Middle East Journal of Agriculture Research
ISSN 2077-4605

Volume : 07 | Issue : 04 | Oct.-Dec. | 2018
Pages:1419-1430

Chicken Manure Tea and Effective Micro-organisms Enhanced Growth and Productivity of Common Bean Plants

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Received: 15 August 2018 / Accepted 20 Oct. 2018 / Publication date: 15 Nov. 2018

ABSTRACT

The effect of soil drenched application of chicken manure tea (CMT) at different levels of dilution (without, 1 : 1 and 1 : 2 v/v) applied singly or combined with effective micro-organisms (EM1) at rate of 5 cm/l compared with soil application of inorganic fertilizers (NPK) at recommended batches (45 N : 60 P_2O_5 : 90 K_2O kg/ha) on vegetative growth, dry seed yield and quality of common bean plants cv. Nebraska was evaluated in a two-year field experiment. Freshly prepared solution of chicken manure tea was applied for seven times at weekly intervals started at 3 weeks after sowing date. The experiments were conducted under newly reclaimed sandy soil conditions during two successive growing seasons of 2016 and 2017 at the Experimental and Production Station of National Research Centre, El-Noubaria region, Beheira Governorate, Egypt. A randomized complete block design with 3 replicates was used. The obtained results emphasized that the highest values of vegetative growth, dry seed yield and the quality attributes of common bean plants were fluctuated between the treatments of soil drenched application of diluted chicken manure tea 1 : 2 incorporated with effective micro-organisms at 5 cm/l and soil applied inorganic fertilizers at recommended doses (45 N : 60 P_2O_5 : 90 K_2O kg/ha). In most cases no significant differences were realized between them. In contrast, the lowest significant values of all measured parameters were achieved when common bean plants received chicken manure tea without dilution singly or combined with effective micro-organisms as soil drenched compared with the other treatments in both seasons of the study. Using chicken manure tea alone without dilution caused an evident inhibition effect on plant vegetative growth, which certainly reflected on the dry seed yield and quality. Such inhibitory effect may be attributed to a higher EC value of chicken manure tea. On the other hand, the increment in vegetative growth and productivity of common bean plants was evident with increasing the dilution rate of chicken manure tea. Such increment was more pronounced when effective micro-organisms was combined. Application of diluted chicken manure tea as soil drenched combined with beneficial and effective micro-organisms could be partially or totally substituted with inorganic fertilizers for sustainable crop production and it is believed to be a promising and useful agriculture practice as well as eco-friendly approach.

***Keywords*:** *Phaseolus vulgaris* L., Chicken manure tea, Effective micro-organisms, Soil drenched application, Vegetative growth, Dry seed yield and quality.

Introduction

Common bean (*Phaseolus vulgaris* L.) belongs to family Fabaceae, being one of the most important legumous vegetable crops in Egypt. It is considered as an important staple food, provides an appreciable amount of plant proteins, minerals, dietary fibers and calories. Nutritionally, legumes come in the second order after cereals in human diet. It is believed that legumes can play a significant role in combating hunger, malnutrition and to ensure food security in developing countries (FAO, 2016).

Globally, great efforts have been made to ensure more and better food production to bridge the food gap between production and consumption, and to meet food demand of rising populations in

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the developing countries. In order to achieve the highest yield, farmers tended to apply excessive amounts of chemical fertilizers. The intensive use of inorganic fertilizers led to a negative impact on environment and depleted the soil health and fertility over the time (Adediran *et al.,* 2004; Nishio, 2012), in addition to decrease farmer's profitability due to the expensive cost of chemical fertilizers. In this regard, many workers proved that chemical fertilizers could be substituted partially or totally by organic fertilizers to reduce the dependence on hazardous agro-chemicals which destructive the agro-ecosystems, without affecting crop yields (Dauda *et al.,* 2008; Alex, 2009). Furthermore, it was reported that application of organic fertilizers improves soil physical, chemical (Jagadeesha, 2008; Lakhdar *et al.*, 2008; Ayoola and Maknide, 2009) and biological characteristics (Hawke and Summers, 2006; Alabadan *et al.,* 2009) which positively enhanced plant growth and productivity as well as maintained soil fertility.

Amongst the organic fertilizers, chicken manure is highly preferred due to its high organic matter content, concentration of plant macro and micro nutrients in available form easy to uptake by the plant as well as its availability throughout the year in significant amounts and cheaper than soil applied fertilizers. Chicken manure if applied with sufficient quantity could be covered the plant nutrient requirements (Amanullah *et al.,* 2007; Agbede *et al.,* 2008; Guo and Song, 2009; Demir *et al.,* 2010). Chicken manure could be applied as a solid organic fertilizer, mixed and incorporated into the soil directly or as a liquid organic fertilizer (manure tea and compost leachate), manure tea could be applied to the soil via irrigation system (fertigation) or as soil drench and/or to the plant foliage via foliar spraying (ROU, 2007).

Chicken manure tea is a liquid extract produced from soaking chicken manure material in water to create a liquid rich in organic and inorganic soluble nutrients, and a large number of micro-organisms. Chicken manure tea could be made through two different brewing methods, non-aerated method "passive" and aerated method "bucket-bubbler" (ROU, 2007).

Chicken manure has been used for decades as an organic fertilizer for growing a wide range of vegetables (Naeem *et al.,* 2006; Azzaz *et al.,* 2009; El-Tantawy *et al.,* 2009; Oustani *et al.,* 2015; Abo-Sedera *et al.,* 2016; Alhrout *et al.,* 2016; Shaheen *et al.,* 2016; Pokhrel *et al.,* 2017) and for reducing plant diseases incidence and severity or suppressing soil borne diseases (Litterick *et al.,* 2004; Scheuerell and Mahaffee, 2004; Haggag and Saber, 2007; Koné *et al.,* 2010; Santos *et al.,* 2011). Using chicken manure tea is becoming a common agriculture practice in sustainable crop production of organic farming (Gross *et al.,* 2008) as a balanced source of nutrients in available form in the rizosphere, growth stimulants and disease suppressors. In addition to its beneficial impacts on soil physical and chemical attributes as well as soil biodynamic systems. On the other hand, Hawke and Summers (2006) reported some negative effects of chicken manure on soil electrical conductivity (EC), groundwater pollution, spread of pathogens and the emission of greenhouse gases (GHG) which aggravate the climate change phenomenon.

Effective micro-organisms (EM) is a trade name for a series of products founded and developed in the late of 1970's by Japanese horticulturist scientist Dr. Teruo Higa. It is microbial inoculants which contain a wide variety of beneficial and nonpathogenic of aerobic and anaerobic micro-organisms (photosynthetic bacteria, lactic acid bacteria, yeast, actinomycetes and others micro-organisms), generally available in a liquid suspension produced through a natural process of fermentation (Higa, 2000). These combinations of beneficial micro-organisms can synthesize useful substances i.e. antimicrobial substances, bioactive substances, amino acids, vitamins, sugars, lactic acid, enzymes and hormones, such substances had an important and effective role in promoting plant growth and root development, increasing nutrients availability, nutrients uptake and the effective microflora in the rizosphere, accelerating the decomposition of organic materials and suppressing soil borne diseases (Higa, 2004).

EM can be applied to the seed before sowing as seed treatment, to the soil alone or combined with organic manures before sowing or applied to the soil alone after sowing at any stages of plant growth and/or foliar spraying (Xiaohou *et al.,* 2001; Javaid, 2010). EM application illustrated beneficial effects on growth, crop yield and quality of vegetables (Naseem, 2000; Daiss *et al.,* 2008; Chantal *et al.,* 2010; Javaid and Bajwa 2011; Ndona *et al.,* 2011; Olle and Williams, 2013).

Application of beneficial micro-organisms in soils amended with organic manures showed insignificant effect on plant growth and yield of pea plants compared to NPK fertilizers treatment (Javaid, 2006). Moreover, inoculation of EM with chicken manure or directly applied to the soil

significantly increased photosynthesis, fruit yield and quality of tomato plants (Xu *et al.,* 2000). In the same regard, Xu (2000) concluded that application of EM plus organic manure fertilizers enhanced root growth, grain yield and promoted photosynthetic efficiency and capacity of sweet corn in comparison to chemical fertilizers. The highest significant values of leaf area, pods length and numbers, fresh and dry weights of pods, pod yield and harvest index were attained by cowpea plants supplied with organic manure with EM solution in relative to inorganic fertilized plants (Seran and Shahardeen, 2013). Moreover, using chicken manure plus bio-fertilizer showed an increment of nutrient availability in the root zone, subsequently increased the vegetative growth and pods yield of bean plants (Feleafel and Mirdad, 2014).

Little attention has been paid for the application of chicken manure tea combined with effective micro-organisms on common bean plants grown under newly reclaimed sandy soil conditions. Therefore, current study was conducted to evaluate the influence of soil drenched chicken manure tea with different levels of dilution alone or incorporated with effective micro-organisms in comparison with inorganic soil applied fertilizers (NPK) at recommended doses on vegetative growth, dry seed yield and quality of common bean plants.

Materials and Methods

Site description and plant material

Two field experiments were carried out under newly reclaimed sandy soil conditions at The Experimental and Production Station of National Research Centre, El-Noubaria region, Beheira Governorate, Egypt (altitude of 27 m above sea level, latitude 30° 72' 66" N and longitude 30° 20' 18" E), during the two successive growing early summer seasons of 2016 and 2017. Current study was carried out to investigate the effect of soil drenched chicken manure tea (CMT) at different levels of dilution alone or combined with effective micro-organisms (EM) compared with chemical fertilizers NPK at recommended levels on vegetative growth, dry seed yield and quality of common bean plants. Seeds of *Phaseolus vulgaris* L. cv. Nebraska were obtained from Horticultural Research Institute, Agricultural Research Center (ARC), Ministry of Agriculture and Land Reclamation, Giza, Egypt. Physical and chemical properties of the experimental soil are shown in Table 1.

Table 1: Physical and chemical properties of the experimental soil.

Soil physical properties										
Sand		**Silt**		**Clay**		**Texture**				
90.08		0.66		9.26		Sandy				
Soil chemical analysis										
ECe (dS/m)	**pH**	**OM (%)**	**$CaCO_3$ (%)**	**meq/l**						
1.7	8.2	0.43	5.50	**Ca^{++}**	**Mg^{++}**	**Na^{+}**	**K^{+}**	**P^{+++}**	**HCO_3^{-}**	**Cl^{-}**
				7.02	0.53	0.98	0.31	0.11	1.3	0.5

Experimental design

The experiments were set in a randomized complete block design (RCBD) with 3 replicates per treatment. The experimental treatments (seven treatments) were randomly arranged within the block, each block consisted of 7 plots. Each plot contained 5 drip irrigated ridges with 5 m length and 0.8 m width with a net area of 20.0 m^2 for each experimental plot. The first and fifth ridges were left as a guard border among experimental plots to avoid the interaction among soil drenched treatments. Furthermore, common bean plant samples were taken from the middle of each experimental plot.

Experimental site preparation and cultivation

Experimental soil was prepared by land plough and then divided into three main experimental blocks. Then 7 plots per each experimental block were constructed. All experimental plots were

received the organic manure as compost at rate of 10 ton/ha, the full dose of compost was applied during the final preparation of experimental soil and thoroughly mixed and incorporated into the soil. In addition, control treatment plots only were received recommended doses of inorganic fertilizers, phosphorus at 60 kg P_2O_5/ha as calcium super-phosphate (15.5% P_2O_5) and nitrogen at 45 kg N/ha in the form of ammonium sulphate (20.6% N) as starter N dose. Full dose of phosphorus and the half dose of nitrogen were applied during the final preparation of experimental soil. Whereas, the other half dose of nitrogen fertilizer was added 25 days after sowing date. Also, potassium fertilizer was added at rate of 90 kg K_2O/ha in the form of potassium sulphate (48% K_2O). The whole amount of potassium was divided into two equal portions and added as a plant side-dressing, the first after 40 days from sowing date and the other one at flowering stage after 60 days from sowing date.

Common bean seeds were directly sown in the third week of February, during early summer seasons of 2016 and 2017, in holes with 3 seeds per hole and 30 cm apart on one side of drip irrigated ridge and then the germinated seeds were thinned later into two plants per hole. The normal agricultural practices of regular irrigation, fertilization, controlling of pest, disease and weed and other management practices were performed throughout the entire experiment.

Experimental treatments

The non-aerated brewing method "passive" for chicken manure tea (CMT) preparation was used by soaking chicken manure of at least 45 days old obtained from chicken broiler production farm at the above mentioned experimental and production station, in water with a ratio of 1 : 10 (w/v) in a 200 liter tank, then kept in a shaded area for two days to allow the nutrients in the chicken manure to leach into the water. Afterwards, the mixture was filtered through cheesecloth before application to remove suspended particles to obtain almost a clear solution of chicken manure tea. Chicken manure tea was freshly prepared for each time of application. Chemical properties for chicken manure and chicken manure tea are presented in Table 2.

A liquid suspension of effective micro-organisms (EM1) was obtained from The Centralized Management of Afforestation and the Environment, Ministry of Agriculture and Land Reclamation, Giza, Egypt. It consists of mixed beneficial micro-organisms (photosynthetic bacteria, *Rhodopseudomonas palustrus* and *Rhodobacter spaeroides*; lactic acid bacteria, *Lactobacillus plantarum*, *Lactobacillus casei* and *Streptoccus lactis*; yeast, *Saccharomyces cerevisiae* and *Candida utilis*; actinomycetes, *Streptomyces albus* and *Streptomyces griseus* as well as fermenting fungi, *Aspergillus oryzae*, *Penicillium* sp. and *Mucor hiemalis* (Higa and Parr, 1994).

The seven experiment treatments were applied as follow:

1- Using chicken manure tea without dilution.
2- Using chicken manure tea without dilution + EM1 at rate of 5 cm/l.
3- Using chicken manure tea at 1 : 1 water dilution (v/v).
4- Using chicken manure tea at 1 : 1 water dilution (v/v) + EM1 at rate of 5 cm/l.
5- Using chicken manure tea at 1 : 2 water dilution (v/v).
6- Using chicken manure tea at 1 : 2 water dilution (v/v) + EM1 at rate of 5 cm/l.
7- Using inorganic fertilizers N : P : K at recommended doses (45 N : 60 P_2O_5 : 90 K_2O kg/ha) as a control treatment.

Table 2: Chemical properties of chicken manure and chicken manure tea.

Source	pH	EC (dS/m)	%			Ppm					
			N	P	K	Fe	Zn	Mn	Pb	Co	Cd
Chicken manure	7.95	13.8	3.24	1.18	1.86	856	213	242	2.23	*	*
Chicken manure tea	7.61	8.22	1.81	0.67	1.03	443	152	46	*	*	*

***** Not detected.

Treatments of common bean plants were started three weeks after sowing date and applied weekly intervals for seven times as soil drench with solution of chicken manure tea applied singly or in combined with EM1. A total of 25 liter of prepared solution was used per each experimental plot at

rate of 5 liter per each drip irrigated ridge. A 25 liter was soil drenched before the end of drip irrigation by 20 min. Solution of chicken manure tea was freshly prepared for each time of application.

Data recorded

Vegetative growth characters

At 65 days after sowing date, a sample of 8 common bean plants was randomly taken from the middle of each experimental plot. Then harvested plants were transferred to the laboratory for measurements of vegetative growth characters i.e. plant length, number of leaves/plant, number of branches/plant and fresh and dry weights of whole plant.

Dry pods quality and dry seed yield attributes

At harvesting stage, 100 days after sowing date 25 dry pods from the middle of each experimental plot were randomly chosen and used for determining pod physical properties i.e. the average of pod length, pod diameter and pod weight as well as the average number of seeds/pod and weight of 100 seeds. In addition, the average number of pods/plant, number of seeds/plant, weight of seeds/plant and the dry seed yield as kg/ha were also determined.

Nutritional value of dry bean seeds

From the above mentioned dry common bean pods, a sample of 20 dry bean seeds were randomly selected for nutritional value measurements. Bean dry seeds were oven dried at 70 °C for 48 h. Then dried seed samples were fine ground and wet digested as described by Wolf (1982). Acid digested solution of dried seed samples was used to determine mineral contents on a dry weight basis. Total nitrogen was determined using micro Kjeldahl method according to the procedures described by Cottenie *et al.* (1982). Phosphorus percentage was assayed according to the modified colorimetric (molybdenum blue) method using spectrophotometer (SPECTRONIC 20 D, Milton Roy Co. Ltd., USA) according to the procedures described by Cottenie *et al.* (1982). Moreover, potassium percentage was measured using flame photometer method (JENWAY, PFP-7, ELE Instrument Co. Ltd., UK) as described by Chapman and Pratt (1982). Concerning micro-element contents Fe, Zn and Mn were determined using atomic absorption (ANALYST 200, Parkin Elmer, Inc., MA, USA) as described by Chapman and Pratt (1982). Moreover, a total crude protein in dry seeds was calculated by multiplying nitrogen percentage value by conversion factor of 6.25.

Statistical analysis

The collected data were tabulated and subjected to statistical analysis of variance procedure using one-way-ANOVA of the Statistical Package for the Social Sciences software (SPSS version 17.0 for Windows, SPSS Inc., Chicago, IL, USA). Values are given as an average of three measurements. The least significant differences (LSD) test was employed to compare the significant differences among means of the treatments at ($p \leq 0.05$) level of significance according to the procedures reported by Gomez and Gomez (1984).

Results and Discussion

Vegetative growth characters

It is clear that common bean plants which received inorganic fertilizers N : P : K at recommended batches (45 N : 60 P_2O_5 : 90 K_2O kg/ha) as soil applied fertilizers recorded the highest significant ($p \leq 0.05$) values of all measured parameters of plant vegetative growth i.e. plant length, number of leaves/plant, number of branches/plant and whole plant fresh and dry weights followed

insignificantly by application of diluted chicken manure tea (CMT) 1 : 2 incorporated with effective micro-organisms (EM1) as soil drenched and significantly by using diluted chicken manure tea 1 : 1 combined with effective micro-organisms. It is appeared that these treatments caused a remarkable promotion of plant vegetative growth parameters in relative to other treatments. These findings were true in both experimental seasons of 2016 and 2017 (Table 3). On the contrary, using chicken manure tea (CMT) without dilution singly or combined with effective micro-organisms (EM1) as soil drenched caused an obvious inhibition of all measured plant vegetative growth characters. Where, application of chicken manure tea without dilution or chicken manure tea without dilution incorporated with effective micro-organisms treatments gave significantly the lowest values of all measured characters of plant vegetative growth of common bean plant compared with the rest of treatments in both seasons of the study.

It is of interest to mention that insignificant differences were detected among all treatments concerning the parameters of number of leaves/plant and number of branches/plant in both seasons of study as shown in Table 3. In this regard, the number of leaves/plant as well as the number of branches/plant traits seemed to be genetically controlled or less affected characters in comparison with the other plant growth characters (Ghoulam *et al.,* 2002). Also the inhibitory effect on vegetative growth parameters of common bean plants could be attributed to a higher EC value of chicken manure tea applied without dilution about 8.22 dS/m, which is too high for common bean plants as a salt sensitive crops (Hawke and Summers, 2006; Oagile and Mufwanzala, 2010).

Table 3: Effect of using chicken manure tea (CMT) at different levels of dilution alone or combined with effective micro-organisms (EM1) as soil drenched on vegetative growth characters of common bean plants grown under newly reclaimed sandy soil conditions during seasons of 2016 and 2017.

Treatments	Plant length (cm)	Number/plant		Plant weight (g/plant)	
		Leaves	Branches	Fresh	Dry
First season 2016					
CMT without dilution	40.33	12.67	4.00	169.53	18.90
CMT without dilution + EM1	44.67	13.00	4.33	184.53	21.28
CMT diluted 1 : 1	54.67	14.67	4.67	198.20	27.42
CMT diluted 1 : 1 + EM1	61.00	15.00	5.00	221.43	37.43
CMT diluted 1 : 2	57.67	14.67	5.00	214.53	33.74
CMT diluted 1 : 2 + EM1	63.67	15.33	5.33	239.03	43.77
N : P : K (45 : 60 : 90 kg/ha)	67.00	15.33	5.33	259.33	49.77
LSD at 5%	**3.34**	**NS***	**NS**	**16.58**	**7.12**
Second season 2017					
CMT without dilution	45.00	13.00	4.67	181.83	19.74
CMT without dilution + EM1	48.67	14.00	5.00	194.40	21.19
CMT diluted 1 : 1	58.67	15.67	5.33	208.77	23.04
CMT diluted 1 : 1 + EM1	65.00	16.33	5.67	242.57	26.85
CMT diluted 1 : 2	61.00	16.00	5.67	228.63	25.01
CMT diluted 1 : 2 + EM1	68.00	16.33	6.00	264.7	30.19
N : P : K (45 : 60 : 90 kg/ha)	70.00	16.67	6.33	266.7	31.18
LSD at 5%	**3.54**	**NS**	**NS**	**13.21**	**2.96**

* **NS:** Non-significant.

According to the results obtained, it could be stated that with the increase of chicken manure tea dilution, an increase in vegetative growth parameters was attained, such increment was more

pronounced when effective micro-organisms was combined. The obtained results are in good accordance with Naseem (2000); Xu (2000); Amanullah *et al.* (2007); Jagadeesha (2008); Azzaz *et al.* (2009); Shaheen *et al.* (2016); Pokhrel *et al.* (2017). They demonstrated that soil application of organic manure or organic manure tea incorporated with beneficial micro-organisms led to significant increase in plant vegetative growth characters. Such increment almost was insignificant in comparison with inorganic fertilizers used.

It is important to declare that the positive impact of chicken manure tea combined with effective micro-organisms on plant growth could be explained due to enhance of photosynthetic efficiency and capacity (Xu, 2000; Xu *et al.,* 2000), augment the formation of nodulation, consequently the biological nitrogen fixation process increased (Sangakkara and Higa, 1994), maintain soil fertility and improve soil physical, chemical and biological characteristics (Hawke and Summers, 2006; Ayoola and Maknide, 2009; Alabadan *et al.,* 2009; Demir *et al.,* 2010) and provide readily plant nutrients in a available form in the rizosphere (Gross *et al.,* 2008; Feleafel and Mirdad, 2014), subsequently enhanced plant vegetative growth. Furthermore, combinations of beneficial micro-organisms with organic manure had an important and effective role in promoting plant growth and root development, increasing nutrients availability and nutrients uptake as well as suppressing soil borne diseases (Higa, 2004), these effects may be attributed to activate many species of beneficial living micro-organisms which synthesized growth stimulants and other useful substances in the root zone.

Dry pods quality and dry seed yield attributes

Data presented in Table 4 indicate that the highest values of all determined parameters of dry pods physical properties (averages of pod length, diameter, weight) and dry seed yield (number of pods/plant, number of seeds/pod, number of seeds/plant, weight of seeds/plant, weight of 100 seeds and dry seed yield as kg/ha) were recorded when common bean plants treated with diluted chicken manure tea (CMT) 1 : 2 combined with effective micro-organisms (EM1) at rate of 5 cm/l as soil drenched or application of inorganic fertilizers N : P : K at recommended doses (45 N : 60 P_2O_5 : 90 K_2O kg/ha) as soil applied fertilizers treatment without a significant difference between both of them. The same trends were noticed in both seasons of the study. On the other hand, common bean plants which received chicken manure tea without dilution as soil drenched showed significantly ($p \leq 0.05$) the lowest values of dry pods physical properties and dry seed yield when compared with other treatments in both seasons of 2016 and 2017.

No significant differences were detected among all treatments in both seasons of the study concerning the average of dry pod diameter, number of seeds per dry pod and the average weight of 100 seeds. In spite of insignificant differences were realized among all treatments, using inorganic fertilizers N : P : K at recommended doses (45 N : 60 P_2O_5 : 90 K_2O kg/ha) as soil applied fertilizers treatment gave the highest values of dry pod diameter and number of seeds per dry pod. Whereas, the lower values were attained by chicken manure tea (CMT) applied singly without dilution. However, the highest and the lowest values of weight of 100 seeds were achieved by diluted chicken manure tea 1 : 2 plus effective micro-organisms and diluted chicken manure tea 1 : 1 without effective micro-organisms as soil drenched, respectively. These findings were true in both seasons of the study as shown in Table 4.

It is appeared that the parameter of number of dry pods per plant was the most affected trait by different treatments of soil drenched solutions of chicken manure tea plus effective micro-organisms. This parameter is highly reflected on common bean yield as number of seeds per plant and weight of seeds per plant which ultimately led to increase the dry seed yield. In this concern, number of dry pods per plant and dry seed yield as kg/ha were increased by up to 36.53 - 39.99% and 50.96 - 48.49% in the first and second seasons, respectively, when diluted chicken manure tea 1 : 2 plus effective micro-organisms as soil drenched was used. In another mean, the increment of dry seed yield of common bean plants was mainly attributed to the increase in number of dry pods per plant which accompanied by this treatment.

Table 4: Effect of using chicken manure tea (CMT) at different levels of dilution alone or combined with effective micro-organisms (EM1) as soil drenched on pod characters and dry seed yield of common bean plants grown under newly reclaimed sandy soil conditions during seasons of 2016 and 2017.

Treatments	Dry pod characters					Dry seed yield			
	Length (cm)	Diameter (cm)	Weight (g)	No. of pods/ plant	No. of seeds /pod	Weight of 100 seeds	No. of seeds /plant	Weight of seeds /plant	Dry seed yield (kg/ha)
First season 2016									
CMT without dilution	9.50	0.83	1.93	11.00	3.33	56.83	36.67	20.57	1234.12
CMT without dilution + EM1	10.83	0.87	2.10	11.33	3.67	56.83	42.33	24.42	1464.90
CMT diluted 1 : 1	11.83	0.93	2.73	13.00	4.00	52.23	52.00	26.99	1619.25
CMT diluted 1 : 1 + EM1	12.50	0.93	2.80	16.00	4.00	57.46	63.00	36.49	2189.23
CMT diluted 1 : 2	13.00	0.97	2.93	14.33	4.00	52.98	55.67	29.38	1762.73
CMT diluted 1 : 2 + EM1	13.00	0.93	3.07	17.33	4.00	60.89	69.33	41.95	2516.81
N : P : K (45 : 60 : 90 kg/ha)	13.17	0.97	3.10	17.00	4.00	60.36	67.00	40.36	2421.79
LSD at 5%	**0.81**	**NS***	**0.31**	**2.86**	**NS**	**NS**	**7.38**	**6.57**	**375.41**
Second season 2017									
CMT without dilution	10.50	0.97	2.50	11.00	3.67	60.46	40.00	24.20	1451.98
CMT without dilution + EM1	11.67	1.00	2.93	12.33	4.00	60.46	49.33	29.83	1790.03
CMT diluted 1 : 1	12.00	0.97	3.00	14.00	4.00	56.88	56.00	31.66	1899.67
CMT diluted 1 : 1 + EM1	13.17	0.97	3.23	17.33	4.00	62.72	69.33	43.39	2603.23
CMT diluted 1 : 2	13.33	1.00	3.30	16.33	3.67	57.42	58.67	33.24	1994.70
CMT diluted 1 : 2 + EM1	13.50	0.97	3.70	18.33	4.00	64.24	73.33	46.99	2819.22
N : P : K (45 : 60 : 90 kg/ha)	13.50	1.07	3.60	18.00	4.00	63.32	72.00	45.38	2722.68
LSD at 5%	**0.97**	**NS**	**0.45**	**1.89**	**NS**	**NS**	**7.85**	**5.94**	**281.96**

* **NS:** Non-significant.

The obtained results are in coincidence with Naseem (2000); Xu *et al.* (2000); Naeem *et al.* (2006); Jagadeesha (2008); Azzaz *et al.* (2009); Chantal *et al.* (2010); Seran and Shahardeen (2013); Oustani *et al.* (2015); Abo-Sedera *et al.* (2016); Alhrout *et al.* (2016); Shaheen *et al.* (2016). All of them reported that application of beneficial micro-organisms with organic manures showed a significant increase in yield as well as quality in a variety of vegetables. In this regard, the increment in plant yield may be explained as a result of vigorous vegetative growth as previously mentioned.

The enhancement of plant yield and yield attributes with the application of chicken manure tea with effective micro-organisms could be explained mainly due to the increase of photosynthetic efficiency (Xu, 2000), biological nitrogen fixation (Sangakkara and Higa, 1994), nutrients availability over the time and nutrients uptake (Gross *et al.,* 2008; Feleafel and Mirdad, 2014) and improve soil physical, chemical and biological characteristics (Hawke and Summers, 2006; Agbede *et al.,* 2008; Alabadan *et al.,* 2009). In addition, Oustani *et al.* (2015) showed that the increase in yield could be attributed to the improvement of both soil moisture retention and potentials of nutrient supply (with macro and micro nutrients). In contrast to this the negative impact appeared when chicken manure tea was used without dilution alone or combined with effective micro-organisms on dry pods quality and dry seed yield of common bean plants may be due to a higher EC value of chicken manure tea (Hawke and Summers, 2006; Oagile and Mufwanzala, 2010). It is important to note that incorporated

effective micro-organisms with chicken manure tea could be alleviated the adverse effect of higher EC of chicken manure tea as well as overcome its inhibitory effect, thus increased plant vegetative growth which resulted in an increase in plant yield (Oustani *et al.,* 2015; Talaat *et al.,* 2015).

Nutritional value of dry bean seeds

The obtained results showed that there were significant differences among all treatments regarding nutritional value of dry bean seeds (protein, N, P, K, Fe, Zn and Mn) in both seasons of 2016 and 2017. It is evident that common bean plants which received diluted chicken manure tea (CMT) 1 : 2 combined with effective micro-organisms (EM1) at rate of 5 cm/l as soil drenched or inorganic fertilizers N : P : K at recommended doses (45 N : 60 P_2O_5 : 90 K_2O kg/ha) as soil applied fertilizers displayed the highest significant ($p \leq 0.05$) values of all measured nutritional attributes compared to the other treatments, without significant differences between them. On the other hand, the lowest significant values were attained by those common bean plants which treated by chicken manure tea without dilution alone or combined with effective micro-organisms in both seasons of the study (Table 5).

Table 5: Effect of using chicken manure tea (CMT) at different levels of dilution alone or combined with effective micro-organisms (EM1) as soil drenched on dry seed protein and mineral contents of common bean plants grown under newly reclaimed sandy soil conditions during seasons of 2016 and 2017.

Treatments	%				ppm		
	Protein	N	P	K	Fe	Zn	Mn
First season 2016							
CMT without dilution	15.52	2.48	0.313	2.36	149.14	25.30	5.09
CMT without dilution + EM1	16.90	2.70	0.359	2.56	160.24	28.14	6.31
CMT diluted 1 : 1	19.52	3.12	0.338	2.56	170.52	29.99	6.67
CMT diluted 1 : 1 + EM1	21.21	3.39	0.372	2.68	180.75	30.22	7.80
CMT diluted 1 : 2	20.10	3.22	0.364	2.63	174.71	30.18	7.50
CMT diluted 1 : 2 + EM1	24.92	3.99	0.415	2.67	182.71	31.46	8.26
N : P : K (45 : 60 : 90 kg/ha)	22.35	3.58	0.416	2.72	215.32	32.87	8.93
LSD at 5%	**1.22**	**0.19**	**0.022**	**0.11**	**5.57**	**2.43**	**0.60**
Second season 2017							
CMT without dilution	17.19	2.75	0.340	2.56	152.50	26.33	5.13
CMT without dilution + EM1	18.63	2.98	0.366	2.63	158.31	27.38	5.24
CMT diluted 1 : 1	20.90	3.34	0.361	2.75	183.02	31.78	8.05
CMT diluted 1 : 1 + EM1	22.23	3.56	0.367	2.82	189.50	33.19	7.94
CMT diluted 1 : 2	21.29	3.41	0.366	2.88	187.28	33.13	7.95
CMT diluted 1 : 2 + EM1	25.75	4.12	0.453	2.89	191.63	34.05	8.15
N : P : K (45 : 60 : 90 kg/ha)	23.98	3.84	0.455	2.88	210.38	37.13	9.03
LSD at 5%	**2.12**	**0.34**	**0.051**	**0.16**	**16.86**	**4.16**	**0.91**

It was clear that the addition of effective micro-organisms to diluted chicken manure tea (1 : 1 or 1 : 2 v/v) showed a remarkable increase not only in nutrients availability (macro and micro nutrients) in the rizosphere, but also nutrients uptake by the plant and nutrients accumulated in the plant tissues. Of course, these resulted in an improvement of minerals contents in dry bean seeds.

The obtained results might be attributed to that organic fertilizer improves different soil characteristics (Naseem, 2000; Hawke and Summers, 2006; Agbede *et al.,* 2008; Alabadan *et al.,*

2009; Ayoola and Maknide, 2009; Oagile and Mufwanzala, 2010), which led to maintain fertility of the soil to be able to supply grown plants with nutrients requirement over the season. Soil applied chicken manure inoculated with beneficial micro-organisms significantly increased soil living micro-organisms number and activity, and provided necessary nutrients in available forms in the root zone, consequently improved the absorption and accumulation of mineral contents in plant tissue in comparison to chemical fertilizers (Javaid and Bajwa, 2011; Feleafel and Mirdad, 2014; Talaat *et al.,* 2015; Shaheen *et al.,* 2016). However, chicken manure is considered as preferable organic manure for soil amendment where it can increase soil and plant tissue macro and micro nutrients contents (Duncan, 2005; Agbede *et al.,* 2008).

Chicken manure could be supplied the crops with adequate nutrients in available form easy for the plant to absorb, in particularly nitrogen, phosphorus and potassium. In this regards, Guo and Song (2009) stated that amongst the organic fertilizers, chicken manure has the highest nitrogen, phosphorus and potassium contents. Total nitrogen and phosphorus contents in chicken manure were about 4 and 2%, respectively, (Gross *et al.,* 2008).

Conclusion

From the above mention results it could be concluded that soil drenched application of diluted chicken manure tea incorporated with effective micro-organisms is considered as a useful agriculture and eco-friendly practice for sustainable crop production in organic farming. Whereas, the best values of vegetative growth, dry seed yield and quality attributes of common bean plants grown under newly reclaimed sandy soil conditions were attained with treatments of soil drenched application of diluted chicken manure tea 1:2 incorporated with effective micro-organisms at rate of 5 cm/l and soil applied inorganic fertilizers at recommended doses (45 N : 60 P_2O_5 : 90 K_2O kg/ha), without significant differences between both of them.

References

Abo-Sedera, F.A., A.S. Shams, M.H.M. Mohamed and A.H.M. Hamoda, 2016. Effect of organic fertilizer and foliar spray with some safety compounds on growth and productivity of snap bean. Annals Agric. Sci., Moshtohor, 54(1): 105-118.

Adediran, J.A., L.B. Taiwo, M.O. Akande, R.A. Sobulo and O.J. Idowu, 2004. Application of organic and inorganic fertilizer for sustainable maize and cowpea yields in Nigeria. J. Plant Nutr., 27(7):1163-1181.

Agbede, T.M., S.O. Ojeniyi and A.J. Adeyemo, 2008. Effect of poultry manure on soil physical and chemical properties, growth and grain yield of sorghum in Southwest Nigeria. Amer-Eurasian J. Sustain. Agric., 2(1): 72-77.

Alabadan, B.A., P.A. Adeoye and E.A. Folorunso, 2009. Effect of different poultry wastes on physical, chemical and biological properties of soil. Caspian J. Environ. Sci., 7(1): 31-35.

Alex, G., 2009. Organic alternatives to chemical fertilizer. In: Haimovich, A. Ed. Catalyst vol. I.: University of Colorado. Colorado, USA, pp. 33-40.

Alhrout, H.H., H.K.H. Aldal'in, M.A. Haddad, N.M. Bani-Hani and S.Y. Al-Dalein, 2016. The impact of organic and inorganic fertilizer on yield and yield components of common bean (*Phaseolus vulgaris*). Adv. Environ. Bio., 10(9): 8-13.

Amanullah, M.M., E. Somasundaram, K. Vaiyapuri and K. Sathyamoorthi, 2007. Poultry manure to crops - A Review. Agric. Rev., 28: 216-222.

Ayoola, S.R. and E.A. Makinde, 2009. Maize growth, yield and soil nutrient changes with N-enriched organic fertilizers. African J. Food Agric. Nutr. Dev., 9(1): 580-592.

Azzaz, N.A., E.A. Hassan and E.H. Hamad, 2009. The chemical constituent and vegetative and yielding characteristics of fennel plants treated with organic and bio-fertilizer instead of mineral fertilizer. Aust. J. Basic Appl. Sci., 3: 579-587.

Chantal, K., S. Xiaohou, W. Weimu and T.I.O. Basil, 2010. Effects of effective microorganisms on yield and quality of vegetable cabbage comparatively to nitrogen and phosphorus fertilizers. Pak. J. Nutr., 9: 1039-1042.

Chapman, H.D. and P.F. Pratt, 1982. Methods of plant analysis, I. Methods of analysis for soil, plant and water. Chapman Publishes, Riverside, California, USA.

Cottenie, A., M. Verloo; L. Kickens, G. Velghe and R. Camerlynck, 1982. Chemical analysis of plant and soils. Laboratory of Analytical and Agrochemistry, State University, Ghent, Belgium.

Daiss, N., M.G. Lobo, A.R. Socorro, U. Bruckner, J. Heller and M. Gonzalez, 2008. The effect of three organic pre-harvest treatments on Swiss chard (*Beta vulgaris* L. var. cycla L.) quality. Eur. Food Res. Technol., 226: 345-353.

Dauda, S.N., F.A. Ajayi and E. Ndor, 2008. Growth and yield of watermelon (*Citrullus lanatus*) as affected by poultry manure application. J. Agric. Social Sci., 4: 121-124.

Demir, K., O. Sahin, Y.K. Kadioglu; D.J. Pilbeam and A. Gunes, 2010. Essential and nonessential element composition of tomato plants fertilized with poultry manure. Sci. Hortic., 127: 16-22.

Duncan, J., 2005. Composting chicken manure. WSU Cooperative Extension, King County Master Gardener and Cooperative Extension Livestock Advisor.

El-Tantawy, I.M., A.M. El-Ghamry and A.H. Habib, 2009. Impact of farmyard manure and manure compost tea on potato yield and soil fertility. J. Agric. Sci., 34(1): 669-678.

FAO, 2016. Food and Agriculture Organization of the United Nations, Rome, Italy. http:// www. fao.org /pulses-2016/international-year-of-pulses-seed-the-commons/en/

Feleafel, M.N. and Z.M. Mirdad, 2014. Influence of organic nitrogen on the snap bean grown in sandy soil. Int. J. Agric. Biol., 16: 65-72.

Ghoulam, C., A. Foursy and K. Fares, 2002. Effects of salt stress on growth, inorganic ions and proline accumulation in relation to osmotic adjustment in five sugar beet cultivars. Environ. Exp. Bot., 47: 39-50.

Gomez, K.A. and A.A. Gomez, 1984. Statistical procedures for agriculture research 2nd Ed., Int. Science Publisher, John Wiley and Sons, New York, USA.

Gross, A., R. Arusi, P. Fine and A. Nejidat, 2008. Assessment of extraction methods with fowl manure for the production of liquid organic fertilizers. Biores. Technol., 99(2): 327-334.

Guo, M. and W. Song, 2009. Nutrient value of alum-treated poultry litter for land application. Poultry Sci., 88(9): 1782-1792.

Haggag, W.M. and M.S.M. Saber, 2007. Suppression of early blight on tomato and purple blight on onion by foliar sprays of aerated and non-aerated compost tea. J. Food, Agric. Environ., 5: 302-309.

Hawke, R.M. and S.A. Summers, 2006. Effects of land application of farm dairy effluent on soil properties: A literature review. New Zealand J. Agric. Res., 49: 307-320.

Higa, T., 2000. What is EM technology? EM world J., 1: 1-6.

Higa, T., 2004. Effective micro-organisms - a new dimension for nature farming. In: Parr J.F., Hornick S.B., Simpson M.E. (Eds) Proceedings of the 2nd International Nature Farming Conf., USDA, Washington DC, USA. pp. 20-22.

Higa, T. and J.F. Parr, 1994. Beneficial and effective microorganisms for a sustainable agriculture and environment. International Nature Farming Research Centre. Atami, Japan.

Jagadeesha, V., 2008. Effect of organic manures and bio fertilizers on growth, seed yield and quality in tomato (*Lycopersicon esculentum* Mill.) cv. Megha. M.Sc. Thesis, Seed Science and Technology Dept., College of Agriculture, University of Agricultural Sciences, Dharwad, Hubli, Karnataka, India.

Javaid, A., 2006. Foliar application of effective microorganisms on pea as an alternative fertilizer. Agron. Sustain. Dev., 26: 257-262.

Javaid, A., 2010. Beneficial microorganisms for sustainable agriculture. Sustain. Agric. Rev., 4: 347-369.

Javaid, A. and R. Bajwa, 2011. Field evaluation of effective microorganisms (EM) application for growth, nodulation, and nutrition of mung bean. Turk. J. Agric. For., 35: 443-452.

Koné, S.B., A. Dionne, R.J. Tweddell, H. Antoun and T.J. Avis, 2010. Suppressive effect of non-aerated compost teas on foliar fungal pathogens of tomato. Bio. Control, 52: 167-173.

Lakhdar, A., C. Hafsi, M. Rabhi, A. Debez, F. Montemurro, C. Abdelly, N. Jedidi and Z. Ouerghi, 2008. Application of municipal solid waste compost reduces the negative effects of saline water in *Hordeum maritimum* L. Bioresour. Technol., 99: 7160-7167.

Litterick, A.M., L. Harrier, P. Wallace, C. 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 - a review. Crit. Rev. Plant Sci., 23(6): 453-479.

Naeem, M., J. Iqbal and M.A.A. Bakhsh, 2006. Comparative study of inorganic fertilizers and organic manures on yield and yield components of mung bean. J. Agric. Soc. Sci., 2: 227-239.

Naseem, F., 2000. Effect of organic amendments and effective microorganisms on vegetable production and soil characteristics. Pak. J. Biol. Sci., 3: 1803-1804.

Ndona, R.K., J.K. Friedel, A. Spornberger, T. Rinnofner and K. Jezik, 2011. Effective micro-organisms (EM): an effective plant strengthening agent for tomatoes in protected cultivation. Biol. Agric. Hort., 27: 189-204.

Nishio, M., 2012. Microbial fertilizers in Japan. Food and Fertilizer Technology Center for The Asian and Pacific Region, Taiwan.

Oagile, D. and N. Mufwanzala, 2010. Chicken manure-enhanced soil fertility and productivity: Effects of application rates. J. Soil Sci. Environ. Manag., (3): 46-54.

Olle, M. and I.H. Williams, 2013. Effective microorganisms and their influence on vegetable production - a review. The J. Hort. Sci. Biotech., 88(4): 380-386.

Oustani, M.; M.T. Halilat and H. Chenchouni, 2015. Effect of poultry manure on the yield and nutriments uptake of potato under saline conditions of arid regions. Emir. J. Food Agric., 27(1): 106-120.

Pokhrel, B., J.N. Sorensen and K.K. Petersen, 2017. Effect of plant based organic fertilizers and chicken manure extract on plant growth and root zone activities of tomato. Acta Horticulturae, 1164: 173-180.

ROU, 2007. Recycled Organics Unit, Overview of compost tea use in New South Wales. 2nd ed. http://www.recycledorganics.com

Sangakkara, U.R. and T. Higa, 1994. Effect of EM on nitrogen fixation by bush bean and mung bean. In: Proc. 2nd Int. Conf., Kyusei Nature Farming, Brazil, Oct. 7-11, 1991, pp. 111-117.

Santos, M., F. Diánez and F. Carretero, 2011. Suppressive effects of compost tea on phytopathogens. In: N. Dubey, (Ed.), Natural Products in Plant Pest Management. CABI Publishing, Oxford, UK, pp. 242-262.

Scheuerell, S.J. and W.F. Mahaffee, 2004. Compost tea as a container medium drench for suppressing seedling damping-off caused by *Pythium ultimum*. Phytopathology, 94(11): 1156-1163.

Seran, T.H. and R.N.M. Shahardeen, 2013. Marketable pod yield of vegetable cowpea (*Vigna unguiculata*) as influenced by organic manures fermented with EM solution. The Open Hort. J., 6: 19-23.

Shaheen, A.M., E.H. Abd El-Samad, Fatma A. Rizk, Faten S. Abd El-Al and Awatif G. Behairy, 2016. Growth, yield and fruit quality of sweet pepper (*Capsicum annuum* L.) in relation to organic and bio-fertilizers application. Res. J. Pharm. Bio. Chem. Sci., 7(3): 1545-1559.

Talaat, N.B., A.E. Ghoniem, M.T. Abdelhamid and B.T. Shawky, 2015. Effective microorganisms improve growth performance, alter nutrients acquisition and induce compatible solutes accumulation in common bean (*Phaseolus vulgaris* L.) plants subjected to salinity stress. Plant Growth Regul., 75: 281-295.

Wolf, B., 1982. A comprehensive system of leaf analysis and its use for diagnosing crop nutrients status. Comm. Soil Sci. Plant Analysis, 13: 1035-1059.

Xiaohou, S., L. Diyou, Z. Liang, W. Hu and W. Hui, 2001. Use of EM-technology in agriculture and environmental management in China. Nat. Farm Environ., 2: 9-18.

Xu, H.L., 2000. Effects of a microbial inoculant and organic fertilizers on the growth, photosynthesis and yield of sweet corn. J. Crop Prod., 3: 183-214.

Xu, H.L., R. Wang, M. Amin and U. Mridha, 2000. Effects of organic fertilizers and a microbial inculant on leaf photosynthesis and fruit yield and quality of tomato plants. J. Crop Prod., 3: 173-182.