of CT1 showed that N uptake of radish leaf was about 30.1% higher than that of CT2. CT1 compost tea also increased P and K uptake by 12.6 and 51.5%, respectively, compared with CT2 application. At the end of experiment, soil N, P and K contents were greater in compost amended soil,whereas N uptake of radish leafand root showed only a significant positive correlation with soil N content in the CT2 + N treatments. The populations of the different microorganisms were greater in CT treatment, and increased with time as well. However, it was found that there was a significant negative correlation between leaf and root N uptake of radish and population of anaerobic N_2 fixing bacteria in soil after harvest.

Keywords: Compost, Compost extract, Radish growth, Nutrient uptake, Soil microorganisms

The organic food industry is increasingly lucrative in Egypt. Organic farming involves additions of nutrients besides the non-synthetic materials such as mineral inorganic chemical fertilizers (Winter and Davis, 2006). Major benefits of organic farming are to produce safe food and to protect soil and agriculture production from pollution (Bourn and Prescott, 2002). Organic farming should optimize biological productivity of soil, and eliminate the use of synthetic products. Biodiversity of plant species, invertebrates, birds and other organisms should be higher in organic farms in comparison with conventional ones (Fuller *et al*., 2005).

Therefore, fertilizers such as farmyard manure, composts and other safe organic farm wastes should be applied (Carpenter-Boggs, 2005 and Warman,

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2005). Many communities have composted their municipal organic solid wastes to use them as soil amendments(Otten, 2001).Quality of compostsvaries according to the nature of composted organic wastes or residues, as well as the type of composting procedure(He *et al*., 1995 and NOSB, 2004).Compost and compost extracts applied to the soil improve its quality by altering its chemical and physical properties, by increasing organic matter content, water holding capacity, overall diversity of microbes, by providing macro- and micro-nutrients essential for plant growth, and by suppressing diseases, which indirectly contribute to the increase in plant growth (Heather *et al*., 2006).

Compost tea made of leaf, coffee wastes and kitchen garbage could be useful sources of N, P and K for crops (Ebid *et al*., 2007). The efficiency of application of composts depends on their contents of nutrients and their rate of release (Cassman and Munns, 1980). Compost tea (water extract of solid organic compost) may contain hormones and microorganisms useful for plants and soil (Edris *et al*., 2003) because mineralization N of organic amendment is positively correlated with their contents of total N (Aulakh *et al*., 2000) as well as microbial N content (Antonopoulos, 1999). More research is needed to assess the nutrient supplying capacity of compost. Compost tea, incubated with various nutrients for microorganisms and in some cases inoculated with specific microbiota enhanced the microbial activity of compost extract (Bess, 2000). Compost tea contains high population of microbiota including Rhizobacteria, Trichoderma, and Pseudomonas spp., which enhances plant growth and crop yield (Sylvia, 2004). It also contains growth hormones and anti-pathonic chemicals such assiderophores tannins and phenols (Antonio *et al*., 2008), and vitamin C (Ha *et al*., 2008). Some microorganisms benefit plants through mechanisms such as nitrogen fixation and phosphate solubilization (Dubeikovsky *et al*., 1993).

According to Ingham (2005), sugar or molass, kelp extracts and pulverized rock materials including phosphate rock are used in organic farming. Addition of such material to the composts increased microbial population and growth (Naidu *et al*., 2010), and improved the C/N ratio of the culture growing Chinese cabbage (Pant *et al*., 2009).

Therefore, the present study was conducted to assess the effects of compost teas made with two supplements (molasses and ammonium sulphate) on yield and leaf and root nutrient uptake of radish as well as the effect on soil microbial population.

Material and Methods

A greenhouse study on radish (Raphanus sativus) grown on a sand soil was conducted at the Faculty of Agriculture, Zagazig University, from November 2011 to January 2012. PVC pots contained 6.0 kg soil of each were used. The experiment was carried out in a randomized complete block design factorial with 3 factors (3 replicates) as follows: First factor; compost tea (CT), *i.e.* molass tea (CT1) and ammonium sulphate compost tea (CT2);second factor: compost preparation ratio: three ratios, *i.e.* 1:25 (r_1), 1:50 (r_2), and 1:75 (r_3);and third factor, mineral N application: two doses half dose (N_{50}), and full dose (N_{100}). The full dose represents application of 210g N kg^{-1} soil in the form of ammonium sulphate. Furthermore, there were three other treatments as follows: non-treated, mineral N treated supplied with the full dose of N and compost-treated, supplied with 10 g compost kg^{-1}(about 24 Mg ha^{-1} considering the plough layer where Mg "megagram = 10^6 g"). Application of compost tea was 300 ml/pot , while application of compost was done before seeding and mixed thoroughly with soil; application of mineral N (as ammonium sulphate 210 g N kg^{-1}) was done in two times one after 15 days of seeding and the second after 30 days of seeding. Watering was done so as to keep the moisture at about soil water-holding capacity. All treatments were supplied with P at the rate of 10 mg P kg^{-1} using calcium super phosphate and 10 mg K kg^{-1}as potassium sulphate.

Preparation of compost tea

The solid compost made up of town-refuse compost, which was obtained from the Cairo Organic Fertilizers Company, Cairo, Egypt see (Table 2). Compost tea (water extract of compost) was prepared in Agric. Microbiology Department Laboratory, Faculty of Agriculture, Zagazig University, Egypt, according to the method of Ingham (2005). One kilogram fresh weight of compost was placed in a cotton bag, sealed them submerged for 4 days into 20 L of water in a plastic bucket. The tea compost was supplied with molass (5 ml L^{-1}). Two types of compost tea were prepared. The first (CT1) was not supplemented with N while the second (CT2) was supplemented with mineral (ammonium sulphate N) as 200 mg N L^{-1}. The reason for N-addition was to enhance microbial activity and population. Fresh water was used for tea preparation.

Chemical composition of the compost and compost teas are shown in Table 1. The analysis was done according to standard methods described by Burnner and Wasmer (1978).

TABLE 1. Properties of compost and compost tea used in the study.

Determinations	Compost	Compost tea (CT_1)	Compost tea (CT_2)
pH	7.5	7.2	7.1
EC(dSm^{-1}) (1:5) extract	4.17	2.92	2.32
Total C, g kg^{-1}(solid), g L^{-1}(liquid)	10.27	6.77	6.23
Total N, g kg^{-1}(solid), g L^{-1}(liquid)	5.20	3.50	3.40

Analysis of soil and plant materials

Soil for the experiment was collected from surface (0-30cm) of an arable field near Zagazig City. Soil properties are given in Table 2. The main physical and chemical properties of the soil were determined according to the methods described by Klute (1986) and Page *et al*. (1982).

The plant samples were collected separated into leaf and root and dried at 70° digested using a mixture of concentrated sulfuric (H_2SO_4) and perchloric (HClO) acids (1:1). Nitrogen was determined by the micro Kheldahl method; P was determined in the acid mixture by the molybdate stannous chloride method and K was measured by the flame photometer. Fe, Mn and Zn were measured by the atomic absorption apparatus. These determinations were carried according to methods of Cottenie *et al.* (1982).

TABLE 2 Characteristics of soil used in the experiment

Particle size distribution	**Value**
Sand %	91.9
Silt%	6.0
Clay%	2.1
Textural class	Sand
Organic matter (g kg^{-1})	0.19
$CaCO_3$ (g kg^{-1})	5.0
EC dSm^{-1} (in paste extract)	3.1
pH (1:2.5)	7.91
Total N g kg^{-1}	3.4
Total P g kg^{-1}	1.1
Total K g kg^{-1}	0.6
Available N mg kg^{-1}	19.5
Available P mg kg^{-1}	4.9
Available K mg kg^{-1}	28.5

Soil microbiological analysis

Microbial population was determined directly in soil samples as well as in compost and compost tea samples. Soil samples were collected at 0, 4 and 8 weeks after seeding to determine total bacteria, aerobic N_2-fixing bacteria, actinomycetes and fungi using plate count of most probable number (MPN) technique,bacteria was counted on nutrient agar after incubation at 30°C for 2 days (Difco, 1985). Enumeration of potential strict aerobe N_2-fixing bacteria was done using the most probable number (MPN) technique (Abd-ElMalek, 1971) on Ashby modified medium incubated at 30°C for 7 days, while enumeration of aerobe N_2-fixers was done as surface pellicle formation. Actinomycetes were enumerated on starch casein agar incubated at 28°C for 7 to 14 days (Conn and Leci, 1998), while fungi were enumerated on Martin's streptomycin rose bengal agar, incubated at 25°C for 3–5 days (Atlas, 2005).All enumerations were in three replicates. The microbial populations in microbe-enriched compost and compost tea used in the experiment are shown in Table 3.

TABLE 3. Microbial populations in microbe-enriched compost and compost tea used in the experiment

Microorganisms	Compost (log10 CFU/g)	Compost tea (CT_1) (log10 CFU/ml)	Compost tea (TC_2) (log10 CFU/ml)
Bacteria	8.32	7.86	7.65
Aerobic N_2fixing bacteria	1.23	3.34	1.15
Actinomycetes	6.54	5.72	5.59
Fungi	4.41	2.50	2.78

Results and Discussion

Plant growth and yield

The total number of leaf per plant was higher in the treatments of compost, compost extracts and mineral nitrogen singly or in any combination. The increases ranged from 42.9% to 100% (Table 4). Compost tea was reported to enhance the growth of melons (Bernal-Vicente *et al*., 2008) and of okra (Siddiqui *et al*., 2008).Plants which received mineral N gave the highest number of leaf amounting to 100%. The CT_{50} was more positive effect than the other two ratios. Compost treatment produced the highest fresh weight leaf, followed by CT1+N_{50}. The lowest fresh weight leaf was recorded with CT2+N_{100} treatments. However, CT_{50} gave the highest yield and number of leaf over the other ratios. Similar trends were observed with dry weight of leaf and root (Table 5). Sifola and Barbieri (2006) reported that organic N, as well as organic-inorganic N combinations increased plant growth.

Leaf nutrient uptake

Lowest N uptake was in plants not treated with any fertilizer. Highest uptake was in plants receiving $CT1_{50}$which gave 62.8% increase. The CT1 gave an average of 30.1% over that of CT2 (Table 6). This may indicate that N in the CT2 was subjected to greater immobilization in the soil. Elsherbeny *et al*. (2012) reported that the wide ratio of compost: water increased N uptake in turnip plant. Also, the lowest uptake of P and K were given by the non-treated plants. But, the highest uptake was given by the $CT1_{25}$with full N-dose which showed 47.6% increase in P uptake and by the $CT1_{50}$ with N_{100}which showed 75.4% increase in K uptake (Table 6). In addition, the CT1 compost tea gave greater uptake of P and K over the CT2 amounting to averages of 12.6 and 51.5% for P and K uptake respectively. Elsherbeny *et al*. (2012) reported a decrease in P content in plant treated by inorganic fertilizer compared with plant P content in plant treated by humic and compost tea. Moreover, leaf P and K uptake affected by increasing compost tea ratios. Application of compost tea with or without N dosage increased leaf N and K uptake.

TABLE 4. The influence of different organic wastes and inorganic fertilizer on leaf number plant^{-1} and leaf and root fresh weight of radish

Compost (CT)	Compost ratio (r)	Number of leaf plant^{-1}			Leaf fresh weight (g)			Root fresh weight (g)		
		N support (N)			N support (N)			N support (N)		
		N_{50}	N_{100}	Mean	N_{50}	N_{100}	Mean	N_{50}	N_{100}	Mean
CT1	$CT1_{25}$	10.67	11.67	11.17	19.37	17.67	18.52	16.04	30.93	23.49
	$CT1_{50}$	13.00	13.00	13.00	22.26	19.33	20.80	29.43	38.32	33.87
	$CT1_{75}$	12.00	11.67	11.83	23.30	14.37	18.83	32.42	28.37	30.40
Mean		11.89	12.11		21.64	17.12		25.96	32.54	
CT2	$CT2_{25}$	11.67	10.67	11.17	19.23	12.80	16.02	24.41	17.47	20.94
	$CT2_{50}$	11.33	10.00	10.67	17.47	16.20	16.83	30.27	23.05	26.66
	$CT2_{75}$	11.00	10.67	10.83	14.00	20.77	17.38	21.80	41.98	31.89
Mean		11.33	10.44		16.90	16.59		25.49	27.50	
General mean		11.61	11.28		19.27	16.86		25.73	30.02	
Means of ratios										
CT_{25}		11.17	11.17	11.17	19.30	15.23	17.27	20.23	24.20	22.22
CT_{50}		12.17	11.50	11.83	19.86	17.77	18.81	29.85	30.69	30.27
CT_{75}		11.50	11.17	11.33	18.65	17.57	18.11	27.11	35.18	31.14
Non-treated		9.00			8.67			9.17		
Mineral-N treated		14.00			20.77			31.17		
Compost		11.33			24.67			27.73		
LSD 0.05										
C		NS			NS			0.34		
N		NS			1.03			0.70		
R		NS			0.72			0.75		
C*N		NS			1.46			0.99		
C*R		NS			1.02			1.07		
N*R		NS			1.34			1.40		
C*N*R		NS			1.45			1.51		

*NS: non-significant.

TABLE 5. The influence of different organic wastes and inorganic fertilizer on leaf and root dry weight of radish

Compost (CT)	Compost ratio (r)	Leaf dry weight (g)			Root dry weight (g)		
		N support (N)			N support (N)		
		N_{50}	N_{100}	Mean	N_{50}	N_{100}	Mean
CT1	$CT1_{25}$	1.68	2.64	2.16	1.96	3.65	1.96
	$CT1_{50}$	2.12	2.39	2.26	1.72	3.19	1.72
	$CT1_{75}$	1.69	3.46	2.58	1.97	2.50	1.97
Mean		1.83	2.83		3.11	1.88	
CT2	$CT2_{25}$	1.69	1.41	1.55	1.61	1.92	1.77
	$CT2_{50}$	1.93	1.34	1.63	1.98	1.84	1.91
	$CT2_{75}$	1.46	2.27	1.87	2.45	1.97	2.21
Mean		1.69	1.67		2.01	1.91	
General mean		1.76	2.25		2.56	1.90	
Means of ratios							
CT_{25}		1.69	2.02	1.86	2.63	1.94	2.29
CT_{50}		2.03	1.87	1.95	2.59	1.78	2.18
CT_{75}		1.58	2.87	2.22	2.47	1.97	2.22
Non-treated		0.49			0.86		
Mineral-N		2.47			3.57		
Compost		1.63			2.40		
LSD 0.05							
C		NS			0.19		
N		0.20			0.21		
R		0.19			0.18		
C*N		0.28			0.30		
C*R		0.34			0.26		
N*R		NS			0.34		
C*N*R		0.49			0.37		

*NS:non-significant

Considering the effect of treatments on plant chemical composition, a small increase was observed in N, P and K uptake in plants treated with the combined application of CT and N_{50}. It has been reported that compost, compost tea or biofertilizer increased plant macronutrient content, and this was related to a positive effect on increasing the root surface area unit of soil volume, water use efficiency and photosynthetic activity, which directly affect physiological processes (Siddiqui *et al*., 2011). These suggestions are supported by this study, which illustrates the higher levels of nutrients and beneficial microorganisms in compost tea.

TABLE 6. The influence of different organic wastes and inorganic fertilizer on leaf N, P and K uptake of radish.

Compost (CT)	Compost ratio (r)	Leaf N uptake (mg pot^{-1})			Leaf P uptake (mg pot^{-1})			Leaf K uptake (mg pot^{-1})		
		N support (N)			N support (N)			N support (N)		
		N_{50}	N_{100}	Mean	N_{50}	N_{100}	Mean	N_{50}	N_{100}	Mean
CT1	$CT1_{25}$	45.66	77.24	61.45	19.86	27.74	23.80	80.25	153.61	116.93
	$CT1_{50}$	41.45	73.01	57.23	19.05	26.57	22.81	87.20	163.52	125.36
	$CT1_{75}$	41.18	58.56	49.87	19.43	23.69	21.56	76.08	96.43	86.25
Mean		42.76	69.60		19.45	26.00		81.18	137.85	
CT2	$CT2_{25}$	40.17	34.37	37.27	16.41	18.76	17.58	59.11	67.74	63.42
	$CT2_{50}$	39.87	44.57	42.22	20.90	21.50	21.20	55.01	101.01	78.01
	$CT2_{75}$	43.93	56.14	50.03	20.02	23.58	21.80	61.94	88.76	75.35
Mean		41.33	45.03		19.11	21.28		58.69	85.84	
General mean		42.04	57.32		19.28	23.64		69.93	111.84	
Means of ratios										
CT_{25}		42.92	55.81	49.36	18.13	23.25	20.69	69.68	110.67	90.18
CT_{50}		40.66	58.79	49.73	19.97	24.03	22.00	71.11	132.26	101.68
CT_{75}		42.55	57.35	49.95	19.73	23.64	21.68	69.01	92.59	80.80
Non-treated		8.775			16.24			14.32		
Mineral-N		76.074			16.12			29.38		
Compost		50.034			75.03			22.24		
LSD 0.05										
C		NS			NS			11.29		
N		3.88			1.98			9.00		
R		5.53			2.52			10.09		
C*N		5.49			NS			12.73		
C*R		7.82			8.79			14.27		
N*R		NS			NS			18.69		
C*N*R		11.06			NS			20.18		

*NS :non-significant

Root nutrient uptake

Uptake of nutrient in root was lower than in leaf (Table 7). The lowest N uptake in plants was in untreated ones. While, the highest uptake was in plants of CT_{75}whichgiving 97% over the untreated plants, CT1 gave an average 70% over that of CT2.Root N uptake was higher in CT1+N_{100} compared with those obtained by CT2+N_{100}. On the other hand, the application CT2+N_{50} gave higher N; P and K uptake compared with CT2+ N_{100}. These results are in disagreement with those found by Siddiqui *et al*. (2011) who reported that the combination application of compost tea and N_{50} of the recommended dose increased N, P and K uptake by the plant compared to the combination of compost tea and N_{100}.

Treatment receiving N gave lower P and K uptake compared to those obtained from compost tea and compost treatments. The ratios of compost teas did not affect N uptake. Hirzel *et al*. (2012) reported that adding compost tea to the soil without fertilization did not affect ryegrass dry matter but it had a positive effect on the treatments with solid composts. Compost tea sources and N dosages individually increased N, P and K uptake.

Soil nutrient status after the experiment

At the end of the experiment, there were greater N, P and K contents in soil receiving compost of compost tea (Table 8). The contents increased due to increasing compost tea ratios. Siddiqui *et al*. (2011) found that application of compost tea increased N, P and K soil content compared with inorganic fertilizer alone, and the increase depended on compost tea ratios.

Favorable effect of compost tea on plant growth may be due to enhancement physical, chemical and biological properties of soil. It has been reported that added organic materials, together with microbial activity, improved soil health and fertility (Loveland and Webb, 2003). These changes often result in improved plant growth (Antolan *et al*., 2005). Soil N content increased with compost treatments alone than with compost tea with inorganic fertilizer.

Positive effects are indications of equilibrium of nutrients and water in plant root zone (Aziz *et al*., 2007) as well as vital hormones and enzymes. Applications of CT1+N_{100}as well as CT2+ N_{100} raised soil N content. Similar trend were found with soil P and K after the experiment. Compost tea provided significantly greater amounts of P to the soil than same source of compost, these results agree with those of Hargreaves *et al*. (2008).

Compost tea application along with mineral in half dose increased NPK in soil (Table 8). Continued use of compost tea supplement increased soil fertility as well as N, P and K content of the soil (Siddiqui *et al*., 2011).

TABLE 7. The influence of different organic wastes and inorganic fertilizer on root N, P and K uptake of radish.

Compost (CT)	Compost ratio (r)	Root N uptake(mg pot^{-1})			Root P uptake(mg pot^{-1})			Root K uptake(mg pot^{-1})		
		N support (N)			N support (N)			N support (N)		
		N_{50}	N_{100}	Mean	N_{50}	N_{100}	Mean	N_{50}	N_{100}	Mean
CT1	$CT1_{25}$	34.49	44.10	39.29	8.99	9.65	9.32	43.25	82.41	62.83
	$CT1_{50}$	39.15	44.47	41.81	9.09	10.16	9.63	59.20	68.56	63.88
	$CT1_{75}$	29.28	54.72	42.00	6.54	16.46	11.50	51.98	107.69	79.84
Mean		34.31	47.76		8.21	12.09		51.47	86.22	
CT2	$CT2_{25}$	27.01	19.15	23.08	7.88	5.40	6.64	45.52	36.30	40.91
	$CT2_{50}$	39.57	20.35	29.96	5.37	4.02	4.69	54.79	42.09	48.44
	$CT2_{75}$	28.80	37.78	33.29	4.65	8.08	6.37	30.60	57.16	43.88
Mean		31.79	25.76		5.97	5.83		43.64	45.18	
General mean		33.05	36.76		7.09	8.96		47.56	65.70	
Means of ratios										
CT_{25}		31	32	31	8.43	7.52	7.98	44.38	59.35	51.87
CT_{50}		39	32	36	7.23	7.09	7.16	56.99	55.33	56.16
CT_{75}		29	46	38	5.60	12.27	8.93	41.29	82.43	61.86
Non-treated		2.740			3.69			0.45		
Mineral-N		42.587			52.96			8.21		
Compost		28.693			39.08			4.63		
LSD 0.05										
C		3.17			0.75			5.03		
N		NS			0.85			6.20		
R		3.02			0.71			NS		
C*N		5.37			1.21			8.77		
C*R		4.27			1.01			7.02		
N*R		5.60			1.32			9.20		
C*N*R		6.04			NS			9.93		

*NS non-significant

TABLE 8. The influence of different organic wastes and inorganic fertilizer on soil available N, P, K and organic matter contents.

Compost (CT)	Compost ratio (r)	Soil N (mg kg^{-1}) N support (N)			Soil P (mg kg^{-1}) N support (N)			Soil K (mg kg^{-1}) N support (N)			Soil organic matter (mg kg^{-1}) N support (N)		
		N_{50}	N_{100}	Mean	N_{50}	N_{100}	Mean	N_{50}	N_{100}	Mean	N_{50}	N_{100}	Mean
CT1	$CT1_{25}$	2.20	1.30	1.75	0.29	0.14	0.22	0.22	0.09	0.16	0.66	0.47	0.56
	$CT1_{50}$	2.43	1.47	1.95	0.23	0.19	0.21	0.13	0.09	0.11	0.43	0.39	0.41
	$CT1_{75}$	2.47	2.13	2.30	0.19	0.23	0.21	0.09	0.12	0.10	0.39	0.51	0.45
Mean		2.37	1.63		0.24	0.19		0.15	0.10		0.49	0.46	
CT2	$CT2_{25}$	2.20	2.47	2.33	0.29	0.27	0.28	0.32	0.21	0.26	0.60	0.43	0.52
	$CT2_{50}$	3.27	2.27	2.77	0.53	0.18	0.36	0.40	0.16	0.28	0.70	0.39	0.55
	$CT2_{75}$	2.77	3.17	2.97	0.31	0.41	0.36	0.11	0.16	0.14	0.53	0.43	0.48
Mean		2.74	2.63		0.38	0.29		0.28	0.18		0.61	0.42	
General mean													
Means of ratios													
CT_{25}		2.20	1.88		0.29	0.21		0.27	0.15		0.63	0.45	
CT_{50}		2.85	1.87		0.38	0.19		0.27	0.13		0.57	0.39	
CT_{75}		2.62	2.65		0.25	0.32		0.10	0.14		0.46	0.47	
LSD 0.05													
C		NS			NS			0.03			NS		
N		0.12			0.03			0.04			0.04		
CN		0.23			0.03			0.08			NS		
Control		0.98			NS			NS			NS		
Mineral		NS			0.04			0.12			NS		
Compost		0.42			0.05			0.15			NS		

*NS : non-significant.

Microbial Population in Soil

Soil samples were collected at the beginning of planting, middle age of plants (after 4 weeks of planting) and after8 weeks of planting to determine total count of bacteria, aerobic N_2-fixing bacteria, actinomycetes and fungi. The results presented in Fig. 1 showed that at the beginning of cultivation, all treatments recorded lower total counts of bacteria compared with counts at 4 or 8 weeks later except full dose of N. The non-treated treatment showed the lowest bacterial counts compared with the other treatments.

After 8 weeks of cultivation, bacterial counts were higher compared with those other times. Bacterial counts were higher in the soil treated with compost and compost tea. Carbon energy sources leaked from root stimulates the number of heterotrophic bacteria and free-living N_2-fixers the root zone of soil (Herman *et al*., 1993), particularly where, organic matter is introduced to soil.This can be explained by the increased nutrition supplement due to the compost and compost tea (Heather *et al*., 2006).

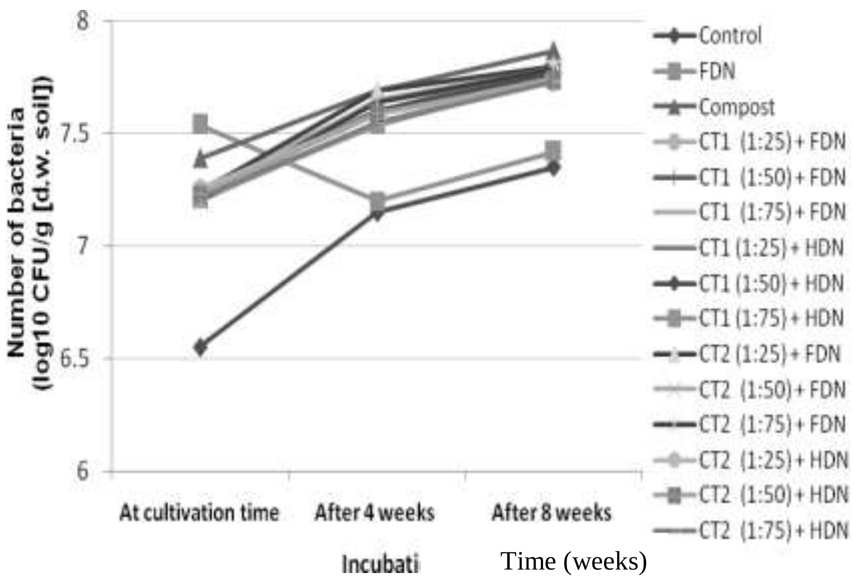


Fig. 1. Changes in total count of bacteria in the soil of cultivation, during the time course of the experiment.

The results presented in Fig. 2 showed counts of aerobic N_2-fixing bacteria in the soil as affected by different treatments of compost and compost tea combined with two N doses. There was an increase due to the various N treatments that contained compost only compared with treatments containing N only. Treatments containing high dose of N, exhibited a significant decrease in aerobic N_2-fixing bacterial count after 4 weeks of cultivation compared with counts after 8 weeks. Also, soils with high contents of N had the lowest counts of N_2 fixing bacteria (Streeter, 1988 and Herman *et al*., 1993).

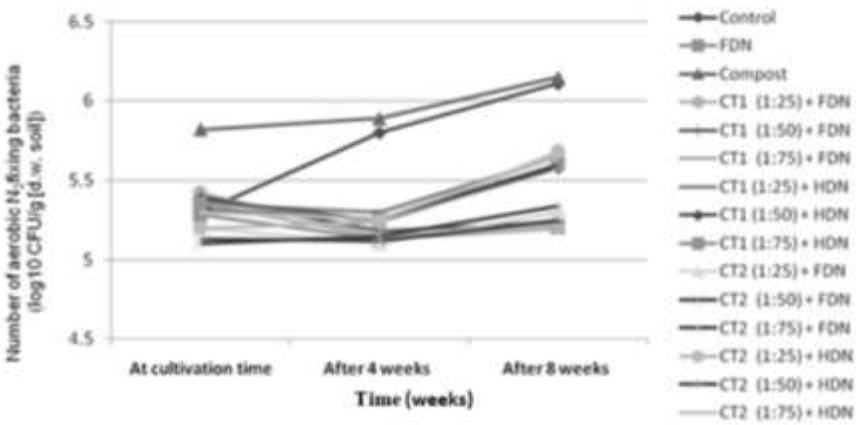


Fig. 2. Changes in total count of aerobic N_2-fixing bacteria in the soil of cultivation, during the time course of the experiment.

A high great increase in actinomycetes counts was observed in all treatments containing compost or compost tea after 4 and 8 weeks of planting compared with the compost-free treatments (Fig. 3). Actinomycetes in a microbial community increase in number in late stages after other microorganisms consume the easily degradable compounds; then after actinomycetes start to utilize more stable compounds (Gagnon *et al*., 2001). However, total counts of actinomycetes were markedly increased compared with most counts of the earlier periods. This could be attributed to antibiotic agents that might be produced by actinomycetes which inhibit activity of other microorganisms and allow for competitor in favor of the actinomycetes (Craft and Nelson, 1996).

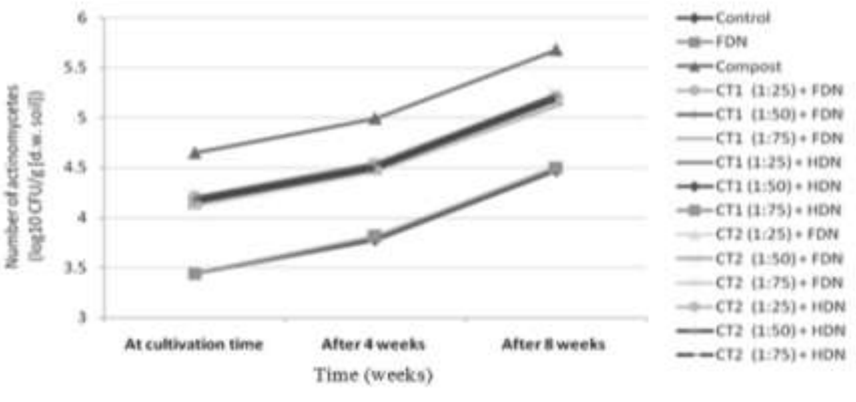


Fig. 3. Changes in total count of actinomycetesin the soil of cultivation, during the time course of the experiment.

Total fungi counts decreased in most compost treatments (Fig. 4) after 8 weeks after planting compared with 4 weeks period. This might be attributed to competition for nutrients, competition for penetration sites (Takenaka *et al*., 2008); hyperparasitism (Danon *et al*., 2007) and induction of plant systematic resistance (Kavroulakis *et al*., 2005). The collective data obtained here are in compatibility with Nelson & Boehm (2002) and Hegazy *et al*. (2013).

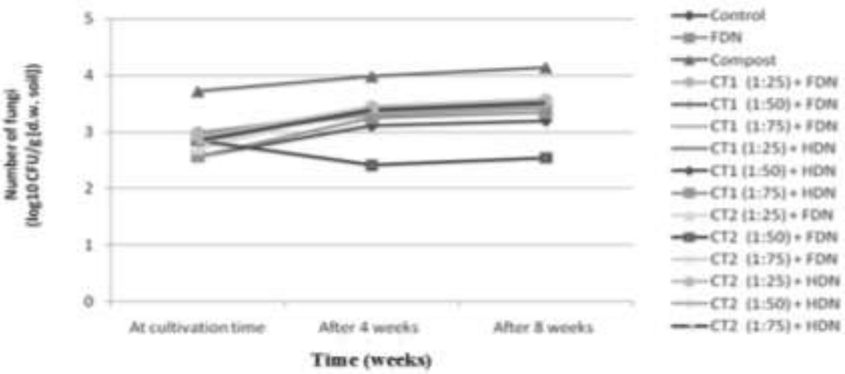
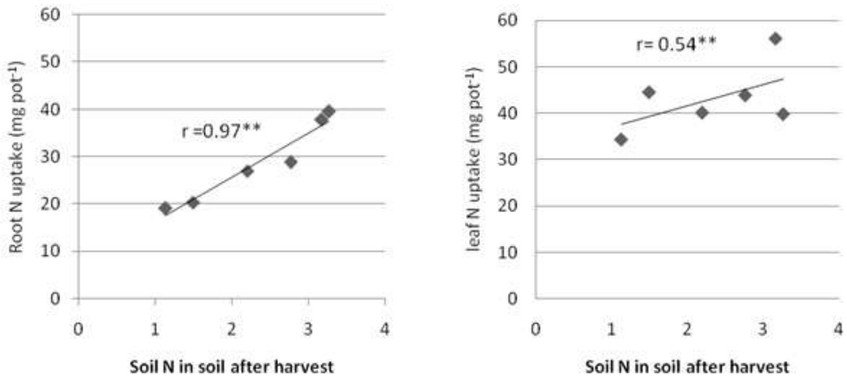


Fig. 4. Changes in total count of fungi in the soil of cultivation, during the time course of the experiment.

Correlations between radish plant N uptake and soil total N after harvest

After harvest, N uptake in radish leaf and root showed a significant positive correlation with soil total N content (Fig. 5) with r = 0.97** and r = 0.54** respectively, with the CT1 + N. Such correlations are similar with (CT2+N treatment).These results agree with those reported by Martynuik *et al.* (2002), Schröder *et al.* (2005) and Angers *et al.* (2010) as well as those by Daugaard (2001) and Ebid *et al.* (2007) who reported that nutrient content decreased with increased soil N. Observations in this study show that amount of N released was independent of the total N of compost tea. A significant positive correlation was obtained between soil organic matter and soil N with correlation coefficient of r = 0.69** (data not shown). This indicates that availability of N in the soil depends on soil organic matter content.

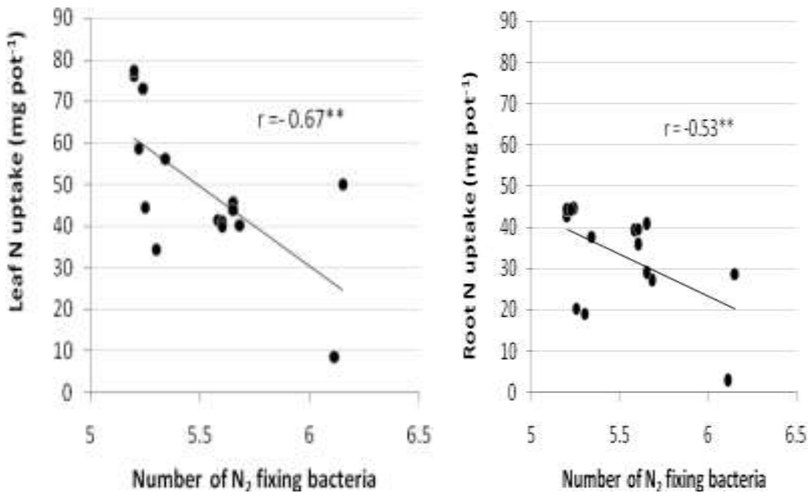


**Correlation is significant at the 0.01 level, *Correlation is significant at the 0.05 level.

Fig. 5. Relationship between radishes leaf and root N uptake and soil N after harvest

Correlations between radish plant N uptake and soil count of anaerobic N_2 fixing bacteria after harvest

At the end of the experiment, leaf and root of radish showed a significant negative correlation between N-uptake and soil counts of anaerobic N_2 fixing bacterial counts (Fig. 6). Results of that N mineralized increased with soil counts of anaerobic N_2 fixing bacterial content; these results emphasis the results reported by Antonopoulos (1999).



** Correlation is significant at the 0.01 level, *Correlation is significant at the 0.05 level.

Fig. 6. Relationships between radishes leaf and root N uptake and soil count of anaerobic N_2 fixing bacteria after harvest

Conclusions

The use of compost tea and N_{100} produced maximum yield as well as N, P and K uptakes by radish plants. CT2 (molasses + ammonium sulphate) +N_{50} showed lower nutrient uptakes of N, P and K uptake and lower soil N, P and K content after harvest. This suggests that ammonium sulphate added to compost tea may enhance residual effect. The integrated application of organic and inorganic fertilizers not only increases the availability of nutrients, but also improves soil fertility. After harvest, a highly significant negative correlation was found between leaf and root N uptake and the number of N_2 fixing bacteria. Therefore, compost tea is considered as an important organic source for enhancing nutrient availability by plant, soil and soil microorganisms.

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الآثارالمترتبة على الإستخدام المشترك لشاي الكومبوست والسماد الغير عضوى على امتصاص وميكروبات التربه (*Raphanus sativus*)العناصر المغذيه لنبات الفجل

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إضافه الأسمدة العضويه للتربه تعتبر من الإستيراتيجيات الهامه لزياده خصوبه التربه و الميكروبات. أجريت تجربة أصص تحت ظروف الصوبة لتوضيح تأثير الكومبوست والتسميد النيتروجينى المعدنى بمستويين هما الجرعة الموصى بها ونصف هذه الجرعة وذلك بالتداخل مع نوعين من شاى الكمبوست (تبعا لطريقه الاستخلاص) هما شاى الكومبوست المضاف الية المولاس (CT1) وشاى الكومبوست مضافا اليه المولاس و سلفات الامونيوم(CT2). تم اضافه شاى الكومبوست على ثلاث تخفيفات (1:25) و (1:50) و (1:75) حجم لحجم ماء وشاى الكومبوست. وقد تم دراسة تأثير هذه الإضافات على أوراق وجذور نباتات الفجل وكذلك كمية النيتروجين و الفوسفور والبوتاسيوم الممتصة وكذلك العناصر الميسره و المجمتعات الميكروبية فى التربة . إضافة CT1أدت الى زياده النيتروجين الممتص بواسطه أوراق الفجل حوالى 30.1 ٪ مقارنه CT2 . وكذلك المعامله بشاى الكومبوست CT1أدت الى زياده الفوسفور و البوتاسيوم الممتص الى حوالى 12.6% و ٪ 51.5 على التوالى بالمقارنه بالمعامله بشاى الكومبوست CT2. فى نهايه التجربه كانت محتوى التربه من العناصر الميسره نيتروجين و فوسفور وبوتاسيوم مرتفع فى النباتات المعامله بالكومبوست وحده. حيث النيتروجين الممتص بواسطه الأوراق و الجذور كان له علاقه معنويه مع الإضافات من شاى الكومبوست CT2 فى المعاملات المضاف إليها الجرعة الكاملة من النيتروجين المعدني .بينما وجدت علاقه معنويه سالبه بين كلا من النيتروجين الممتص بواسطه أوراق و جذور الفجل وبين التجمعات البكتيريه المثبته للنيتروجين فى التربه بعد الحصاد.