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Effect of Bio and Organic Fertilization on Chemical Constituents of Pea Plants and Availability of Npk.

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ABSTRACT

A field experiment was carried out to evaluate the effects of two sources of organic manures (Farmyard manure and chicken manure) as main plots and 3 levels of Effective Microorganisms (EM) in foliar application (0, 1, 2 L.fed^{-1}) as sub-plots on soil characteristics and Pea (*Pisum sativum* L) chemical constituents. Six treatments were arranged in split block design with 3 replicates. Results indicated that using organic manures as FYM and chicken manure recorded the highest values of chlorophyll content, N PK content, crude protein, total carbohydrates, total sugar and vitamin C. In addition, concentrations of NPK mg kg^{-1} soil were significantly increased with using chicken manures. Also, the results showed that the mean values of all mentioned parameters increased with increasing EM at rate of 2L.fed^{-1} comparing with the untreated plant. Best results for interaction between the treatments which recorded the highest values were obtained using chicken manure with foliar application of 2L fed^{-1} EM.

Keywords: EM, FYM, chicken manure and pea plant.

INTRODUCTION

Pea (*Pisums ativum* L.) is one of the foremost important versatile legume crop which is containing highly percentage of digestible nutritious due to its important bio-chemical attributes viz protein content, protein quality (having good amount of essential amino acids such as lysine, methionine, leucineetc which are not synthesized by the human body), minerals, oils and sugar content along with carbohydrates, vitamin A, C, calcium and phosphorus (Negi *et al*., 2004 and Jitendra, 2011). Pea is one of the oldest vegetables in the world and ranks among the top ten vegetable crops. In the past few decades' attention has been paid to the application of chemical, organic and bio-fertilizers to boost up the crop production to meet the need for increasing population of the nation. Use of inorganic fertilizer alone is injurious to soil health and soil productivity. Use of organic and bio-fertilizers enhances crop production and sustain soil heath (Akbari *et al*., 2011).

EM (Effective Microorganisms) contains yeast which is a natural source of cytokinins and has stimulatory effects on beans plants (Amer, 2004). Effective microorganisms culture consists of co-existing beneficial microorganisms, the main being the species of photosynthetic bacteria; *Rhodopseudomonas plastris*and *Rhodobactersphacrodes*; lactobacilli such as *Lactobacillus plantarum*, *L. casei*and *Streptococcus lactis*; yeasts (*Saccharomyces* spp) and *Actinomycetes* (*Strptomyces*spp.) which improve crop growth and yield by increasing photosynthesis, producing bioactive substances such as hormones and enzymes, controlling soil diseases and accelerating decomposition of lignin materials in the soil (Higa, 2000; Hussain *et al.,* 2002). When effective micro-organisms cultures are applied to the soil they stimulate the decomposition of organic wastes and residues thereby releasing inorganic nutrients for plant uptake. Majority of the scientists who are engaged in promoting this technology have no doubt that plant growth is just as good or better and quality of plant products is superior to conventional farming (Xu *et al.*, 2000; Javaid, 2006).

Organic manures play a vital role in improving the soil fertility and productivity of soils which has been acknowledged for generations. In recent years, organic farming is becoming more popular in India because people are now aware about the disastrous side effects caused by chemical farming on health and environment and now prefer organically grown foods (Kumaran 2001).

Chicken manure is often produced in areas where it is needed for pastures and crop fertilization. The increased size and frequent clean out of many poultry operations make poultry manure available in sufficient quantities and on timely basis to supply most fertilizer needs (Eliot, 2005). When properly applied, chicken manure can be a valuable resource for grass, small grains and other crop production. The economics of using chicken manure varies considerably. Poultry litter is made out of raw poultry manure and bedding materials such as sawdust, wood shavings, grass cuttings, banana leaves or rice hulls. This combination provide an excellent source of nitrogen (N), phosphorus (P), potassium (K) and sulfur (S) (Anonymous, 2008).

The objective of the current study was to determine the interaction effects between effective microorganisms and organic manure application on chemical composition of pea (*Pisums ativum*L.) and NPK availability of soil.

MATERIALS AND METHODS

A field experiment was carried out at the Experimental Farm of the Faculty of Agric. El-Mansoura Univ. to evaluate the effects of EM and organic manures on soil properties and chemical constituents of Pea (*Pisum sativum* L).

Six treatments were arranged in split block design with 3 replicates, which were the simple possible combination between two sources of organic manures (FYM and chicken manure) as main plots and 3 levels of EM in foliar application (0, 1, 2 L fed^{-1}) as sub plots.

Table 1. Physical and chemical properties of experimental soil.

Soil characters		Growing season 2015 2015 season2015
Particle size distribution (%)	Coarse sand	5.84
	Fine sand	31.58
	Silt	32.93
	Clay	29.65
	Texture class	Sandy Clay Loam
E.C. dS.m^{-1}(1soil:5water)		0.97
pH (1soil:2.5water)		7.67
Saturation present g kg^{-1}		62.4
O.M. g kg^{-1}		1.72
Total CaCO3 g kg^{-1}		3.61
Available (mg/kg)	N	45.16
	P	4.03
	K	181.6

Pea seeds were sown in hills 10 cm apart on 1st December, 2015. The plot area was 12 m^2 including four rows, 5 m long and 60 cm width.

Organic manures were added to soil before sowing at rate of 11 ton fed^{-1} for FYM and chicken manure, respectively, and watered up to saturation percentage. Then, plots were left for two weeks to elucidate the damage on seedlings and their roots resulted from heat of decomposition. Chemical analysis of the organic manures used are presented in Table (2)

Table .2. chemical analysis of the organic manures

Properties	FYM	Chicken manure
E.C dS.m^{-1} (1:10)	4.03	3.35
pH (1:5)	6.52	5.78
O.M. g kg^{-1}	29.6	34.3
O.C %	17.2	19.9
Total N %	0.91	1.42
C/N	1:19	1:14
otal P %	0.42	0.57
Total K %	0.33	0.49
SP g kg^{-1}	135	163

The NPK fertilizers were added to soil as recommended by the Ministry of Agriculture and Soil Reclamation, 150 kg.fed^{-1} N as ammonium sulphate (20.5% N), 150 kg.fed^{-1} P_2O_5 as super phosphate (7% P) and 50 kg.fed^{-1} as Potassium sulphate (40%K). Phosphorus fertilizer was added to the soil before planting, while N & K fertilizers were added in 2 doses; after 15, 21 days from planting.

Effective Microorganisms fresh solution was used immediately after preparation. The respective plots of EM treatment in foliar way each plot received 0, 1 and 2 L.fed^{-1} of dilute EM solution. These plots were further supplemented with EM solution in 3 times after 15 days from planting and 15 days intervals throughout the experimental period.

At harvesting stage; 90 days after sowing of pea plant representative samples were randomly taken from each experimental plot. Chlorophyll contents (mg g^{-1} F.W) were determined in fresh plant foliage. The plant samples were oven dried at 70^o C till constant weight. The dried plant samples were weighted (g plant^{-1}) and stored for chemical analysis of plant expressed as N, P, K, crude protien% and VC as well as total carbohydrates and total sugar.

Soil samples were taken from soil section (0-10) cm after cultivation for determination of available N, P and K (mg.L^{-1}).

Soil analysis:

- The electrical conductivity values of the 1: 5 soil solution extracts were measured by EC, 1:2.5 suspention for pH value, $CaCO_3$ and organic matter contents were determined according to Sahlemedhin and Taye (2000).
- Particle size distribution, available N, P and K in the soil were determined according to the methods of Haluschak, (2006), Reeuwijk, (2002).

- **Chemical composition and quality fruits:**

- Total N, P and K (%) was determined according to the methods described by Mertens, (2005a& b), Agrilasa, (2002) respectively.
- Chlorophyll content was estimated as the method described by Gavrilenko and Zigalova (2003).
- Ascorbic acid (vitamin C) in pea seeds, crude protein percentage, total soluble sugar and total carbohydrates% were determined according (*A.O.A.C 2000*) and Sadasivam and Manickam, (1996), respectively.

Data were statistically analyzed according to the technique of analysis variance (ANOVA) and the least significant difference (L.S.D) method was used to compare the deference between the means of treatment values to the methods described by Gomez and Gomez, (1984). All statistical analyses were performed using analysis of variance technique by means of CoSTATE Computer Software.

RESULTS AND DISCUSSION

Chlorophyll contents:

It is clear from the data in Table 3 that the mean values of chlorophyll a, b and total in pea plant leaves were significantly affected as a result of adding organic manures in forms of FYM and chicken manure. The highest mean values were recorded with adding chicken manure.

Illustrated data in Table 3 showed that spraying pea plants with EM levels significantly increased chlorophyll a, b and total in pea comparing with the untreated plants. Data clearly show that the highest

significant values of the mentioned parameters were recorded by spraying EM at rate of 2 L.fed^{-1} comparing with the untreated plants which recorded the lowest values.

In the present investigation, application of organic manure and EM application had a marked effect on chlorophyll a, b and total of pea plant leaves as illustrated in Table 3. Pea plants fertilized with 11 ton.fed^{-1}. Of chicken manure + 2 L.fed^{-1} EM were found to be superior for increasing the measured parameters during the season

Table .3. Effects of organic sources and foliar application of EM levels as well as their interactions on chlorophyll contents in pea plant during growing season 2015.

Treat.	Char.	Chlorophyll a, mg/g F.W	Chlorophyll b, mg/g F.W	Total chlorophyll, mg/g F.W
		Organic sources		
FYM		0.724	0.447	1.170
Chicken manure		0.734	0.457	1.191
LSD $_{at\ 5\%}$		0.008	0.007	0.011
		EM foliar application		
Without		0.707	0.435	1.142
1 L.fed^{-1}		0.729	0.452	1.181
2 L·fed^{-1}		0.751	0.469	1.221
LSD $_{at\ 5\%}$		0.005	0.005	0.009
		Interaction		
	Without	0.701	0.430	1.131
FYM	1 L.fed^{-1}	0.724	0.446	1.171
	2 L·fed^{-1}	0.745	0.464	1.209
	Without	0.713	0.439	1.152
Chicken manure	1 L.fed^{-1}	0.733	0.458	1.191
	2 L·fed^{-1}	0.757	0.475	1.232
LSD $_{at\ 5\%}$		0.007	0.007	0.011

N, P, K %:

Results in Table 4 showed the effect of different sources of organic manures on N, P, K% of pea plant during the experiment. Using organic manures significantly increased the average values of N, P and K percentages in pea. The application of 11ton.fed^{-1}. from chicken manure gave the highest values of N, P and K percentages compared to using FYM.

Table 4. Effects of organic sources and foliar application of EM levels as well as their interactions on N, P and K% in pea plant during season of 2015.

Treat.	Char.	N%	P%	K%
		Organic sources		
FYM		2.37	0.341	2.61
Chicken manure		2.49	0.353	2.74
LSD $_{at\ 5\%}$		0.02	0.013	0.03
		EM foliar application		
Without		2.15	0.323	2.43
1 L.fed^{-1}		2.44	0.347	2.68
2 L·fed^{-1}		2.72	0.370	2.91
LSD $_{at\ 5\%}$		0.03	0.003	0.05
		Interaction		
	Without	2.07	0.317	2.37
FYM	1 L.fed^{-1}	2.38	0.340	2.61
	2 L·fed^{-1}	2.66	0.364	2.84
	Without	2.22	0.329	2.50
Chicken manure	1 L.fed^{-1}	2.49	0.353	2.74
	2 L·fed^{-1}	2.77	0.376	2.98
LSD $_{at\ 5\%}$		0.05	0.004	0.07

Regarding the effect of spraying pea plants with EM foliar application, data in Table 4 indicated a significant effect on N, P and K percentages in pea plant compared with the untreated plants during the experiment. Data clearly showed that the highest significant values of N, P & K percentages were recorded with spraying EM at level of 2 L.fed^{-1}, while the untreated plants recorded the lowest values of the mentioned chemical parameters.

The effect of interaction between organic manure and EM foliar application on chemical composition of pea plants, i.e., N, P and K percentages are present in Table 4. In the present investigation, application of chicken manure + 2 L.fed^{-1} EM had a significant

marked effect on N, P and K percentages in pea compared with application of chicken manure alone.

Pea seeds quality:

Obtained data in Table 5 indicate that the average values of crude protein, V.C, total carbohydrates and total sugar in seeds were significantly increased due to an addition sources of organic manures. The highest mean values were recorded at rate 11ton.fed^{-1}, of chicken manure.

In the same Table, concerning the mention parameters, it is very clear that spraying pea plants with EM at different levels significantly increased their values compared with the untreated (withoutEM). The EM at 2 L.fed^{-1} was the best in this concern.

Based on the data presented in Table 5, the average values of crude protein, V.C, total carbohydrates and total sugar of pea seeds were significantly affected due to using chicken manure + 2 L.fed^{-1} EM as compared to application of chicken manure alone. The lowest values of measured parameters recorded with application of chicken manure at 11ton.fed^{-1} alone, while the highest values were with application of chicken manure + 2 L.fed^{-1} EM.

Table .5. Effect of organic sources and foliar application of EM levels as well as their interactions on pea seeds quality during season of 2015.

Treat.	Char.	Crud protein %	Total carbohydrates %	Total sugar %	V.C, mg.100g^{-1}
Organic sources					
FYM		15.45	44.53	6.88	3.29
Chicken manure		16.21	45.20	7.31	3.48
LSD $_{at\ 5\%}$		0.21	0.03	0.10	0.12
EM fo3liar application					
Without		14.44	43.46	6.20	3.04
1 L.fed^{-1}		15.84	44.85	7.13	3.39
2 L·fed^{-1}		17.21	46.29	7.95	3.74
LSD $_{at\ 5\%}$		0.09	0.10	0.06	0.05
Interaction					
FYM	Without	13.98	43.05	5.97	2.96
	1 L.fed^{-1}	15.47	44.57	6.87	3.30
	2 L·fed^{-1}	16.89	45.95	7.78	3.61
Chicken manure	Without	14.89	43.86	6.42	3.11
	1 L.fed^{-1}	16.22	45.12	7.38	3.47
	2 L·fed^{-1}	17.53	46.63	8.12	3.87
LSD $_{at\ 5\%}$		0.13	0.14	0.09	0.07

Soil nutrient availability:

As for the effect of organic manures on the average values of available N, P and K (mg Kg^{-1}) data in Table (6) revealed that available values of N, P & K mg Kg^{-1} were increased with adding organic manures. The highest mean values of N, P and K (mg kg^{-1}) were recorded with adding chicken manure, while the lowest one was recorded with adding FYM.

Table 6. Effect of organic sources and foliar application of EM levels as well as their interactions on N, P and K% in pea seeds during season of 2015.

Treat.	Char.	N, mg.kg^{-1}	P, mg.kg^{-1}	K, mg.kg^{-1}
Organic sources				
FYM		56.38	6.00	209.34
Chicken manure		59.72	6.40	214.54
LSD $_{at\ 5\%}$		0.17	0.09	3.94
EM foliar application				
Without		50.61	5.17	192.18
1 L.fed^{-1}		59.54	6.20	214.88
2 L·fed^{-1}		64.01	7.24	228.77
LSD $_{at\ 5\%}$		0.26	0.12	2.68
Interaction				
FYM	Without	47.96	4.98	188.67
	1 L.fed^{-1}	58.36	5.97	212.60
	2 L·fed^{-1}	62.83	7.04	226.77
Chicken manure	Without	53.27	5.35	195.70
	1 L.fed^{-1}	60.71	6.43	217.17
	2 L·fed^{-1}	65.19	7.43	230.77
LSD $_{at\ 5\%}$		0.37	0.17	3.80

Concerning the effect of foliar application of EM in the same Table, it was found that the available values of N, P & K (mg.kg^{-1})were increased with increasing levels of EM compared with the untreated treatments. The highest mean values were recorded with 2L.fed^{-1} comparing with the untreated plants.

As shown in Table (6), the highest available values of N, P and K (mg.kg^{-1}) under study were

realized due to addition of chicken manure under any level of EM. In addition, the same values were increased up to level 2L.fed^{-1} of EM.

EM application exhibited variable effects on chemical and quality of pea plant seeds as well as soil available nutrients under study. A significant increase was happened for all mention parameters recorded due to EM foliar application and using organic manure to gether.

In general, EM application enhanced chlorophyll content, crud protein, total carbohydrates, total sugar and VC. EM contained a few phytohormones and the subordinates are incorporated by soil organisms like GA_3, cytokinins, auxins and betaines and kinetins which animate the development of chlorophyll and may impact a blend of protochlorophyllide which reflect higher carbohydrate synthesis (Amer, 2004 and El-Tohamy and El-Greadly, 2007). All treatments under studying significantly increased N, P and K% in pea seeds compared with the untreated plant. The best concentrations were 2 L.fed^{-1} EM followed by 1 L.fed^{-1}. The effect of EM may be due to that it segments, for example macro- and microelement nutrients, amino acids, vitamins, cytokinins, auxins, and abscisic acid (ABA) and enhanced nutrients absorption by roots. The same result was obtained by Javaid (2009) who proved that the stimulatory impacts of biofertilizers may result from the production of phytohormones, improvement of availability of some minerals, liberation of phosphate and microelements. These results support the findings of Khaliq *et al*., (2006), who reported that applying combination of effective microorganisms with organic matter or mineral NPK significantly improved cotton yield compared to the treatments where these soil amendments were used without EM application. (Javaid and Shah, 2010; Javaid and Bajwa, 2011)

A promotion effect of organic matter treatments on chlorophyll contents due to addition of chicken manure might be attributed to the fact that N is a constituent of chlorophyll molecule; moreover, nitrogen is the main component of all amino acids in protein and lipids that acting as a structural compound of thechloroplast (Arisha and Bradisi, 1999). Contradictory data about the relationship between growth and chlorophyll content of leaves have been reported in which bio-fertilizers increased the content of photosynthetic pigments, Malgorzata and Georgios (2008).The result was in agreement with that of El-Sherif (2006) who mentioned that using higher addition of compost (6 ton/fed.) compared to 2 and 4 ton/fed. gave a high total chlorophyll in cucumber leaves.

Increasing of N, P, K and pea quality due to addition of chicken manure may be attributed to the roles of chicken manures in soil properties which produce humus substances wherein enhancement the physical and chemical soil properties leading to increasing nutrients release availability, i.e., N, P and K uptake. Moreover, incorporation of organic materials in soils can further increase NPK availability by increasing CO_2 forming H_2CO_3 in the soil solution. In the same connection, it was found that inorganic N, P and K fractions were increased due to application of organic amendments such as poultry manures. The increases were reported by Rizk (2002), Ewulo *et al.* (2008), Ayeni *et al.* (2010) and Khan *et al.*, (2015). The result of increasing N, P, K availability as a response for using organic manures were reported by *(*Abdel- Salam and Salem, 2012).

CONCLUSION

From the above discussion, it may be concluded that chemical and quality of pea plant was most affective with using foliar application2L.fed-1 EM and addition of chicken manure as organic source which improve soil chemical properties.

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تأثير التسميد الحيوي والعضوي على التركيب الكيميائي لنبات البسلة وتيسر النيتروجين والفوسفور والبوتاسيوم

كريم فكرى فودة

قسم الأراضى - كلية الزراعة - جامعة المنصورة – مصر

نفذت تجربه حقليه فى مزرعه خاصة لدراسه تاثير نوعين من التسميد العضوى (سماد بلدى و سماد الدواجن) كقطاعات رئيسيه و الرش ب 3 مستويات من الكائنات الحيه الدقيقه (صفر، 1 ، 2 لتر.فدان$^{-1}$) كقطاعات منشقه في 3 مكررات على المحتوى الكيماوي وجوده نبات البسله و المحتوي الكيمائى للتربه بعد الزراعه. أظهرت النتائج انه عند استخدام صور مختلفه للتسميد العضوى مثل السماد البلدى وسماد الدواجن سجلت اعلى القيم لكل من محتوى الكلوروفيل، النسبه المئويه للنيتروجين، الفوسفور، البوتاسيوم، البروتين، الكربوهيدرات، السكر الكلى ، فيتامين سي بالاضافه الى محتوى التربه من النيتروجين والفوسفور والبوتاسيوم والتى زادت معنويا عند استخدام سماد الدواجن. بالاضافه للنتائج السابقه القيم تحت الدراسه زادت معنويا باضافه الكائنات الحيه الدقيقه وسجلت اعلى القيم عند استخدام 2 لتر.فدان$^{-1}$ مقارنه بالنباتات تحت الدراسه. اما بالنسبه للتاثير المشترك للمعاملات تحت الدراسه سجلت اعلى القيم عند استخدام سماد الدواجن مع الرش ب2 لتر.فدان$^{-1}$ من الكائنات الحيه الدقيقه.