Influence of Successive Additions of Some Organic Conditioners and Mineral Fertilizers on Soil Chemical Properties and Wheat Yield In Sandy Soils

El-Farghal, W. M.[1]; Wafaa M.T. El-Eter[1] and A. M. Morsy[2]

[1]Soil, Water & Environment Research Institute, ARC, Giza, Egypt.
[2]Field Crops Research Institute, ARC, Giza, Egypt.
Email: youssiefwaleed@hotmail.com

Abstract: Two field trials were conducted in sandy soil of the farm at Ismailia agriculture Research Station during successive winter seasons (2011 / 2012 and 2012 / 2013) cultivated with wheat crop (Giza 168) under sprinkler irrigation system to study the influence of successive additions of some organic conditioners such as molasses, compost tea and their combinations in presence of NPK mineral fertilizers on soil properties and wheat yield components. The experiment was laid out in a split-plot design with four replications, the main plots rates of mineral fertilizers (50 and 100 % of the recommended NPK dose) whereas the sub main plots treatments included the molasses (2.5 and 5 ton fed.$^{-1}$) and compost tea (400 and 600 L fed.$^{-1}$) and their combinations. All organic conditioners were applied every 15 days until booting growth stage of wheat plants at two growth seasons. The obtained results indicated that, at both seasons, the successive addition of molasses and tea compost either alone or their combinations in presence of mineral fertilizers at 50 or 100% to the sandy soils led to a decrease in soil pH values, while increased soil EC values, organic matter content (OM), cation exchange capacity (CEC) and available contents of N, P and K as well as increased wheat yield parameters. Moreover, the application of molasses (M_2) 5.0 ton fed^{-1} combined with compost tea (CT_2) 600 L fed^{-1} at 100 % of NPK were high significant effect on the soil chemical properties as compared to other treatments and control. In addition, wheat yield components such as plant height, spike length, weight of 1000 grain and biological yield as well as protein content, P and K concentrations in wheat grain were significantly increased by addition of all organic conditioners either alone or associated with each other in the presence of NPK mineral fertilizers (50 and 100 %). Moreover, the highest mean values of straw and grain yields were (4.70 ton fed^{-1}) and (13.83 rd. fed.$^{-1}$), respectively, when applied 100 % of NPK fertilizers associated with ($M_2 + CT_2$) as compared to control treatment. In general, these results suggest that the successive addition of molasses and compost tea either alone or mixed with each other in the presence of mineral fertilizers at 100% of recommended dose to the sandy soils had a positive impact on some soil properties and so on the wheat yield components.

[El-Farghal, W. M.; Wafaa M.T. El-Eter and A. M. Morsy. **Influence of Successive Additions of Some Organic Conditioners and Mineral Fertilizers on Soil Chemical Properties and Wheat Yield In Sandy Soils.** *Nat Sci* 2019;17(4):163-171]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 15. doi:10.7537/marsnsj170419.15.

Keywords: Molasses, Compost tea, Mineral Fertilizers, Soil Chemical Properties, Sandy soils, Wheat Yield

1. Introduction

In recent years, the high cost of agricultural production of various agricultural crops has become one of the most important problems facing sustainable agricultural development in Egypt. The increase in the prices of mineral fertilizers leads to an increase in the cost of agricultural products, especially strategic field crops (cereal crops, such as wheat and corn), which require high quantities of mineral fertilizers. Also, the use of mineral fertilizers in large quantities (especially, nitrogen fertilizers) for these crops in the sandy soil may lead to contamination of agricultural soil and thus pollution of the water by nitrates and ammonium. All this leads to a significant deterioration in soil and groundwater quality and the systems are clearly unsustainable **(Zhu, et al., 2005).**

Hence, the term clean agriculture and organic agriculture, through which the plant provides its nutrient requirements by adding compost to the soil or use of compost tea and its extracts, **(Ingham, 2003*),*** as well as reuse the secondary products such as molasses from agro-industries the sugar industry of sugar cane and sugar beet, whether for soil with irrigation water or scattering on the root zone during the stages of plants growth.

For this reason, aerated compost tea is one such organic fertilizer becoming more widely used with the hopes of improving soil quality and managing crop nutrition. Aerated compost tea is made by mixing compost with aerated water (**National Organic Standards Board, 2004**). Compost tea is commonly applied to the soil by drenching the soil, directing compost tea into the root zone and affects the rhizosphere of the plant. Nutrients supplied with the compost tea are used by the plants **(Ingham, 2005)**. Soil application of compost or compost tea gave better effect on all vegetative characteristics and leaves chemical constituents of macro and micro elements, total carbohydrates and C/N ratio compared to control of pear trees **(Mohammed et al., 2010).**

Moreover, compost tea has been utilized in agriculture as a good source of organic matter and soil amendments that providing plants with mineral nutrients and other benefits. In modern terminology compost tea is a compost extract produce of the fermented compost in water (**Litterick et al., 2004**). In addition, the compost tea is proper than compost because it contain on soluble nutrients so it can be used for soaking seeds or seedlings before planting. It can be applied to soil through irrigation systems or to plant foliage. Moreover, the efficiency of EM (Effective Microorganisms) as a bio-fertilizer is attributed to its role in accelerating the mineralization processes of organic matter and helping the release of nutrients resulting in, enhancing the utility values of soil organic matter content and cation exchange capacity, **Yadav (1999).**

Compost tea has emerged as an important component of the integrated nutrients supply system and holds a great promise to improve crop yield through nutrients supplies. It is worthy to note that the compost tea not only acts as a soil amendment but also acts as a bio-organic fertilizer and plant growth promoting Rizobacteria. This means that this product may enhance the growth, yield and its chemical composition either legumes or non legume crops under sandy soils conditions. **Sarwar (2005)** found that grain yield and yield components of wheat significantly increased with the application of different organic materials resulting in the compost to be the most superior one. Moreover, **Youssef (2011)** concluded that using the EM (Effective Microorganisms) bio-fertilizer in the presence of organic and mineral nitrogen resulted in increases in the wheat grain yield of wheat.

Molasses is the residual syrup from the processing of sugar beet and sugar cane *(***Honma et al., 2012***)*. Molasses is produced annually in large amounts and were used in different industries including animal feeding, alcohol and fertilizers. The use of molasses in agriculture stimulates nutrient elements uptake efficiency and soil biological activity, also, the molasses contains of an organic acids such as amino, humic and fulvic acids which have significant effects on plant growth, (**Samavat and Samavat, 2014**). Humic materials are the main constituents of soil organic matter and are used in agriculture where they have an effect on soil chemistry and fertility and can greatly benefit plant growth. Moreover, **Mohammadi and Barimvandi (2008)** reported that use of molasses increased total nitrogen and potassium and decreased available phosphorus in soil. **Chandraju et al**. **(2008)** reported that the use of a diluted solution of molasses will increase macronutrients uptake and productivity of leafy vegetables.

In this respect, a field investigation was carried out to study the influence of successive applications of molasses, compost tea and their combinations in presence of NPK mineral fertilizers at different rates on soil chemical properties and productivity of wheat crop cultivated in sandy soils under sprinkler irrigation system.

2. Materials and Methods

Two field trials were conducted in sandy soil at Ismailia Agriculture Research Station farm in Ismailia Governorate, Egypt. The institute farm is located at 30^o 35`41.9" N Latitude and 32$^o$ 16` 45.8" E Longitude. Some physical and chemical characteristics of the studied soil are presented in Table (1).

The experiments were carried out during two successive winter seasons of (2011 / 2012) and (2012 / 2013) cultivated with wheat crop (Giza 168) under sprinkler irrigation system to study the influence of successive additions of two types of organic conditioners (molasses and compost tea) at different rates combined with applying the NPK mineral fertilizers (50 and 100% of the recommended doses) and their impact on some soil chemical properties (ECe, pH, OM, CEC and available contents of NPK) as well as on wheat yield cultivated in sandy soil.

Preparation of compost tea

Aerated compost tea was prepared from matured compost, with addition of 20 Kg of matured compost blended with 1 kg molasses, 250 g $(NH_4)_2SO_4$, 50 g $MgSO_4.7H_2O$ and 5 g NaCl in a 150 litter plastic barrel. These ingredients were drenched in 100 liter from irrigation water. This mixture had been allowed to stand in a shaded place for 7 days with a suitable daily stirring by an air composer. After elapsing of incubation time, the liquid mixture was filtered and become ready to use (**Abdel-Wahab et al., 2007).** The compost tea was sprayed regularly in the surface layer of the soil after planting and every 15 days from cultivation until booting stage.

Preparation of molasses

The molasses were diluted at 1:20 times and sprayed regularly on the surface layer of the soil in graded doses. The first dose was two weeks after wheat planted and applied every 15 days until booting stage.

Some chemical properties of the compost tea and molasses were analyzed every season by following the procedure of **APHA (2005)**, the resulted of analysis are shown in Table (2).

Table (1): Some physical and chemical properties of the experimental soil.

Property	Sand %	Clay %	silt %	Texture Grad	pH (1:2.5)	$CaCO_3$ %	CEC meq. 100 g^{-1} soil	O.C %	OM %
1st season	90.00	3.84	6.16	sandy	8.02	1.85	5.90	0.22	0.38
2nd season	89.10	3.70	7.20	sandy	8.05	1.74	5.35	0.23	0.40

Property	EC* dSm^{-1}	Soluble anions and cations								Available nutrients (mg Kg^{-1})		
		Anions meq 100 g^{-1} soil				Cations meq100 g^{-1} soil						
		CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+	N	P	K
1st season	0.42	--	0.55	2.15	1.50	1.00	0.50	2.30	0.40	35.25	4.55	39.55
2nd season	0.45	--	0.60	2.35	1.55	1.25	0.75	2.13	0.37	30.40	5.01	40.50

*EC, Cations and anions are determined in the (1:5 extract).

Table (2): Chemical properties of organic conditioners used

Property	Compost tea (CT)	Molasses (M)
	1st season 2nd season	1st season 2nd season
pH	6.55* 6.68*	4.31** 4.25**
Organic-C	2.90 2.66	19.79 20.19
Organic matter (%)	5.00 4.59	34.11 31.35
EC dSm^{-1}	2.17* 2.12*	3.60** 3.55**
Soluble Cations (mg L^{-1})		
Ca^{++}	130.0 120.0	231.60 256.00
Mg^{++}	42.0 42.50	91.44 86.40
Na^+	243.6 224.25	241.50 207.00
K^+	58.50 76.10	246.33 254.15
Total content of NPK		
N	145.5 (mg Kg^{-1}) 150.5 (mg Kg^{-1})	1.25 % 1.35 %
P	0.014 % 0.012 %	0.05 % 0.06 %
K	0.04 % 0.03 %	4.09 % 4.15 %

* pH and EC in the fresh compost tea extract.
**pH and EC are determined in diluted molasses (1: 10).

Experimental design and treatments

Statistical split-plot experimental design was used with plot dimensions of 7.0 X 3.0 (plot area 21.0 m^2); each treatment was replicated four times. The main plots were rates of NPK mineral fertilizers either 50 or 100 % of the recommended NPK dose for wheat plants. Ammonium nitrate (33 % N) at rates of 150 and 300 kg $fed.^{-1}$ of recommended dose was applied in six split equal doses, calcium super phosphate (15 % P_2O_5) at rates 15 and 30 Kg $fed.^{-1}$ were applied basically before sowing and potassium sulfate (48 % K_2O) at rates of 25 and 50 Kg $fed.^{-1}$ was applied in two split equal doses at sowing and after 30 days from sowing, respectively.

The sub main plots included nine treatments as follows:

1- Control: without organic conditioners
2- Molasses (M) at 2.5 ton/fed. (M_1)
3- Molasses (M) at 5.0 ton/fed. (M_2)
4- Compost Tea at 400 L/fed. (CT_1)
5- Compost Tea at 600 L/fed. (CT_2)
6- Molasses at 2.5 ton/fed + Compost Tea at 400 L/fed. (M_1 + CT_1)
7- Molasses at 2.5 ton/fed.+ Compost Tea at 600 L/fed. (M_1 + CT_2)
8- Molasses at 5.0 ton/fed + Compost Tea at 400 L/fed. (M_2 + CT_1)
9- Molasses at 5.0 ton/fed + Compost Tea at 600 L/fed. (M_2 + CT_2)

After harvested, at both seasons, surface soil samples (0–30 cm) were collected from each plot to evaluate the change of some soil chemical properties, such as ECe, pH, OM, CEC and available contents of NPK according to (**Page et al., 1982).**

Straw and grains of yield and some yield attributes for wheat crop were estimated and recorded. Grain samples were taken, oven dried at 70 ^oC for 48 h up to a constant dry weight, ground and prepared for digestion using H_2SO_4 and H_2O_2 method described by **Page et al. (1982)**. Then the digests were subjected for measurements of macronutrients (N, P and K) using procedure described by **Cottenie et al. (1982).**

Obtained results were statistically analyzed using CoStat software and subjected to analysis of variance (ANOVA) according to the procedure of **Snedecor and Cochran (1980).** Differences between means and the interactions were compared by using L.S.D at 0.05 level of probability.

3. Results and Discussion

Chemical properties of soil

The effect of molasses, compost tea and their combinations in presence of NPK mineral fertilizers on the changes of some soil properties (pH, EC, OM and CEC) are shown in Table (3).

Soil reaction (pH) and electric conductivity (EC)

Data in Table (3) indicated that, at both tested seasons, the mean values of soil pH were positive decreased ($P< 0.05$) when applied all treatments as compared to control. The lowest mean values of soil pH, for two seasons, were 7.65 and 7.42 as a result application of M_2 + CT_2 combined with the rate 50 and 100 % of NPK mineral fertilizers against 8.09 and 7.93 for control treatment, respectively.

Moreover, at two applications rates of NPK treatments, the molasses and compost tea applied either alone or in combination recorded significantly decreased in soil pH values. This may be due to the increase of the application rate of molasses, which led to slightly increase the insoluble acid fraction and acidity of liquid molasses which has low pH between 4 and 5. Similar results were obtained by **Paz et al. (2009)** who reported that the application of vinasse at high rate led to slightly decrease of soil pH and it's due to increase the insoluble acid fraction. Also, these findings could be explained as a result of the role of organic conditioners as an organic material in the composition of some acidic compounds resulting from the simple decomposition of these conditioners and the existence of adequate moisture, reducing slightly the pH of soil (**Albaladejo et al**., **1999 and Nasef et al., 2009).**

Table (3): Chemical properties (EC, pH, OM and CEC) of soil samples (0 – 30 cm) taken after the first and second seasons.

Main Treatment	Sub- Treatments		pH (1: 2.5 susp.)			EC dS m^{-1}			Organic matter %			CEC meq 100g $^{-1}$ soil		
	Organic conditioner	Application Rates	1st Season	2nd Season	Mean	1st Season	2nd Season	Mean	1st Season	2nd Season	Mean	1st Season	2nd Season	Mean
50 % of (NPK) Mineral Fertilizers	Control		8.06	8.09	8.08	0.46	0.43	0.43	0.35	0.40	0.38	6.55	6.45	6.50
	Molasses (Mo)	M_1	7.94	7.96	7.95	0.56	0.60	0.58	0.51	0.48	0.49	7.19	7.15	7.17
		M_2	7.82	7.88	7.85	0.60	0.63	0.62	0.55	0.53	0.54	7.45	7.40	7.43
	Compost Tea (C.T)	$C.T_1$	8.00	7.95	7.98	0.49	0.51	0.50	0.43	0.44	0.44	6.88	6.80	6.84
		CT_2	7.88	7.9	7.89	0.55	0.54	0.55	0.47	0.45	0.46	7.25	7.35	7.30
	Molasses (Mo) + Compost Tea (C.T)	$M_1 + C.T_1$	7.71	7.74	7.73	0.62	0.65	0.64	0.58	0.56	0.57	8.05	8.10	8.08
		$M_1 + CT_2$	7.69	7.70	7.70	0.63	0.66	0.65	0.61	0.59	0.60	8.65	8.74	8.70
		$M_2 + C.T_1$	7.68	7.65	7.67	0.70	0.69	0.70	0.63	0.66	0.64	9.25	9.35	9.30
		$M_2 + C.T_2$	7.64	7.65	7.65	0.80	0.79	0.80	0.72	0.74	0.72	9.65	9.84	9.75
100 % of (NPK) Mineral Fertilizers	Control		8.02	7.99	8.01	0.48	0.45	0.47	0.38	0.41	0.40	7.11	6.95	7.04
	Molasses (Mo)	M_1	7.81	7.84	7.83	0.63	0.64	0.64	0.55	0.54	0.55	7.69	7.86	7.78
		M_2	7.75	7.77	7.76	0.65	0.66	0.66	0.58	0.57	0.58	7.94	7.96	7.95
	Compost Tea (C.T)	$C.T_1$	7.95	7.92	7.93	0.58	0.56	0.57	0.48	0.46	0.47	7.16	7.20	7.18
		CT_2	7.87	7.85	7.86	0.61	0.60	0.60	0.53	0.51	0.52	7.50	7.55	7.53
	Molasses (Mo) + Compost Tea (C.T)	$M_1 + C.T_1$	7.73	7.74	7.74	0.67	0.69	0.68	0.63	0.62	0.63	8.31	8.38	8.35
		$M_1 + CT_2$	7.64	7.63	7.64	0.72	0.73	0.72	0.66	0.65	0.66	8.88	8.95	8.92
		$M_2 + C.T_1$	7.51	7.49	7.50	0.76	0.75	0.76	0.70	0.69	0.70	9.60	9.64	9.62
		$M_2 + C.T_2$	7.41	7.42	7.42	0.85	0.87	0.86	0.74	0.77	0.75	11.25	10.95	11.10
* L.S.D at 0.05			0.0146	0.0014		0.0066	0.0036		0.0072	0.0005		0.0934	0.0700	
** L.S.D at 0.05			0.0324	0.0059		0.0099	0.0044		0.0036	0.0027		0.0010	0.0317	
*** L.S.D at 0.05			0.2960	0.0026		0.0040	0.0020		0.0139	0.0012		0.5017	0.4336	

* L.S.D between the Mean treatments. ** L.S.D between the Sub – treatments.
*** L.S.D interaction between the Mean and Sub-mean treatments.

On the other hand, data in Table (3) showed that, at two rates of NPK mineral fertilizers, the EC in soil significantly increased with the increasing of the application of both molasses and compost tea either alone or in combination as compared to the control treatments, at two tested seasons. The highest mean values for two seasons were (0.80 and 0.86 dSm^{-1}) with application of (M_2 + CT_2) combined with the rate 50 % and 100 % of NPK mineral fertilizers, respectively, as compared to control and other treatments. This increase was expected due to the molasses had salts as shown in (Table 2). The increased of soil EC might be attributed to the addition of salts through application of increase dose of mineral fertilizer (**Selvi et al**., **2002)**. However the increase in soil EC was well within the safe limit of 1.0 dSm^{-1}, (**Richards**, **1973**).

Organic matter and cation exchange capacity

Organic matter is widely regarded as a vital component of a healthy soil. It is an important part of soil physical, chemical and biological fertility. The effect of mineral fertilizer combined with different rates of molasses and compost tea on soil organic matter are shown in Table (3). Data indicate that, at two both seasons, the soil organic matter content increased significantly ($P < 0.05$) with the application of all organic conditioner treatments compared to control. The highest organic matter content values of 0.72 and 0.75 % were obtained in the plots treated with (M2 + CT_2) combined with 50 and 100 % of NPK fertilizer compared to the control treatments (0.38 and 0.41%), respectively. These results were due to the high content of the organic matter for both molasses and compost tea which representing in Table (2). These results are similar to those obtained by **Rakkiyappan et al**. (**2001**) who reported that sugar mill effluent amendments increased EC, pH, total organic carbon and available phosphorus, exchangeable Na, K, Ca and Mg in soil. **Iren et al.** ***(*****2014**) and **Ayito, et al**. (**2018**) added that the positive influence for used organic and inorganic fertilizers increasing soil organic matter.

Concerning of soil CEC, the results at two growing seasons showed that, the CEC of soil significantly ($P< 0.05$) affected by the application of all organic conditioners rates (Table 3) as compared to control which had no significant difference for CEC.

The highest mean values of soil CEC, at both two seasons, were 9.75 and 11.10 meq100 g^{-1} soil when applied (M_2 + CT_2) combined application with 50 and 100 % of NPK, respectively as compared to control and other treatments. This could be due to the high concentrations of cations in the molasses and compost tea. These results are agreement with **Selvamurugan et al**. (**2013**).

Macronutrients availability

The availability of NPK contents in soil are shown in (Table 4). The data indicted that, application of all treatments significantly increased the soil N, P and K availability after the two growing seasons compared to control.

The highest mean values of available N content of 110.48 and 90.57 mg Kg^{-1} were obtained when applied (M_2 + CT_2) combined with 100 and 50 % of NPK against of 53.06 and 36.34 mg Kg^{-1} for control, respectively. This may be due to applied organic conditioners which content high level of organic matter and nitrogen beside, application high rate of nitrogen fertilizers; also, might be due to the mineralization of organic material in the soil (**Chidankumar** and **Chandraju**, **2009**). **Sathisha** (**2000**) also reported that, distillery effluent of molasses application increased the soil available N content.

It may be worth to mention that, data was observed a marked decline of the values of available N at the end of the cultivation seasons, that the available N values in the soil were below than the maximum limits for the available nitrogen in agricultural soils (Guidelines values, more than 120 mg Kg^{-1}), which might be due to the progressive removal of nitrogen elements by the crop, losses due to volatilization and leaching, these results are close agreement with the findings by **Selvakumar** (**2006**).

With regard to available P content in soil, the values significantly increased with applying type of organic conditioners (molasses and compost tea) either alone or in combination in presence of NPK mineral fertilizer over the control.

The highest mean values of available P (15.02 and 10.22 mg Kg^{-1}) were obtained in treatment treated with (M_2 + CT_2) combined with 100 and 50 % NPK ferltizers as compared to control which were 6.69 and 4.49 mg Kg^{-1}, respectively. It might be due to the released phosphorus from the organic matter decomposition as well as produced organic acids which maintain and increase the phosphorus availability in the soil. Similar results are observed with **Maerere et al**. (**2001)** and **Adeleye et al.** (**2010)** who found that the applications dairy cow manures significantly increased the available soil P levels.

Also, the behavior of potassium availability followed the same trend of those recorded by nitrogen and phosphorus availability which revealed that the application of (M_2+CT_2) in combination of 50% and 100% NPK mineral fertilizers were significant increased as compared either control or other treatments. These results are in close agreement with the findings of **Valliappan** (**1998**).

Effect of organic conditioners and mineral fertilizers on wheat yield components

1- Plant height (cm), Spike length (cm) and weight of 1000 grain (g)

Results in Table (5) revealed that the yield attributes of wheat, plant height, spike length and 1000 grain weight were enhanced due to the addition of molasses and compost tea either alone or in combination in presence of the NPK mineral fertilizers at two rates. At both season, the response was higher in the plots treated with (M_2 + CT_2) combined with 100 and 50 % of NPK, as compared to other treatments and control, and recorded to 114.25 and 93.8 cm for the plant height, 12.05 and 10.15 cm for spike length as well as 48.4 and 46.18 gm for 1000 grain weight, respectively. These increases of plant height and spike length are attributed to the fact that nitrogen encourages the elongation and cell division leading to an overall increase in the plant height. **Mohamed et al.** (**2013**) who reported that application of organic compost and bio-fertilizer positively affects wheat yield and its component. Bio-fertilizer + compost tea treatment gave the highest values of biological yield, 1000-grain weight as well as grain and straw yields (ton $fed.^{-1}$).

Table (4): Available contents of NPK in soil samples at both growth seasons after wheat yield harvested

Main Treatment	Sub- Treatments		Macronutrients availability								
	Organic conditioner	Application Rates	N (mg kg^{-1})			P (mg kg^{-1})			K (mg kg^{-1})		
			1st Season	2nd Season	Mean	1st Season	2nd Season	Mean	1st Season	2nd Season	Mean
50 % of (NPK) Mineral Fertilizers	Control		35.80	36.87	36.34	4.56	4.42	4.49	41.55	44.5	43.03
	Molasses (Mo)	M_1	60.30	58.45	59.38	6.15	6.50	6.33	61.23	63.74	62.49
		M_2	65.65	71.50	68.58	6.87	6.90	6.84	64.85	62.45	63.65
	Compost Tea (C.T)	CT_1	40.80	41.18	41.00	6.95	6.86	6.91	50.46	52.15	51.31
		CT_2	55.04	51.25	53.15	7.15	7.36	7.26	59.26	58.12	58.69
	Molasses (Mo) + Compost Tea (C.T)	$M_1 + C.T_1$	76.54	73.32	74.93	7.65	7.81	7.73	70.46	71.27	70.87
		$M_1 + CT_2$	81.75	77.60	79.68	8.78	9.01	8.30	72.35	70.27	71.31
		$M_2 + C.T_1$	82.66	84.45	83.56	9.66	9.5	9.58	74.25	76.74	75.50
		M2 + C.T2	90.75	90.38	90.57	10.12	10.31	10.22	76.96	78.05	77.52
100 % of (NPK) Mineral Fertilizers	Control		52.67	53.44	53.06	6.61	6.77	6.69	56.35	58.92	57.64
	Molasses (Mo)	M_1	75.44	76.66	76.05	7.48	7.28	7.38	75.61	73.90	74.76
		M_2	80.45	82.47	81.46	8.49	8.66	8.58	81.32	79.98	80.65
	Compost Tea (C.T)	$C.T_1$	65.18	66.29	65.74	8.36	8.32	8.34	65.32	67.21	66.27
		CT_2	72.84	67.6	70.22	9.59	9.02	9.31	72.83	69.56	71.20
	Molasses (Mo) + Compost Tea (C.T)	$M_1 + C.T_1$	92.06	91.65	91.86	10.03	10.11	10.08	88.52	86.18	87.35
		$M_1 + CT_2$	95.09	92.86	93.98	11.18	11.10	11.14	91.08	88.85	89.97
		$M_2 + C.T_1$	99.15	96.22	97.69	11.65	11.81	11.73	93.61	97.32	95.47
		$M_2 + C.T_2$	112.45	108.50	110.48	14.05	15.98	15.02	98.89	103.25	101.07
* L.S.D at 0.05			0.0115	0.0005		0.0014	0.0250		0.037	1.810	
** L.S.D at 0.05			0.0542	0.0433		0.0305	0.0620		0.038	2.383	
*** L.S.D at 0.05			0.0766	0.3420		0.0136	0.0611		0.053	0.062	

* L.S.D between the mean treatments. ** L.S.D between the sub – treatments.
*** L.S.D interaction between the mean and sub-mean treatments.

2- Straw and grain yields

Data illustrated in Table (5) reported that, at both growth seasons, the wheat yield (straw and grains) was significantly affected by applications of the investigated organic conditioners either alone or associated with each other in presence of 50 and 100 % of NPK mineral fertilizers, compared to control.

Moreover, application of (M_2 + CT_2) combined with 100 % of NPK mineral fertilizers gave a significant increase in the wheat yield straw and grains which recorded 4.70 Ton $fed.^{-1}$ and 13.83 Ard. $fed.^{-1}$ compared to control treatment were recorded 2.36 ton $fed.^{-1}$ and 8.30 Ard. $fed.^{-1}$, respectively. These may be attributed to the additions effect of these organic conditioners improved the physico-chemical and biological properties as well as fertility status of the soil, **Abo Baker** (**2017**). In this respect, **Khalil et al.** (**2004**) found that the total dry biomass production of wheat plants increased as a result of applying organic materials (chicken manure and compost). Moreover, these results are in an agreement with those obtained by and **Yassen et al**., (**2006*)***. **Javaid and Shah (2010)** reported that the wheat dry biomass yield was significantly increased with the application of the different organic materials combined with molasses resulted in high dry matter yield of wheat plants and the differences between the treatments in presence or absence of molasses were significant. Molasses contain different substrates considered as an important source of nutrients and energy for microorganisms and plants.

Table (5): Wheat yield components as affected by organic soil conditioners and mineral fertilizers after the first and second season.

Main treatment	Sub- treatments		Plant height (cm)			Spike Length (cm)			1000 Grain Weight (g)			Straw Yield (Ton/ fed.)			Grain Yield (Ard/ fed.)		
	Organic conditioner	Application Rates	1st Season	2nd Season	Mean	1st Season	2nd Season	Mean	1st Season	2nd Season	Mean	1st Season	2nd Season	Mean	1st Season	2nd Season	Mean
Control			69.50	73.20	71.35	6.50	6.20	6.35	30.50	30.20	30.28	2.25	2.150	2.20	6.60	6.40	6.50
50 % of (NPK) Mineral Fertilizers	Molasses (Mo)	M_1	80.90	82.30	81.60	7.60	7.80	7.70	38.20	37.80	38.00	2.85	2.94	2.90	8.90	9.10	9.15
		M_2	82.50	83.30	82.90	8.20	8.40	8.30	40.45	39.80	40.15	2.93	2.96	2.95	9.20	9.40	9.34
	Compost Tea (CT)	$C.T_1$	74.80	76.50	75.65	6.90	7.20	7.05	35.40	36.10	35.75	2.65	2.55	2.60	7.60	7.71	7.66
		CT_2	79.50	80.40	79.95	7.40	7.60	7.50	36.80	37.10	36.95	2.73	2.77	2.75	8.20	8.60	8.40
	Molasses (Mo) + Compost Tea (CT)	$M_1 + C.T_1$	84.60	87.60	86.10	9.20	8.80	9.00	41.23	40.50	40.87	3.11	3.05	3.08	9.70	10.20	9.95
		$M_1 + CT_2$	88.80	90.20	89.50	9.50	9.30	9.40	42.80	41.60	42.20	3.45	3.32	3.39	9.95	10.40	10.18
		$M_2 + C.T_1$	90.80	92.50	91.65	9.80	9.70	9.75	44.60	43.50	44.05	3.65	3.52	3.52	10.20	10.60	10.40
		$M_2 + C.T_2$	93.00	94.60	93.80	10.20	10.10	10.15	46.65	45.70	46.18	3.84	3.61	3.73	10.45	10.90	10.68
Control			73.80	75.40	74.20	7.20	7.50	7.35	35.98	33.60	34.79	2.43	2.30	2.36	8.10	8.50	8.30
100 % of (NPK) Mineral Fertilizers	Molasses (Mo)	M_1	84.60	86.50	85.55	9.60	9.80	9.70	41.48	39.40	40.44	3.23	3.33	3.28	9.80	10.10	9.95
		M_2	85.90	88.40	87.15	10.10	10.20	10.15	42.78	40.80	41.79	3.87	3.65	3.76	10.30	10.60	10.45
	Compost Tea (CT)	$C.T_1$	76.80	77.20	77.00	7.80	8.20	8.00	36.80	35.40	36.10	2.65	2.74	2.70	8.50	8.70	8.60
		CT_2	79.40	80.80	84.10	8.50	8.60	8.55	38.35	37.20	37.78	2.98	3.01	3.00	9.20	9.50	9.35
	Molasses (Mo) + Compost Tea (CT)	$M_1 + C.T_1$	88.60	89.50	89.05	10.90	10.60	10.75	43.12	43.50	43.31	4.01	3.94	3.98	10.90	11.20	11.05
		$M_1 + CT_2$	90.20.	91.70	91.00	11.20	11.00	11.10	45.60	45.50	45.55	4.23	4.11	4.17	11.40	11.80	11.65
		$M_2 + C.T_1$	95.30	97.50	96.40	11.80	11.70	11.75	46.98	47.20	47.09	4.50	4.43	4.47	12.50	13.05	12.78
		$M_2 + C.T_2$	113.30	115.20	114.25	12.20	11.90	12.05	48.50	48.30	48.40	4.74	4.65	4.70	13.45	14.23	13.83
* L.S.D at 0.05			0.043	0.043		0.0005	0.0720		0.036	0.375		0.0144	0.028		0.117	0.115	
** L.S.D at 0.05			0.153	0.059		0.0650	0.1678		0.039	0.141		0.0422	0.078		0.165	0.174	
*** L.S.D at 0.05			0.217	0.084		0.0920	0.2374		0.055	0.198		0.0596	0.112		0.234	0.245	

* L.S.D between the mean treatments. ** L.S.D between the sub – treatments.
*** L.S.D interaction between the Mean and Sub-mean treatments.

In addition, application 50 % of NPK mineral fertilizers combined with (M_2 + CT_2) significantly increases the biological yield of wheat (straw and grain), compared to other treatments and control. Accordingly, the addition of these organic conditioners has a direct effect as a good alternative to mineral fertilizers, and indirectly by improving nutrient uptake, **Osman (2010).**

Effects on protein content, P and K concentrations in wheat grains

The data presented in Table (6) at both seasons, indicated that the protein content, P and K concentrations in wheat grain were significantly increased by the additions of each organic conditioners at different rates either alone or associated with each other in the presence of NPK mineral fertilizers in different rates.

The highest mean values (12.55 and 12.15 %) for protein content, (0.63 and 0.57 %) for P and (3.0 and 2.64) for K concentrations were obtained with applied (M_2 + CT_2) combined with 100 and 50 % of NPK mineral fertilizers, respectively as compared to control and the other treatments. These results may be due to that, the addition of organic conditioners leads to the enhancement of metabolic activity within the plants and the promotion of the migration of metabolites through the root and stems towards the leaves. Thereby, it may increase the percentages of nutrients in leaves and stems (**Sikander, 2001**). These results harmonize with those obtained by **Kabesh et al. (2009)** who reported that organic fertilizers amended with biofertilizers caused significant increases in the NPK content and uptake of wheat plants. **Abo-baker** (**2017**) mentioned that the successive additions of the organic amendments (filter mud cake and farm yard manure) to the soil in combination with molasses and acid producing bacteria increased the available N, P and K in the soil. This also induced increases in the plant dry matter yields as well as N, P and K uptake by wheat and sorghum plants. Improvement in soil properties and soil fertility status occurred due to the successive additions of the investigated organic treatments.

Table (6): Protein content, P and k concentrations in grains of wheat crop as affected by the application of organic conditioners and NPK mineral fertilizers, (at both growth seasons).

Main treatment	Sub- Treatments		Protein (%)			P (%)			K (%)		
	Organic conditioner	Application Rates	1st Season	2nd Season	Mean	1st Season	2nd Season	Mean	1st Season	2nd Season	Mean
50 % of (NPK) Mineral Fertilizers	Control		8.23	8.50	8.37	0.36	0.33	0.35	1.46	1.32	1.39
	Molasses (Mo)	M_1	9.15	9.25	9.20	0.38	0.42	0.40	1.95	1.84	1.90
		M_2	10.35	9.87	10.11	0.40	0.42	0.41	2.11	2.21	2.16
	Compost Tea (CT)	$C.T_1$	8.60	8.75	8.68	0.41	0.45	0.43	1.64	1.66	1.65
		CT_2	8.80	9.20	9.00	0.44	0.47	0.46	1.75	1.82	1.79
	Molasses (Mo) + Compost Tea (C.T)	$M_1 + C.T_1$	10.85	10.44	10.65	0.48	0.46	0.47	2.20	2.30	2.25
		$M_1 + CT_2$	10.96	10.88	10.92	0.49	0.52	0.51	2.33	2.40	2.37
		$M_2 + C.T_1$	12.00	11.59	11.80	0.52	0.56	0.54	2.55	2.37	2.46
		$M_2 + C.T_2$	12.25	12.05	12.15	0.56	0.58	0.57	2.64	2.64	2.64
100 % of (NPK) Mineral Fertilizers	Control		9.20	9.45	9.33	0.38	0.42	0.40	1.66	1.48	1.57
	Molasses (Mo)	M_1	10.30	10.56	10.43	0.46	0.47	0.47	2.05	1.99	2.02
		M_2	10.95	11.20	11.08	0.48	0.52	0.50	2.25	2.54	2.40
	Compost Tea (C.T)	$C.T_1$	9.50	9.81	9.66	0.42	0.45	0.44	2.00	2.23	2.12
		CT_2	10.10	10.34	10.22	0.45	0.48	0.47	2.17	2.32	2.25
	Molasses (Mo) + Compost Tea (CT)	$M_1 + C.T_1$	11.23	11.64	11.44	0.47	0.51	0.49	2.55	2.55	2.55
		$M_1 + CT_2$	11.76	11.91	11.84	0.49	0.52	0.51	2.68	2.64	2.66
		$M_2 + C.T_1$	11.98	12.50	12.24	0.53	0.56	0.55	2.90	2.78	2.84
		$M_2 + C.T_2$	12.20	12.90	12.55	0.60	0.65	0.63	2.97	3.02	3.00
* L.S.D at 0.05			0.03	0.137		0.0005	0.016		0.042	0.013	
** L.S.D at 0.05			0.04	0.120		0.0088	0.028		0.053	0.056	
*** L.S.D at 0.05			0.06	0.169		0.0039	0.013		0.075	0.079	

*L.S.D between the Mean treatments. ** L.S.D between the Sub – treatments.
*** L.S.D interaction between the Mean and Sub-mean treatments.

Conclusion

In conclusion, the successive additions of the investigated organic conditioners (molasses and compost tea) either alone or associated with each other in presence of 100 % of NPK mineral fertilizers from recommended doses to the sandy soils led to a decreased in the values of soil pH, while increased in soil EC values, organic matter content, cation exchange capacity and soil content of macronutrients. The improved in soil properties and soil fertility status occurred due to the successive additions of the investigated organic treatments. This also induced increased in the wheat yield as well as protein, P and K content by wheat plants. More studies are needed to investigate the effect of long term successive additions of such organic treatments on soil properties and available nutrients as well as, plant growth and nutrient uptakes and it also needs to be replicated on other field crops, especially the cereal crops which need large quantities of mineral fertilizers growing in sandy soils, in order to reach the best recommendation for minimize the use of mineral fertilizers because it has an economic return on the Egyptian farmer.

Acknowledgment

The author's wishes to express sincere gratitude and appreciation to the Development of Soil Conditioners Project, Dept. of Physics and Chemistry of Soil, Soils, Water and Environ. Res. Inst., Agric. Res. Center (ARC), Giza, Egypt, for introducing all facilities needed to accomplish this study.

References

1. Abdel-Wahab, A.F. M., F. Badawi, Sh. F., Mekhema, G. A. A. and W. M. El Farghal. (2007). Effect of enriched compost tea and rhizobacteria on nodulation, growth and yield of chickpea in sandy soil. Minufiya J. Agric. Res., 32:297 – 321.
2. Abo–Baker, A.A. (2017). Successive application impact of some organic amendments combined with acid producing bacteria on soil properties, NPK availability and uptake by some plants. Intern. J. of Current Microb and App. Sci., 6: 2394-2413.
3. Adeleye, E.O., L.S. Ayeni and S.O. Ojeniyi (2010). Effect of poultry manure on soil physico-chemical properties, leaf nutrient contents and yield of Yam (*Dioscorearotundata*) on Alfisol in southwestern Nigeria. J. Am. Sci., 6: 871-878.
4. Albaladejo, J., M. Stocking, E. Diaz and V.Castilloa (1999). Land rehabilitation by urban refuse amendments in a semi-arid environment: effect on soil chemical properties. Soil Tech., 7: 249-260.
5. APHA (2005). Standard Methods for the Examination of Water and Wastewater. (2005) American Public Health Association, 21st Ed, Washington, DC.
6. Ayito, E. O., B. I. Otobong and J. Kingsley (2018). Effects of neem-based organic fertilizer, npk and their combinations on soil properties and growth of okra (*Abelmoschus esculentus*) in a degraded ultisol of calabar, Nigeria. Intern. J. Plant & Soil Sci. 24: 2320-7035.
7. Chandraju, S., H.C. Basavaraju and C.S. Chidankumar (2008). Investigation of impact of Irrigation of distillery on the nutrients of cabbage and mint leaf. Indian Sugar, 39:15-28.
8. Chidankumar, C.S. and S.Chandraju (2009). Impact of distillery spentwash irrigation on the yields of some condiments: An investigation. - Sugar Technol. 11: 303-306.
9. Cotteine, A., M. Verloo, L. Kiekns, G. Velghe and R. Camerlynek (1982). Chemical analysis of plants and soils. Lab. Anal. and Agroch. St. State Unv., Ghent, Belgium. Composting, Vol. 2. Blackie Academic and Professional, Glasgow, pp. 1138–1141.
10. Honma T., A.Kaneko, H.Ohba and T.Ohyama (2012). Effect of application of molasses to paddy soil on the concentration of cadmium and arsenic in rice grain. Soil Sci. Plant Nutr., 58:255-260.
11. Ingham, E. R. (2003). Compost tea: Promises and practicalities. Fourth Edition, March, 2003 (US and Australia). Acres. 33:1–5.
12. Ingham, E., R. (2005). The compost tea brewing manual as printings. Fifth Edition, Soil Food Web Incorporated, vegan, 3: 31-32.
13. Iren, O.B., N.M. John and E.A. Imuk (2014). Effects of sole and combined applications of organic manures and urea on soil properties and yield of fluted pumpkin (*Telfairia occidentalis*, Hook f.). Nigerian J. of Soil Sci., 24:125-133.
14. Javaid, A. and M. B. M. Shah (2010). Growth and yield response of wheat to EM (effective microorganisms) and parthenium green manure. Afr. J. Biotechnol. 9: 3373-3381.
15. Kabesh, M. O., M. F. El-kramany, G. A. Sary, H. M. El-Naggar and Sh. H. Gehan, Bakhoum (2009). Effect of sowing methods and some bio-organic fertilization treatments on yield and yield components of wheat. Res. J. Agric. Biol. Sci., 5: 97-102.
16. Khalil, A. A., M. A. Nasef, F. M. Ghazal and M. A. El-Emam (2004). Effect of integrated organic manuring and bio-fertilizer growth and nutrient uptake of wheat plants grown in diverse textured soils. Egypt J. Agric. Res., 82:221-234.
17. Litterick, A.M., L. Harrier, P. Wallace, C.A. Watson and M.Wood (2004). The role of un-composted materials, composts, manures, and compost extracts in reducing pest and disease incidence and severity in sustainable temperate agricultural and horticultural crop production review. Crit. Rev. Plant Sci., 23:453–479.
18. Maerere, A. P., G. G. Kimbi and D. L. M. Nonga (2001). Comparative effectiveness of animal manures on soil chemical properties, yield and root growth of amaranthus (*Amaranthus cruentus* L.). AJST., 1: 14-21.
19. Mohamed, A. Y., M. E. Mahmuod and I. S. Ihab (2013). Impact of organic manure, bio-fertilizer and irrigation intervals on wheat growth and grain yield. Amer.-Eurasian J. Agric. & Environ. Sci., 13: 1488-1496.
20. Mohammadi, T. A. and A.R. Barimvandi (2008). The effects of sugar cane molasses on calcareous soil chemical characteristics. Pajouhesn-Va

Sazandegi Winter, 21:47- 53. (81 In Agronomy and Horticulture).
21. Mohammed, S.M., T.A. Fayed, A.F. Esmail and N.A. Abdou (2010). Growth, nutrient statues and yield of Le- Conte pear trees as influenced by some organic and biofertilizer rates compared with chemical fertilizer. Bull. Fac. Agric. Cairo Univ., 61: 17-32.
22. National Organic Standards Board (2004). Compost tea task force report. Availableat: www.ams.usda.gov/nosb/meetings/CompostTeaTaskForceFinalReport.pdf.
23. Nasef, M.A., Kh. A. Shaban and Abd El-Hamide, F. Amal (2009). Effect of compost, compost tea and biofertilizer application on some chemical soil properties and rice productivity under saline soil condition. J. Agric. Mansoura Univ., 34: 2609-2623.
24. Osman Mona, A. (2010). The possible use of diluted vinasse as a partial replacement with mineral fertilizer sources for wheat production and improving nutritional status in sandy soil. Nature and Sci., 8:245-251.
25. Page A. L., R. H. Miller and D. R. Keeney (1982). Method of Soil Analysis. II- Chemical and Microbiological Properties. Soil Sci. Amer., Madison Wisconsi, USA.
26. Paz, C.B. Rub, J. A.M. Ginenez, R. G. and R.J. Ballesta (2009). Impacts caused by the addition of wine vinasse on some chemical and mineralogical properties of a Luvisol and Vertisol in La Mancha. Journal of Soils and Sediments. 121-128.
27. Rakkiyappan, P., S. Thangavelu, R. Malathi and R. Radhamani (2001). Effect of biocompost and enriched pressmud sugarcane yield and quality. Suger Tech. 3: 92–96.
28. Richards, L. A. (1973). Diagnosis and improvement of saline and alkali soils. USA Dpt.
29. Samavat, S. and S. Samavat (2014). The effects of fulvic acid and sugar cane molasses on yield and qualities of tomato. Intern. Res. J. of Appl. and Basic Sci., 8:266-268.
30. Sarwar, G. (2005). Use of compost for crop production in Pakistan. Ecology and environmental protection. 26/2005. University of Kassel, Department of Landscape Ecology and nature conservation, Witzenhausen, Germany.
31. Sathisha, G.C. (2000). Bioconversion of sugar industrial effluent wastes into enriched compost and its effect on soils and crops. Ph.D. Thesis. - Tamil Nadu Agricultural University, Coimbatore, India.
32. Selvakumar, K. (2006). Impact of post-methanated distillery spentwash on the yield and quality of sweet sorghum and on soil health. M.Sc. Thesis, - Tamil Nadu Agricultural University, Coimbatore, India.
33. Selvamurugan, M., V. R. Ramkumar, P. Doraisamy and M. Maheswari (2013). Effect of bioemethanated distillery spentwash and biocompost application on soil quality and crop productivity. Asian J. of Sci. and Techn. 4:124-129.
34. Selvi, D., P. Santhy and M. Dhakshinamoorthy (2002). Effect of continuous application of organic and inorganic fertilizers on micronutrient status of an inceptisol. Agropedology, 12:148-156.
35. Sikander, A. (2001). Effect of organic manure and inorganic fertilizers on the dynamics of soil microorganism: biomass, composition and activity. In: "Alternate/organic fertilizers" D8 Workshop, Islamabad, Pakistan, 19-20 June.
36. Snedecor, G. W. and W. G. Cochran (1980). “Statistical Methods” 7th Ed., Iowa State Univ. Press, Amr., USA, pp. 255 – 269.
37. Valliappan, K. (1998). Recycling of distillery spentwash – An ecofriendly effective reclamation technology for sodic soils. Ph.D. Thesis, - Tamil Nadu Agricultural University, Coimbatore, India.
38. Yadav, S.P. (1999). Effective micro-organisms, its efficacy in soil improvement and crop growth sixth international conference on kyusei.Nature Farming Pretoria, South Africa, 28-31 October.
39. Yassen, A.A., M. Abd El-Hady and S.M. Zaghloul (2006). Replacement part of mineral N fertilizer by organic ones and its effect on wheat plant under water regime conditions. World J. Agric. Sci., 2: 421-428.
40. Youssef, M.A. (2011). Synergistic impact of effective microorganisms and organic manures on growth and yield of wheat and marjoram plants. Ph. D. Thesis, Fac. Agric., Assiut Univ., Assiut, Egypt.
41. Zhu, J.H., X.L. Li, P. Christie and J.L. Li (2005). Environmental implications of low nitrogen use efficiency in excessively fertilized hot pepper cropping systems. Agric., Eco. and Environ., 111: 70-80.

4/9/2019