

SUBSTITUTION OF COMPOST TEA INSTEAD OF A PART OF MINERAL FERTILIZERS FOR PEA PLANT (*Pisum Sativum L.*)

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ABSTRACT

Two pot experiments were carried out under green house conditions at Faculty of Agriculture.; El-Mansoura University during the two successive winter seasons of 2005-2006 and 2006-2007 to study the substitution of tea compost (compost extract) which made from rice straw + chicken manure instead of a part of mineral fertilizer to produce a safe yield of pea plant . 9 treatments were arranged in complete randomize block design with 3 replicates , which were the simple possible combination between two treatments of compost tea CT (5 % and 10 % CT) and three treatments of recommended dose (RD) of mineral fertilizer (0 , 50 % and 100 %) and their combination .

Obtained results showed that :

- 1- foliar application of CT at the rate of 10 % was superior for increasing the values of growth parameters , chemical composition and seed quality of pea plants .
- 2- Single fertilization of N , P and K at the rate of 50 % and 100 % from the recommended dose for pea plants significantly increased the values of all parameters under study .

In spite of the highest values for all parameters under investigation were realized due to the treatment of 100 % RD + 10 % CT .

INTRODUCTION

In Egypt , using of the conventional mineral fertilizers cause many troubles, since over usage in modern agriculture contributes to several environmental problems . Moreover , they deplete the overall fertility of soil ; causing an increase in plant absorption of some nutrients which caused a toxic effect in plants . In addition , most amounts of chemical fertilizer applied are not absorbed and run off into soil ground water which caused water pollution (Amer; 2005) .

Many investigators studied the effect of NPK fertilizer on plant parameters of plant such as Ahmed *et al.* (2007) , Ahmed and El-Abagy . (2007) , Amin *et al.* (2007) , El-Saady *et al.* (2007) , Hammad *et al.* (2007) and Sarhan *et al.* (2007) working on faba bean plants ; the combination of fertilizers with foliar treatment (N , P and K) gave the highest values of plant growth parameters as compared with the control treatments .

Concerning the effect of NPK fertilizers on chemical composition of plant . Abou El-Fotoh *et al* (2008) indicated that N, P and K concentration and uptake in broad bean seeds were increased as a result of all treatments i.e. control , K (24kg K₂O/fed , and (Fe + Zn + Mn) .

Hegazi *et al* (2007) and Youssef *et al* (2007) pointed out that N-fertilizer led to a significant increase in available P and N of soil as compared with the control treatment .

On the other hand , rice straw is considered a large crop residues in Egypt which lost by burning in fields . This process causes a lot of troubles in soil micro flora , air and health of human . Moreover , rice straw contain useful macronutrients such as nitrogen , phosphorus , and potassium (Margaret and Ladha; 1995) . So all world back to organic farming by using a new method to produce organic fertilizer from organic wastes such as compost tea to produce safe food and protection the environment from pollution (Abd El- Hamid *et al* ; 2004) .

Compost tea mean a liquid extract of compost that contains plant macro and micronutrients , plant growth regulators and beneficial microorganisms . (Abd El-Hamied *et al* ; 2004) . This extract have been derived from plant materials (rice straw) and animal manures (chicken manure) was produced by steeping finished compost in water in order to extract beneficial microorganisms and compounds into solution (Ingham, 2000 a) . Compost tea can be applied directly to the plant as a foliar spray as a fine mist on leaves of plants (Ingham, 2000 b) .

Compost tea contain a lot of benefits such as : Increase the biomass , species diversity of microbes and microbial inoculant via soil application to help build soil microbial population (Schmitz, 2002) ; increase the ability of soil to hold nutrients , retain water (Abd El-Hamid *et al*, 2004) ; reduce fertilizer use and leaching into ground water (Amer, 2005) and Provide nutrients for foliar or spray application (Ryan *et al*, 2005) .

The present work aime to : Produce a safe food (organic farming) ; reduces chemical fertilizer ; return rice straw to useful things (compost tea) ; Protection environment from rice straw smoke and Provide nutrients to plants and raising fertility soil .

MATERIAL AND METHODS

Two pot experiment were conducted under the green house of Fac. of Agric., El-Mansoura University during two successive winter seasons of 2005-2006 and 2006-2007 . This work aimed to evaluate the substitution of compost tea instead of a part of mineral fertilizers for pea plant (*Pisum sativum* L.)

The experimental soil : soil was collected from the surface layer of special farm ; near El-Mansoura City , Dakahlia Governorate . Soil Sample was taken and analyzed for some physical and chemical characteristics as shown in Table (1)

Table (1) : Physical-chemical properties of the investigated soil .

Seasons	Mechanical analysis				Textural class	EC dS.m ⁻¹ Soil. past	pH 1:2.5	%			Avai-nutrients ppm					
	C.sand	f.sand	silt	clay				CaCO ₃	OM	S.P	N	P	K	Fe	Mn	Zn
1 st	2.4	21.9	24.1	51.6	clayey	3.92	8.07	2.35	1.95	72	38.6	4.92	325	16.08	8.46	3.54
2 nd	2.9	20.3	25.6	51.2	clayey	3.76	7.96	1.86	2.03	69	42.3	5.10	345	12.78	8.16	2.28

Preparation of compost tea : before sowing , 20 kg of rice straw was chopped into segments of 2-5 cm and divided into two heaps ; one was mixed with 0.5 kg of chicken manure and the other with 1.0 kg to produce 5% and 10 % compost , respectively , also ; 10 % w.w were added in the form of Ammonium sulfate and 30 % w.w from calcium super-phosphate. Each heap was moistened to reach about 60% of its water holding capacity ; covered with plastic sheet and left to decay for 90 days . Throughout the decay ; each heap was turned every 15 days and sprayed with water to keep its moisture around 60 % of water holding capacity .

After 90 days ; one kilogram of solid compost was put in plastic tanks and soaked into 10 L. of tap water over 24 hours . then, this mixture was stirred for 2 hours and strained by cheesecloth into other plastic tank . chemical analysis of compost tea is shown at table 2

Table (2) : chemical analysis of compost tea (aquies extraction) in the two seasons .

Sample	season	Available nutrients (mg.kg ⁻¹)					
		N	P	K	Fe	Mn	Zn
5%	1 st	47	13.6	290	30.9	14.9	9.5
	2 nd	42	12.8	325	22.7	13.2	7.9
10%	1 st	58	15.2	305	45.3	20.6	12.1
	2 nd	53	14.9	345	40.7	18.7	10.3

Treatments : 9 treatments were arranged in a complete randomized block design with 3 replicates , which were the simple possible combination between two treatments of compost tea and three treatments of mineral fertilizer as well as their combination as follow :

1-control treatment.

2- 5% CT (10 kg rice straw + 0.5 kg chicken manure).

3- 10 % CT (10 kg rice straw + 1 kg chicken manure).

4- 50 % RD (50 kg N. fed⁻¹ +150 kg P₂O₅. fed⁻¹ + 50 kg K₂O. fed⁻¹).

5- 50 % Rd + 5 % CT .

6- 50 % RD + 10 % CT.

7- 100 % RD (100 kg N. fed⁻¹ +300 kg P₂O₅. fed⁻¹ + 100 kg K₂O. fed⁻¹).

8- 100 % RD + 5 % CT .

9- 100 % RD + 10 % CT.

where ; RD = recommended doses of N , P and K .

CT = Aquies extraction of compost tea .

Cultivation : 27 polyethylene pots, 30 cm in diameter and 40 cm height were used. Each pot was filled with 15 kg clean air dried soil . In the 6 and 5 of December 2005 and 2006 , respectively . Ten seeds of pea plant (cv. master

pea) were selected for uniformity in size and colour and were sown after mixed with rhizobia . After 15 days from sowing plants were thinned to the most five uniform plants per pot .

Fertilization : Ammonium sulfate (20.5 % N) , calcium super-phosphate (7 % P) and potassium sulphate (40 % K) were used at the rates of 100 , 300 and 100 kg / fed as a sources of N , P and K , respectively for the treatments of 100 % RD while , half of these doses were for the treatments of 50 % RD .

Each level of N , P and K fertilization was divided into two doses ; one was added after 15 days from sowing and the other 2 weeks later .

Foliar application of compost tea at the rates of this study was conducted 3 times beginning after 21 day from sowing with one weak interval . All other practical agricultural were done as recommend for pea plant .

Experimental procedures : At flowering stage (50 days after sowing) plant growth parameters expressed as ; plant height (cm) , number of leaves , fresh weight and dry weight were measured . At full green maturity stage (65 days after sowing) yield and its components in expression of fresh pod weight (g) , Number of pod / plant , number of seeds / pod , 100 green seeds weight and yield g / pot were recorded .

- The oven dried leaves and seeds of pea plant were wet digested with sulphuric-perchloric acid mixture to determine N , P , K , Fe , Mn and Zn in the leaves and P , Fe and Zn in the seeds . In addition , Crude protein , total carbohydrates and vitamin C were determined in the seeds of pea plants.

Method of analysis : Total nitrogen (%) , Organic matter and Available nitrogen and Potassium % were according to Hesse (1971). Total phosphorus (%) , Total Potassium (%) and Available phosphorus were estimated as described by Jackson (1967). Total Fe , Mn , Zn and Available Fe , Mn , Zn were according to Chapman et al. (1961). Vitamin C was determined according to A.O.A.C (1965) . Protein (%) : was calculated according to A.O.A.C (1970) using a conversion factor . protein (%) = Nitrogen (%) x 6.25. Carbohydrate : was calculated according to Somogy (1952) . Mechanical analysis and CaCO₃ was described by (piper, 1950).

Statistical analysis : The statistical analysis of the collected data was done according to the method described by (Gomez and Gomez 1984) using LSD to compare the means of treatment values.

RESULTS AND DISCUSSION

Vegetative growth characteristics :

Data in Table (3) show the effect of mineral fertilizer and compost tea on vegetative growth characteristics of pea plants expressed as plant height , number of leaves per plant , fresh and dry weight of plant in 2005 / 2006 and 2006 / 2007 seasons .

Data show Clearly that all the studied growth parameters were positively affected due to the application of both mineral and compost tea treatments compared with the control treatments in both seasons . Comparing with the untreated plants ; single application of compost tea either

at the rate of 5 % or 10 % significantly increased the values of all growth parameters under investigation . On the other hand ; soil addition of 50 % from the recommended dose of N , P and K , significantly increased the mean values of plant height , number of leaves , fresh weight and dry weight of pea plant . Moreover , increasing the rate of N , P and K fertilization from 50 to 100 % from the recommended doses had no any significant effect between the values of the growth studied as compared to the same values obtained for the plants received 50 % from the recommended dose . This trend was true during the both seasons.

Data of Table (3) also reveal that ; soil addition of mineral fertilizer (N , P and K) either as 50 or 100 % from the recommended doses (RD) in combination with foliar application of compost tea (CT) at the levels of this investigation led to a significant increases in all the measured growth aspects of pea plant as compared with the control treatment .

It can be concluded that , an application of compost tea either in a single form or in combination with mineral fertilization led to a positive effect on the growth of pea plants this can be attributed to the role played by this substance for hastening the performance of nutrients availability in presence of mineral fertilizer.

These results were reported by El-Dossoky . (2005) , Tartoura et al .(2005) Abd El-Wahab et al . (2007) who demonstrated that foliar application of compost tea gave increases effect on shoot dry weight of chick pea plants as compared with the control treatments .

Table (3) : Plant growth parameters of pea plant as affected by mineral

Seasons		2005-2006			2006-2007				
Characters	Treatments	Plant Height cm	No of leaves plant ⁻¹	Fresh weight (g)	Dry weight (g)	Plant Height cm	No of leaves plant ⁻¹	Fresh weight (g)	Dry weight (g)
		Control	40.37	12.82	11.34	1.46	40.66	12.88	11.75
fertilizer , compost tea in the two seasons .									
	5% CT	41.45	12.97	11.69	1.45	41.42	13.29	12.02	1.62
	10% CT	41.49	13.06	11.95	1.49	41.85	13.49	12.35	1.71
	50% RD	42.83	13.68	12.36	1.59	41.12	12.95	11.82	1.56
	50% RD + 5%CT	43.88	13.90	12.80	1.64	42.06	13.44	12.42	1.68
	50% RD + 10% CT	44.76	14.13	12.93	1.64	42.77	13.70	12.77	1.79
	100% RD	43.43	13.77	12.54	1.60	41.66	13.36	12.05	1.59
	100% RD + 5% CT	45.05	14.40	13.24	1.77	42.80	13.95	12.49	1.73
	100% RD+ 10% CT	45.82	14.74	13.36	1.80	43.62	14.22	12.95	1.85
	LSD 5%	0.65	0.13	0.20	0.05	0.60	0.43	0.30	0.03

CT :Compost tea

RD: Recommended dose (NPK)

Yield and its components :

Data in Table (4) reveal that application of compost tea at the rate of 5 % or 10 % significantly increased the values of number of pods per plant , number of seeds per pod . 100 green seeds weight and yield per pot over the untreated plants . On the other hand ; soil addition of 50 % from the

recommended dose of N , P and K for plant significantly increased the mean values of number of pod per plant , number of seeds per pod , 100 green seeds weight and yield per pot . While , increasing the rate of N , P and K fertilization from 50 to 100 % from the recommended doses had no any significant effect between the values of yield and it is components as compared to the same values obtained for the plants received 50 % from the recommended dose . This trend was true during both seasons of the experimentation .

Table (4) : Yield and its components of pea plant as affected by mineral fertilizer , compost tea in the two seasons .

Seasons		2005-2006					2006-2007				
Characters	Treatments	Fresh Pod weight(g)	No of Pod.plant ⁻¹	No of Seeds.pod ⁻¹	100 green seeds W (g)	Yield g pot ⁻¹	Fresh Pod weight (g)	No of Pod.plant ⁻¹	No of Seeds.pod ⁻¹	100 green seeds W (g)	Yield g / pot
		Control	4.63	6.91	7.61	43.93	30.45	4.72	7.25	7.01	44.10
	5% CT	4.76	7.06	7.69	44.26	31.45	4.93	7.49	7.17	44.42	32.44
	10% CT	4.88	7.17	7.85	44.32	32.71	5.02	7.68	7.28	44.80	32.95
	50% RD	5.10	7.39	8.13	44.86	36.07	4.88	7.45	7.12	44.23	32.25
	50% RD + 5%CT	5.41	7.65	8.24	45.41	38.82	4.97	7.66	7.25	44.62	32.73
	50% RD + 10% CT	5.44	7.80	8.39	45.60	40.46	5.10	7.83	7.44	44.79	33.69
	100% RD	5.28	7.52	8.15	45.07	37.12	4.96	7.63	7.26	44.46	33.19
	100% RD + 5% CT	5.64	7.91	8.49	45.78	42.08	5.06	7.78	7.39	44.75	33.84
	100% RD+ 10% CT	5.71	8.16	8.55	46.15	43.96	5.19	8.02	7.62	44.89	34.49
	LSD 5%	NS	0.14	0.04	0.25	1.06	NS	0.19	0.14	0.26	1.01

Data presented Table (4) also reveal that ; soil addition of mineral fertilizer (N , P and K) at the rates of this study in combination with foliar application of compost tea (CT) at the levels of 5 % and 10 % led to a significant increases in the measured yield aspects of pea plant in comparing with the control treatments but fresh pod weight was not significantly affected during two seasons .

It can be concluded that , this trend may be due to that the compost tea has enough values of macro , micro nutrients and has high amount of needed bacteria , fungi and actinomycetes . In addition this results imply that the role of foliar application of the compost tea in promoting of yield productivity , also NPK fertilizer allow legumes to achieve high N fixation rates.

The results were reported by Tartoura and El-Saei . (2006) , Owolade et al . (2006) , Abd El-Hamied . (2007) , Abd El-Wahab et al . (2007) , El-Saady et al . (2007) , Hammad et al . (2007) , Sarhan et al (2007) who observed that 100 % NP fertilizers from the recommended dose gave the highest yield of soybean than 50 and 75 % from the recommended dose respectively .

N, P and K % in the leaves :

The statistical analysis of the data presented in Table (5) reveal that ; there is a significant differences between the values of N , P and K % for the plants treated with compost tea at the rate of 5 % and 10 % as foliar spraying

as compared to the untreated plants . This trend was during both seasons of the experiment .

Data in Table (5) also reveal that ; soil addition of mineral fertilizer (N , P and K) either at the rate of 50 or 100 % from the recommended doses either as single addition or in combination with foliar application of compost tea (CT) at the levels of this investigation led to a significant increases in the values of N , P and K in the leaves aspects of pea plant in comparison with the control treatments . The same trend was true in the second season.

Table (5) : N , P and K % in the leaves of pea plant as affected by mineral fertilizer , compost tea in the two seasons .

Seasons Treatments Characters	2005-2006			2006-2007		
	N%	P%	K%	N%	P%	K%
Control	2.79	0.316	1.76	2.95	0.335	1.88
5% CT	2.86	0.323	1.77	3.02	0.349	1.97
10% CT	2.96	0.344	1.84	3.16	0.363	2.02
50% RD	3.21	0.380	2.08	3.10	0.348	1.96
50% RD + 5% CT	3.37	0.406	2.23	3.22	0.365	2.06
50% RD + 10% CT	3.40	0.414	2.27	3.33	0.377	2.15
100% RD	3.29	0.391	2.13	3.40	0.362	2.10
100% RD + 5% CT	3.48	0.426	2.33	3.59	0.380	2.19
100% RD+ 10% CT	3.51	0.431	2.43	3.76	0.393	2.28
LSD 5%	0.12	0.009	0.04	0.23	0.012	0.10

It can be concluded that , application of compost tea either in a single form or in combination with mineral fertilization led to a positive effect on NPK concentration of pea plants . This result confirmed the prominent role of organic tea which develop the root system of plant and improved nutrient uptake .

Fe , Zn and Mn mg . kg⁻¹ in the leaves :

Data illustrated in Table (6) indicated that ; foliar application of compost tea at the rate of 10 % was superior for increasing the average values of Fe , Zn and Mn (mg . kg⁻¹) in the pea leaves plants over and significant the plants received compost tea at 5 % and the untreated ones .

Data in Table (6) also reveal that ; soil mineral fertilizer addition (N , P and K) either at the rate of 50 or 100 % from the recommended doses (RD) with or without compost tea (CT) led to a significant increases in the values of Fe , Zn and Mn in the leaves of pea plants comparing with the control treatments . The highest values of Fe , Zn and Mn mg . kg⁻¹ were realized for the plants fertilized with 100 % RD combined with 10 % compost tea in foliar way in the two seasons.

It can be concluded that , application of either separated compost tea either in a single form or in combination with mineral fertilization led to a positive effect on Fe , Zn and Mn concentration in pea plants . This result imply that the role of foliar application of compost tea extract which contain a lot of micro nutrients which absorb by leaves , beside , soil mineral fertilizer application (NPK) increased the availability of soil Fe , Zn and Mn and according improved nutrients uptake .

The results were confirmed by the work of Gamal and Ragab . (2003) , Maksoud and Haggag . (2004) and Sarhan . (2007) who stated that , foliar application of mineral fertilizer increased Fe , Zn and Mn content compared with the control .

Table (6) : Fe , Zn and Mn mg . kg⁻¹ in the leaves of pea plant as affected by mineral fertilizer , compost tea in the two seasons .

Seasons Treatments Characters	2005-2006				2006-2007			
	Mg.100g ⁻¹ seed		%		Mg.100g ⁻¹ seed		%	
	Fe	v.c	Crud protein	Carboh ydrate	Fe	v.c	Crud protein	Carboh ydrate
Control	0.92	29.33	4.13	11.79	0.95	29.45	4.13	11.95
5% CT	0.93	29.79	4.31	11.95	0.99	30.33	4.31	12.15
10% CT	1.05	30.34	4.56	12.18	1.06	30.70	4.56	12.42
50% RD	1.22	31.69	4.94	12.74	1.02	29.80	4.50	12.25
50% RD + 5%CT	1.24	32.25	5.13	13.22	1.10	30.75	4.81	12.76
50% RD + 10% CT	1.32	33.66	5.23	13.35	1.18	31.40	4.94	12.88
100% RD	1.21	31.95	5.06	12.81	1.09	30.18	4.75	12.65
100% RD + 5% CT	1.35	33.10	5.31	13.42	1.16	30.76	5.06	12.91
100% RD+ 10% CT	1.35	33.90	5.38	13.49	1.23	31.55	5.15	13.18
LSD 5%	0.07	0.05	0.03	0.05	0.08	0.04	0.05	0.03

Seed quality of pea plants :

Iron , vitamin C , crude protein and carbohydrates in the seeds :

Seed quality of pea plants expressed as Fe and V.C (mg . 100 g⁻¹) and crude protein and total carbohydrates (%) are presented at Table (7) .

Data reveal that ; except the treatments of 5 % compost tea which had a significant effect in the two seasons foliar application of compost tea and mineral fertilization with N , P and K at the rates of this investigation either in a single form or in combination significantly increased the values of seed quality parameters during the both seasons of 2005-2006 and 2006-2007 . Although , the highest values of these parameters were realized for the treatments of 100 % RD + 10 % CT during both seasons of the experiment .

It can be concluded that , application of compost tea either in a single form or in combination with mineral fertilization led to a positive effect on Fe, vitamin C , crude protein and carbohydrates and this might be attributed the compost tea increased the bioactivities within the plant cell El-Saady. (2006) , Tartoura . (2006) , El-Saady et al . (2007) confirmed these findings.

Table (7) : Fe , vitamin C mg / 100g seed, crude protein and carbohydrates % in the seeds of pea plant as affected by mineral fertilizer , compost tea in the two seasons .

Seasons Treatments Characters	2005-2006			2006-2007		
	Fe mg . kg ⁻¹	Zn mg . kg ⁻¹	Mn mg . kg ⁻¹	Fe mg . kg ⁻¹	Zn mg . kg ⁻¹	Mn mg . kg ⁻¹
Control	42.00	32.14	9.93	42.80	33.90	10.75
5% CT	42.22	32.91	10.06	43.15	34.12	11.13
10% CT	42.79	34.56	10.85	43.62	34.95	11.83
50% RD	43.92	37.08	12.37	43.77	34.17	10.88
50% RD + 5%CT	45.75	38.21	12.94	44.52	34.88	11.59
50% RD + 10% CT	46.84	39.29	13.16	45.63	35.97	12.08
100% RD	44.66	38.19	12.78	44.50	34.52	11.48
100% RD + 5% CT	47.83	39.80	13.69	45.69	35.28	11.73
100% RD+ 10% CT	49.08	40.72	14.10	46.33	36.71	12.35
LSD 5%	0.70	1.04	0.33	0.75	0.25	0.50

Conclusion : under the same condition of this study could be recommended that ; foliar spraying of compost tea extract at the rate of 10 % was beneficial for producing the best and safe product of pea plants .

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إحلال شاي الكومبوست محل جزء من الأسمدة المعدنية لنبات البسلة

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- أجريت تجربة أصص بكلية الزراعة جامعة المنصورة خلال موسمين زراعيين ٢٠٠٥/٢٠٠٦ و ٢٠٠٦/٢٠٠٧ وذلك لدراسة إحلال شاي الكومبوست محل جزء من الأسمدة المعدنية لإنتاج منتج نظيف من محصول البسلة. إذ تم استخدام ٩ معاملات في تصميم قطاعات كاملة العشوائية في ثلاثة مكررات . تم استخدام معاملتين من شاي الكومبوست وهما (٥% و ١٠%) وثلاث معاملات من التسميد المعدني (بدون تسميد , ٥٠% , ١٠٠%) من الموصى به من الأسمدة النيتروجينية والفوسفاتية والبوتاسية والدمج بينهم .
- ١- أدى إضافة معاملة ١٠% من شاي الكومبوست رشا إلى زيادة قيم النمو والتركيب الكيماوي وجودة بذور البسلة .
- ٢- أدى التسميد ب ٥٠% و ١٠٠% من الموصى به لنبات البسلة من الأسمدة النيتروجينية والفوسفاتية والبوتاسية فرديا إلى الزيادة المعنوية للقيم تحت الدراسة .
- تشير النتائج المتحصل عليها إلى إن القيم المرتفعة للصفات تحت الدراسة ترجع إلى استخدام معاملة ١٠٠% من الموصى به مع ١٠% من شاي الكومبوست .