WHEAT PRODUCTIVITY GROWN UNDER MODERATELY SALINE SOIL AS AFFECTED BY VERMICOMPOST, MAGNETITE AND SUGAR INDUSTRY WASTES

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ABSRACT

A field experiment was conducted on clayey soil at Kom Abou-Khallad village, Nasser district, Bani-Suef Governorate, Egypt during the winter season of 2014/2015. This study was conducted to identify the effect of applied vermicompost at rates 2.5, 3.3 and 4 Mg fed^{-1}, magnetite at rates 100, 150 and 200 k.g fed^{-1} and Sugar industry wastes (a mixture of the Filter Mud and Sugar lime wastes with a ratio of about 1:1) at rates 6.7, 10 and 13.3 Mg fed^{-1} as either solely or combined treatments, on some soil properties as well as the vegetative growth, nutritional status and yield of wheat **(***Triticum aestivum L.* cv Bani-Suef 5**)**. The suitability class of the used irrigation water is C3S1 (ECiw = 2.08 dS/m and SAR= 7.12) for Baha drainage water.

The obtained results of the investigated soil indicated that, the values of EC, ESP and pH, were decreased with application of vermicompost, magnetite and sugar industry wastes. These decreases varied from treatment to another, the best treatment was found to be (T_{10}= filter mud + sugar lime (1:1) w/w (13.3 Mg fed^{-1}) and T_{13}= filter mud + sugar lime (1:1) (6.7 Mg fed^{-1}) + vermicompost) as compared to the other combined or solely ones. However, the treatments effect on OM% and CEC have the opposite trend since their combination caused increase of OM and CEC values. Also, application of vermicompost, magnetite and Sugar industry wastes were more pronounced in decreasing soil bulk density, and increasing both hydraulic conductivity, total porosity and soil moisture content values. The obtained data emphasized that the achieved enhancing soil properties were positively reflected on the nutrient contents of plant tissues and plant parameters. (grain and straw yields).

So that, it could be recommended that applications of vermicompost, magnetite and sugar industry wastes should be used to alleviate the hazardous effects of a saline soil or saline irrigation water. In addition, such favourable conditions should be enhance continuous biological activity and nutrients slow release along the growth stages of wheat plants, and in turn to minimize their possible losses by either leaching or volatilization processes. This approach represents a best

strategy in agriculture field that has a long-term positive agronomic value and an effective practice of fertilization management on long-term.
Key words: **Vermicompost, Magnetite, Sugar Industry wastes, Wheat and Plant growth and quality parameters**

INTRODUCTION

Soil salinity is one of the most problems facing its productivity for most of the common crops, due to the high osmotic potential in solution within the crop root zone, which causes disturbances in nutrients balance, reduces either soil available nutrients or water uptake and consequently reduces the quality and yield of crops **(Ayers and Westcot, 1985).** The harmful effect of salinity stress is more attributed with the disturbances in plant growth through its negative influence on plant physiology and on the balance in the water and ionic status in the cells. Thus, an ionic imbalance occurs in the cells due to the excessive accumulation of Na^+ and Cl^- reduces uptake of other mineral nutrients, such as K^+, Ca^{2+} and Mn^{2+} **(Tester and Davenport, 2003).**

Nutrients availability, mobility, and uptake are usually the most limiting factors for plant growth in saline soils. Many investigations on salinity-nutrients issue were focused on either nutrient influence on the plant **(Svoboda and Haberle, 2006)** or salinity as limiting plant growth factor **(Supanjani and Lee, 2006).** Wheat (*Triticum aestivum L.)* considered one of the most important cereal crops in Egypt. The amount needed from it is greater than that locally produced, therefore increasing its productivity as well as cultivated area is highly recommended **(Sajid *et al.*, 2008).**

The use of organic waste as a soil amendment (i.e. vermicompost and filter mud) to a value suitable environment for planting the reclaimed salt-affected soil under the severe Conditions of the Egyptian soils.

Vermicompost could be used as a natural fertilizer having a number of advantages over chemical fertilizers **(Venugopal *et al.*, 2010)**. Moreover, Vermicomposting in future will be one of the best techniques for treatment of municipal solid waste (MSW) **(Dalal 2012).**

Filter mud (FM) or press mud (PM) also known as filter cake (FC) produced by the sugar mills has been used as fertilizers and ameliorant in sodic and saline-sodic soils **(Barry *et al.*, 2001)** and for extraction of various valuable chemicals **(Partha and Sivasubramanian, 2006**).

Magnetite (magnetic iron) is considered as one of the most saline soil amendment which enhances crop productivity. Many researchers reported that the application of magnetite. gradually increased plant growth parameters and yield and its components as well as chemical composition **Yasser *et al.*, (2011).**

Sugar factory lime (SL) is a byproduct obtained from the beet sugar industry at the stage of purification of raw juice by milk of lime and CO_2 gases and the main part of this byproduct consists of $CaCO_3$ containing up to 25.7 % of CaO, **(Abd El-Hamid *et al.*, 2011)** and contain organic acids (acetic acid and carbonic acid), 5Mg from sugar factory lime ≡ 1Mg gypsum reported by **(El-Morsy 2014).**

This work was conducted to deal with salinity and its effects on plant growth through different treatments of these the addition of sugar industry waste as soil amendments that have one of the most important practices for improving physical and chemical properties of their soils. And using vermicompost and magnetite (magnetic iron).

The main purpose of this work was:

1. Evaluate the (sugar lime + filter mud) application in combination with magnetite and organo-stimulant (vermicompost) on productivity of salt-affected clay soils.
2. Evaluate the effective role of applied (sugar lime + filter mud), magnetite and vermicompost as solely or combined treatments on the tolerance of wheat plants grown under a slight soil salinity condition.
3. Evaluate the studied amendments economically.

MATERIALS AND METHODS

The main purpose of this work was to improve wheat **(***Triticum aestivum L.* cv Bani-Suef 5**)**, its quality and alleviate the harmful impacts of salinity stress. To achieve the aforementioned target, a field experiment was carried out on salt-affected soil at Kom Abou-Khallad village, Nasser district, Bani-suef Governorate, Egypt during the winter season of 2014/2015. The suitability classes of the used drainage water as irrigation water from Baha drainage water. The chemical characteristics of irrigation water were carried out according to the described methods and suitability criteria for irrigation after **Page *et al.* (1982) and Ayers and Westcot (1985)**, respectively, as shown in Table (1).

Also, the chemical analysis of the used vermicompost**,** magnetite, sugar industry wastes and soil characteristics used were presented in Tables (2), (3) and (4) respectively. The experimental design was Randomized Complete Blocks Design (RCBD) with four replicates. The area of each soil plot was 10.5 m^2 (3.0 m width x 3.5 m length). Soil plots were plowed twice in two ways after received superphosphate fertilizer (15 % P_2O_5) at a rate of 15 kg fed^{-1} and 24 k.g K / fed^{-1} as potassium sulphate (48 % K_2O). nitrogen which applied at a rate of 90 k.g N/fed as ammonium sulphate (20.6 % N), in two equal doses during the growing period (after 25 and 45 days) from planting.

The applied treatments were as follows:

T_1 = Control
T_2 = Magnetite (100 k.g fed^{-1})
T_3 = Magnetite (150 k.g fed^{-1})
T_4 = Magnetite (200 k.g fed^{-1})
T_5 = Vermicompost (2.5 Mg fed^{-1})
T_6 = Vermicompost (3.3 Mg fed^{-1})
T_7 = Vermicompost (4 Mg fed^{-1})
T_8 = Filter Mud and Sugar Lime Mix (1:1) (6.7 Mg fed^{-1})
T_9 = Filter Mud and Sugar Lime Mix (1:1) (10 Mg fed^{-1})
T_{10} = Filter Mud and Sugar Lime Mix (1:1) (13.3 Mg fed^{-1})
T_{11} = Magnetite (100 k.g fed^{-1}) and Vermicompost (2.5 Mg fed^{-1})

T_{12} = Magnetite (100 k.g fed^{-1}) and Filter Mud and Sugar Lime Mix (1:1) (6.7 Mg fed^{-1})

T_{13} = Filter Mud and Sugar Lime Mix (1:1) (6.7 Mg fed^{-1}) and Vermicompost (2.5 Mg fed^{-1})

Table (1): Chemical properties of the irrigation water in Baha drainage.

pH	EC dSm^{-1}	Soluble ions (meq L^{-1})							SAR	*Irrigation water suitability
		Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{2-}		
7.65	2.08	3.59	3.11	13.07	0.31	3.23	10.73	6.14	7.12	C3S1

*According to **Ayers and Westcot (1985)** scale.*

Table (2): The main chemical characteristics and nutrients status of vermicompost.

Composition and characteristics	Value
Density (g cm^{-3})	0.82
pH (1: 5)	7.42
EC (1: 5) dS m^{-1}	3.78
Organic Carbon (%)	14.24
Organic matter (%)	24.55
C/N Ratio	11.17
Total Nitrogen (%)	1.69
Total Phosphorous (%)	0.65
Total Potassium (%)	0.87
Total micronutrients (mg k.g^{-1})	
Fe	570
Mn	127
Zn	93

Table (3): Some characteristics of sugar industry wastes.

Composition and characteristics	Sugar lime (S.L)	Filter mud (F.M)
Density (g cm^{-3})	0.74	0.14
SP (%)	70.0	310
$CaCO_3$ (%)	78.2	-----
pH (1: 5)	8.34	6.75
EC (1: 5) dS m^{-1}	1.65	5.07
Organic Carbon (%)	----	27.75
Organic matter (%)	4.42	47.84
C/N Ratio	----	12.50
Total nitrogen (%)	0.50	2.22
Total Phosphorous (%)	0.15	0.90
Total Potassium (%)	0.10	0.44
Total micronutrients (mg k.g^{-1})		
Fe	169	654
Mn	78	196
Zn	27	58

Magnetite **(**Magnetic iron) Al-Ahram for Mining company Magnetite (Magnetic iron), which contained 48.8% Fe_3O_4, 17.3% FeO, 26.7% Fe_2O_3, 2.6% MgO, 4.3% SiO_2 and 0.3% CaO, was obtained from "El-Ahram Company", El Talbia, Faisal St. area, El-Giza Governorate.

The Experimental soil was planted with a wheat grain (*Triticum aestivum L.* cv Bani-Suef 5) at 25 of November 2014 and harvested at maturity stage to determine the yields of grains and straw. Harvest of the wheat crop was done at 25 of April 2015 at harvest, the grains were separated from the vegetative part (straw) and straw wheat per plots was recorded as dry weight. The obtained straw and grain from 1.0 m^{-2} central area of all experimental plots were analyzed separately for N, P, and K.

Table (4): Some physical and chemical characteristics of the experimental soil.

Soil characteristics	Value	Soil characteristics	Value
Particle size distribution %		***Soluble cations (soil paste, m molcl^{-1})***	
Sand	**11.7**	Ca^{2+}	**15.65**
Silt	**25.8**	Mg^{2+}	**13.85**
Clay	**62.5**	Na^{+}	**47.79**
Textural class	**Clayey**	K^{+}	**0.67**
Soil chemical properties:		***Soluble anions (soil paste, m molcl^{-1})***	
Soil pH (soil paste)	**7.91**	CO_3^{2-}	**0.00**
ECe (dS/m. soil paste extract)	**7.79**	HCO_3^{-}	**4.15**
$CaCO_3$ %	**7.92**	Cl^{-}	**57.32**
Organic matter %	**1.61**	SO_4^{2-}	**16.49**
CEC cmolc k.g^{-1}	**37.56**	ESP %	**14.62**
Soil physical properties		***Available macronutrients (mg k.g^{-1})***	
P.D Mg m^{-3}	**2.70**	N	**25.46**
B.D Mg m^{-3}	**1.29**	P	**6.24**
T.P %	**52.22**	K	**221**
Moisture % (w/w)		***Available micronutrients (mg k.g^{-1})***	
Field capacity	**46.45**	Fe	**13.21**
Wilting point	**23.63**	Mn	**8.56**
Available water	**22.82**	Zn	**1.01**
Hydraulic conductivity cm h^{-1}	**0.15**	**Total soil N %**	**0.075**

Soil samples were collected from the surface layer (0-30 cm) before applying the treatments, then dried, crushed and sieved through a 2-mm screen. These samples were physico – chemical analyzed to measure the electrical conductivity (EC_e) and pH (**Jackson, 1973).** Particle size distribution and calcium carbonate were determined according to **(Piper, 1950).** Soil bulk density and total porosity according to **Black and Hartge, (1986).** Hydraulic conductivity and available water according to **Klute (1986).** Soil organic matter was determined according to Walkley-Black method **(Black et al., 1965).** Cation exchange capacity was determined by using the method of

(Richards, 1954). The physical and chemical analyses of the studied soil before cultivation are shown in Table (4). Also, plant samples (grain and straw) were taken after harvesting and digested to determine the contents of N, P, K, Fe, Mn and Zn according to **Cotteine *et al.*, (1982).** The data obtained of the tested plant characters were subjected to the statistical analysis according to **Snedecor and Cochran (1981)** to define the least significant difference test (L.S.D. at p=0.05 level), which was used to verify the differences between the tested treatments.

Results and Discussion

I- Response of some soil chemical and physical properties and available nutrient contents to the applied treatments:

a. Soil chemical properties as affected by treatments:

Presented data in Table (5) showed the response of some soil chemical properties i.e. pH, EC, ESP %, CEC and O.M % to the wheat treatments particularly those treated with the (T_{10} > T_{13} > T_7). Because of the combined effects of applied organic wastes (such as filter mud and vermicompost) and sugar lime treatments cause the noticeable reduction in the values of soil pH, EC, and ESP vs a pronounced increase in CEC and soil organic matter that could be interpreted as follows:

1- The released soluble Ca^{+2} ions partial substituted by exchangeable Na and leads from coagulates Na-separated clay particles leading to reduce ESP values. Such clay domains are coated with the released active organic acids and then form coarse sizes of water stable aggregates isolated or separated by conductive coarse pores. These pores accelerating leaching of a pronounced content of soluble salts and reducing the ECe value. These results took the same trend with **Ewees and Abdel Hafeez, (2010).**

2- Organic wastes the decomposition of (such as vermicomposting and filter mud) tends to produce active organic and inorganic acids that led to decrease soil pH. on the other hand, the applied organic wastes play an important role in reducing accumulation of salts in the experimental soil which reached to lowest value when soil was treated with T_{10}= filter mud + sugar lime (1:1) w/w (13.3 Mg fed^{-1}) and T_{13}= filter mud + sugar lime (1:1) (6.7 Mg fed^{-1}) + vermicompost (2.5 Mg fed^{-1}) and T_7= vermicompost (4 Mg fed^{-1}) where the EC_e value decreased to 4.21, 4.27, 4.29 dS m^{-1}, respectively as compared with control treatment 5.14.

Under such favorable conditions of soil salinity and sodicity the associated soil chemical properties i.e. organic matter, pH, ESP and CEC should be improved compared with control as shown in Table (6). These results are in harmony with those reported by **Osman and Ewees, (2008).**

As a general, the obtained results indicated that building up of salinity and sodicity in control treatment herein was due to the influence of water salinity in the absence of organic wastes (vermicompost and filter mud) and sugar lime (as a source of calcium). On basis of soil ECe and ESP values, soil salinity and sodicity were generally lower in case of amended treatments with organic wastes and sugar lime added solely or in combination vs a greater salinity and sodicity levels in the case of untreated soil (control). So, the sequence of the third best treatments superiority of the applied treatments under current experimental conditions could be arranged into a descending order: ($T_{10} > T_{13} > T_7$).

Table (5): The effect of treatments on some chemical properties of soil after wheat.

Treatment	pH	EC_e dS m^{-1}	ESP %	CEC $cmol_c$ $k.g^{-1}$	O.M %
Control	8.12	5.14	14.42	40.79	1.69
T_2	8.06	4.86	13.97	41.48	1.78
T_3	8.07	4.68	13.83	42.19	1.81
T_4	8.10	4.45	13.72	42.84	1.84
T_5	8.06	4.76	13.69	43.72	1.88
T_6	8.09	4.59	13.46	44.93	1.91
T_7	8.11	4.29	13.35	46.51	1.98
T_8	8.05	4.75	13.73	44.41	1.93
T_9	8.06	4.53	13.38	46.42	1.97
T_{10}	8.07	4.21	12.97	48.61	2.05
T_{11}	8.09	4.37	13.36	44.75	1.90
T_{12}	8.07	4.31	13.22	45.63	1.93
T_{13}	8.06	4.27	13.09	47.14	2.01
L.S.D. $_{0.05}$	0.005	0.065	0.093	0.558	0.024

T_1 = Control T_2 = Magnetite (100 k.g fed^{-1}) T_3 = Magnetite (150 k.g fed^{-1}) T_4 = Magnetite (200 k.g fed^{-1}) T_5 = V.C. (2.5 Mg fed^{-1}) T_6 = V.C. (3.3 Mg fed^{-1}) T_7 = V.C. (4 Mg fed^{-1}) T_8 = F.M + S.L (1:1) (6.7 Mg fed^{-1})	**T_9 = F.M + S.L (1:1) (10 Mg fed^{-1}) T_{10} = F.M + S.L (1:1) (13.3 Mg fed^{-1}) T_{11} = V.C. (2.5 Mg fed^{-1}) + Magnetite (100 k.g fed^{-1}) T_{12} = Magnetite (100 k.g fed^{-1}) + F.M + S.L (1:1) (6.7 Mg fed^{-1}) T_{13} = F.M + S.L (1:1) (6.7 Mg fed^{-1}) + V.C. (2.5 Mg fed^{-1})**	**pH = pH in soil saturated paste ECe= Electrical Conductivity in soil saturated paste extract ESP%= Exchangeable Sodium Percentage CEC = Cation Exchangeable Capacity O.M % = Organic Matter**

b. Soil physical properties as affected by treatments:

Concerning the variations in soil bulk density Table (6) among the different used amended treatments, data show that a gradual decrease in B.D values occurred with the treatment T_{10}= filter mud + sugar lime (1:1) w/w (13.3 Mg fed^{-1}) and T_{13}= filter mud + sugar lime (1:1) (6.7 Mg fed^{-1}) + vermicompost (2.5 Mg fed^{-1}) and T_7= vermicompost (4 Mg fed^{-1}) which gave lowest soil bulk density values (1.148 and 1.154 and 1.159 Mg m^{-3} respectively).

This effect could be attributed to the pronounced content of organic colloidal particles, which plays an important role in modifying distribution pattern of pore space in the soil. These findings are in agreement with those obtained by **Ewees and Abdel Hafeez, (2010).** However, the application of organic wastes specially filter mud and sugar lime (as a source of calcium) encouraged the creation of water stable soil aggregates and their inter-aggregates (useful ≈ strong pores) or outer-aggregates pores (conductive pores). Both pore types lead to ameliorating soil moisture regime through increasing the soil available water and hydraulic conductivity, which enhances leaching of more salts out the root zone and consequently reduce osmotic potential which results in an increase of available water range. These results are in agreement with those obtained by **Ewees and Osman, (2013).**

Table (6): The effect of treatments on some physical properties of the soil.

Treatment	Bulk Density (Mg m^{-3})	Total Porosity %	Hydraulic Conductivity mm h^{-1}	Field Capacity %	Wilting Point %	Available Water %
Control	1.228	54.52	0.19	50.32	26.20	24.12
T_2	1.196	55.70	0.28	51.73	26.52	25.21
T_3	1.187	56.04	0.31	52.45	26.47	25.98
T_4	1.183	56.19	0.34	52.81	26.02	26.79
T_5	1.180	56.30	0.33	54.03	26.67	27.36
T_6	1.169	56.70	0.41	55.11	26.96	28.15
T_7	1.159	57.07	0.46	55.98	27.19	28.79
T_8	1.175	56.48	0.36	54.21	26.58	27.63
T_9	1.163	56.93	0.42	55.37	27.11	28.26
T_{10}	1.148	57.48	0.49	58.31	28.65	29.66
T_{11}	1.172	56.59	0.39	55.94	27.67	28.27
T_{12}	1.170	56.67	0.41	56.36	27.83	28.53
T_{13}	1.154	57.26	0.47	57.77	28.32	29.45
L.S.D. $_{0.05}$	0.005	0.178	0.020	0.557	0.193	0.388

T_1 = Control T_2 = Magnetite (100 k.g fed^{-1}) T_3 = Magnetite (150 k.g fed^{-1}) T_4 = Magnetite (200 k.g fed^{-1}) T_5 = V.C. (2.5 Mg fed^{-1})	T_6 = V.C. (3.3 Mg fed^{-1}) T_7 = V.C. (4 Mg fed^{-1}) T_8 = F.M + S.L (1:1) (6.7 Mg fed^{-1}) T_9 = F.M + S.L (1:1) (10 Mg fed^{-1}) T_{10} = F.M + S.L (1:1) (13.3 Mg fed^{-1})	T_{11} = V.C. (2.5 Mg fed^{-1}) + Magnetite (100 k.g fed^{-1}) T_{12} = Magnetite (100 k.g fed^{-1}) + F.M + S.L (1:1) (6.7 Mg fed^{-1}) T_{13} = F.M + S.L (1:1) (6.7 Mg fed^{-1}) + V.C. (2.5 Mg fed^{-1})

Also, the above-mentioned case is more attributed to an increase in soil moisture content of field capacity, which is more dependent upon the modified soil structure, surpassed that occurred at the wilting point which is more affected by soil texture that is non-effected, and consequently a pronounced increase in soil available water range was achieved.

In addition, the promotive effect of organic amendments on soil total porosity of the studied soil may be due to the values of soil bulk density behaved the opposite trend with those obtained from total porosity.

Generally, the beneficial effects of the applied different treatments on the tested soil physical properties under wheat plants could be arranged in the following order:

For Bulk density ($T_{10}>T_{13}>T_7>T_9>T_6>T_{12}>T_{11}>T_8>T_5>T_4>T_3>T_2>T_1$).

For Total porosity ($T_{10}>T_{13}>T_7>T_9>T_6>T_{12}>T_{11}>T_8>T_5>T_4>T_3>T_2>T_1$).

For Hydraulic conductivity ($T_{10}>T_{13}>T_7>T_9>T_6>T_{12}>T_{11}>T_8>T_4>T_5>T_3>T_2>T_1$).

For Available water ($T_{10}>T_{13}>T_7>T_{12}>T_{11}>T_9>T_6>T_8>T_5>T_4>T_3>T_2>T_1$).

***c. Soil available macro and micronutrient contents as affected treatments*:**

The effects of organic wastes (such as vermicompost and filter mud) added as either solely or combined with sugar-lime to the experimental soil plots under cultivation with wheat crop caused a pronounced ameliorated effect in the soil content of some available macronutrient (i.e. N, P and K) and micronutrients (i.e. Fe, Mn, and Zn) as shown in Table (7).

Table (7): The effect of the studied treatments on available soil macronutrient and micronutrients after wheat.

Treatment	Total Soil N%	Available soil macronutrient (mg K.g^{-1})			Available soil micronutrient (mg K.g^{-1})		
		N	P	K	Fe	Mn	Zn
Control	0.081	31.87	8.21	239.55	16.51	7.33	1.09
T_2	0.083	33.26	9.16	243.07	17.02	7.54	1.14
T_3	0.085	34.96	9.90	245.74	17.87	7.86	1.17
T_4	0.086	36.03	10.50	251.35	18.30	8.07	1.21
T_5	0.088	39.69	11.28	281.58	18.61	8.29	1.23
T_6	0.090	43.54	12.11	289.30	20.33	8.83	1.30
T_7	0.092	46.64	13.56	302.77	21.07	9.14	1.34
T_8	0.089	40.61	11.64	288.52	18.63	8.47	1.25
T_9	0.091	45.21	13.04	307.57	20.85	8.96	1.32
T_{10}	0.094	48.91	14.93	318.35	21.53	9.67	1.39
T_{11}	0.090	43.77	13.06	294.17	18.98	8.43	1.30
T_{12}	0.091	44.10	13.15	296.24	19.53	8.67	1.31
T_{13}	0.093	47.13	14.24	313.33	21.25	9.36	1.37
L.S.D. $_{0.05}$	0.001	1.325	0.479	6.629	0.388	0.175	0.022

T_1 = Control
T_2 = Magnetite (100 k.g fed^{-1})
T_3 = Magnetite (150 k.g fed^{-1})
T_4 = Magnetite (200 k.g fed^{-1})
T_5 = V.C. (2.5 Mg fed^{-1})
T_6 = V.C. (3.3 Mg fed^{-1})
T_7 = V.C. (4 Mg fed^{-1})
T_8 = F.M + S.L (1:1) (6.7 Mg fed^{-1})
T_9 = F.M + S.L (1:1) (10 Mg fed^{-1})
T_{10} = F.M + S.L (1:1) (13.3 Mg fed^{-1})
T_{11} = V.C. (2.5 Mg fed^{-1}) + Magnetite (100 k.g fed^{-1})
T_{12} = Magnetite (100 k.g fed^{-1}) + F.M + S.L (1:1) (6.7 Mg fed^{-1})
T_{13} = F.M + S.L (1:1) (6.7 Mg fed^{-1}) + V.C. (2.5 Mg fed^{-1})

The data showed that a significant increase in the amount of available macronutrients and micronutrients upon treating the soil with organic wastes in combination with sugar-lime particularly T_{10}, T_{13} and T_7 as compared with other treatments the these best treatments were ($T_{10} > T_{13} > T_7$). In general, the increase in available nutrient contents may be attributed to the pronounced decreases in the values of soil EC and ESP vs the favourable amelioration in soil biological conditions that encouraging the released of available nutrients from soil native sources as well as easily mobility towards plant roots, and in turn their uptake by plants. These findings are also in agreement with **Ewees and El-Sowfy, (2013).**

In general, the relative increase in available nutrient contents may be attributed to the modified suitable air-moisture regime that control the availability of nutrients, besides the applied organic compost leads to alleviate the depressive effect of salinity stress on the released nutrient from either organic residues or nutrient bearing minerals.

It was also observed that, data in Table (7) indicated that the superiority of combined effects of application T_{10}= filter mud + sugar lime (1:1) w/w (133 Mg fed^{-1}) treatments for the noticeable reduction in the values of soil ECe and ESP vs a pronounced increase in soil organic matter content, CEC and soil available nutrient contents and biological conditions that enhancing nutrients uptake by plants.

II-Influence of applied treatments on grain and straw yields of wheat plants:

The obtained data in Table (8) showed a positive effect of all treatments on grain and straw yields of wheat plants and the greatest values were achieved by plants grown on soil treated with (T_{10}). Meanwhile, the lowest values were recorded at the control treatment. The results can be explained on the basis that the organic wastes treated soil plots became enriched in the release nutrient contents, especially those of micronutrients, which are involved directly or indirectly in the formation of starch, protein, and biological components through their roles in the respiratory and photosynthesis mechanisms as well as in the activity of various enzymes **(Nassar *et. al.*, 2002).**

In addition, the aforementioned results came to a conclusion that the applied treatments, which those include organic wastes and sugar lime (especially T_{10}, $T_{13,}$ and T_7) led to improve soil physio-chemical, hydrological and biological characteristic, and also the fertility status. Such positively effects are reflected in soil productivity and returned on increasing the biological nutrients uptake by wheat plant and then increasing wheat grain yield and straw (Table 8). Also, the applied organic wastes (especially vermicompost and filter mud) are enrichments in both organic and mineral substance essential to plant growth and activating the biochemical processes in plants, i.e. respiration, photosynthesis, and chlorophyll content, which increased the grain quantity of wheat.

From the above- mentioned results the sequence of the superiority for the applied treatments under the current experimental conditions could be arranged into the following order:

For wheat grain: ($T_{10} > T_{13} > T_7 > T_{12} > T_{11} > T_9 > T_6 > T_4 > T_8 > T_5 > T_3 > T_2 > T_1$).
For wheat straw: ($T_{10} > T_{13} > T_7 > T_{12} > T_{11} > T_9 > T_6 > T_4 > T_8 > T_3 > T_5 > T_2 > T_1$).

Table (8): The effect of the studied treatments on grain and straw yields of wheat plants.

Treatment	Wheat Grain (Mg Fed^{-1})	Wheat Grain (Ardeb Fed^{-1})	Wheat Straw (Mg Fed^{-1})
Control	**2.355**	**15.70**	**3.970**
T_2	**2.772**	**18.48**	**4.414**
T_3	**2.856**	**19.04**	**4.541**
T_4	**2.998**	**19.99**	**4.762**
T_5	**2.877**	**19.18**	**4.535**
T_6	**3.121**	**20.81**	**4.972**
T_7	**3.338**	**22.25**	**5.305**
T_8	**2.918**	**19.45**	**4.671**
T_9	**3.166**	**21.11**	**5.036**
T_{10}	**3.373**	**22.49**	**5.369**
T_{11}	**3.206**	**21.37**	**5.099**
T_{12}	**3.215**	**21.43**	**5.114**
T_{13}	**3.351**	**22.34**	**5.339**
L.S.D. $_{0.05}$	**0.068**	**0.455**	**0.099**

T_1 = Control
T_2 = Magnetite (100 k.g fed^{-1})
T_3 = Magnetite (150 k.g fed^{-1})
T_4 = Magnetite (200 k.g fed^{-1})
T_5 = V.C. (2.5 Mg fed^{-1})
T_6 = V.C. (3.3 Mg fed^{-1})
T_7 = V.C. (4 Mg fed^{-1})
T_8 = F.M + S.L (1:1) (6.7 Mg fed^{-1})
T_9 = F.M + S.L (1:1) (10 Mg fed^{-1})
T_{10} = F.M + S.L (1:1) (13.3 Mg fed^{-1})
T_{11} = V.C. (2.5 Mg fed^{-1}) + Magnetite (100 k.g fed^{-1})
T_{12} = Magnetite (100 k.g fed^{-1}) + F.M + S.L (1:1) (6.7 Mg fed^{-1})
T_{13} = F.M + S.L (1:1) (6.7 Mg fed^{-1}) + V.C. (2.5 Mg fed^{-1})
Ardeb wheat grain = 150 k. g

III-Plant nutrient contents as affected by treatments:

Data of Tables (9 and 10) represent concentrations of macronutrients and micronutrients (N, P, K, Fe, Mn, and Zn) in grain and straw of wheat plants. The obtained results exhibited pronounced increases due to the applied combined treatments that contain organic wastes and sugar lime compared to the control. So, the superiority of applied treatments attained organic wastes plus sugar lime (especially T_{10} and T_{13}) could be attributed to enrichment this waste in the organic substance that ameliorates soil moisture regime and biological soil conditions, which have the ability to reserve the released nutrients as a storehouse in available forms to uptake by wheat plants roots.

Also, such treatments had a great extent favourable effect on the mobilization of the released nutrients as compared to the organic wastes or sugar lime treatments alone. This beneficial effect could be explained by many aspects i.e., increasing the released either macro or micro nutrient contents through the decomposition of applied organic wastes (filter mud and vermicompost), reduction of nutrient fixation and forming the stable complex of micronutrients–humic substances supplied from such wastes and keeping them in available forms for extended period **(Shanmugam and Veeraputharn, 2001).** Moreover, the organic matter treated soil is characterized by nutrients slow release during organic material decomposition and mineralization process **(Ewees and Abdel Hafeez, 2010).**

Thus, the above-mentioned results are also in harmony with many various benefits of organic wastes which have been reported to promote an increase nutrient uptake and stimulate plant growth. however, it promotes plant growth by its effect on ion transfer at the root level by activating the oxidation-reduction state of the plant growth medium and so increased absorption of nutrients, especially micronutrients, by preventing precipitation in the in the nutrient solution.

In addition, it enhances cell permeability, which in turn made for a more rapid entry of nutrient into root cells and so resulted in higher uptake of plant nutrients. This effect was associated with the function of hydroxyls and carboxyls in these compounds. The principal physiological function of organic waste maybe that they reduce oxygen deficiency in plants, which results in better uptake nutrients **(Humax, 2006).**

The combined treatment of F.M + S.L (1:1) W/W (13.3 Mg fed^{-1}) and F.M + S.L (1:1) W/W (6.7 Mg fed^{-1}) plus vermicompost (2.5 Mg fed^{-1}) and vermicompost (4 Mg fed^{-1}) exhibited a superior attributed to their ability on improving soil physio-chemical properties.

The nutrients contents in grain and straw of wheat plant could be arranged in the following order:

Macronutrients:

For grain: ($T_{10} > T_{13} > T_7 > T_9 > T_6 > T_{12} > T_{11} > T_8 > T_5 > T_4 > T_3 > T_2 > T_1$).

For straw: ($T_{10} > T_{13} > T_7 > T_9 > T_6 > T_{12} > T_{11} > T_8 > T_5 > T_4 > T_3 > T_2 > T_1$).

Micronutrients:

For grain: ($T_{10} > T_{13} > T_7 > T_9 > T_6 > T_{12} > T_{11} > T_5 > T_8 > T_4 > T_3 > T_2 > T_1$).

For straw: ($T_{10} > T_{13} > T_7 > T_9 > T_6 > T_{12} > T_{11} > T_8 > T_5 > T_4 > T_3 > T_2 > T_1$).

Table (9): The effect of the studied treatments on the concentration of macronutrients and micronutrients in wheat grain.

Treatment	Dry yield (Mg Fed^{-1})	Conc. of macronutrients %			Conc. of micronutrients mg $k.g^{-1}$		
		N	P	K	Fe	Mn	Zn
Control	2.049	2.01	0.21	0.22	311.33	35.51	15.81
T_2	2.412	2.09	0.24	0.28	325.13	37.07	16.71
T_3	2.485	2.10	0.26	0.29	346.56	40.21	17.75
T_4	2.608	2.11	0.27	0.28	344.25	42.48	18.59
T_5	2.503	2.19	0.29	0.30	384.42	46.14	18.86
T_6	2.715	2.32	0.30	0.30	394.69	47.06	19.13
T_7	2.904	2.37	0.31	0.31	391.49	48.86	19.52
T_8	2.539	2.22	0.30	0.30	377.36	45.30	19.22
T_9	2.754	2.32	0.31	0.30	389.74	47.89	19.46
T_{10}	2.935	2.42	0.33	0.33	405.21	50.37	20.17
T_{11}	2.789	2.20	0.28	0.28	364.83	43.81	18.97
T_{12}	2.797	2.24	0.29	0.29	373.46	44.90	19.06
T_{13}	2.915	2.37	0.31	0.31	398.89	49.53	19.86
L.S.D. $_{0.05}$	0.059	0.027	0.006	0.003	6.47	0.995	0.24

T_1 = Control; T_2 = Magnetite (100 k.g fed^{-1}); T_3 = Magnetite (150 k.g fed^{-1}); T_4 = Magnetite (200 k.g fed^{-1}); T_5 = V.C. (2.5 Mg fed^{-1}); T_6 = V.C. (3.3 Mg fed^{-1}); T_7 = V.C. (4 Mg fed^{-1}); T_8 = F.M + S.L (1:1) (6.7 Mg fed^{-1}); T_9 = F.M + S.L (1:1) (10 Mg fed^{-1}); T_{10} = F.M + S.L (1:1) (13.3 Mg fed^{-1}); T_{11} = V.C. (2.5 Mg fed^{-1}) + Magnetite (100 k.g fed^{-1}); T_{12} = Magnetite (100 k.g fed^{-1}) + F.M + S.L (1:1) (6.7 Mg fed^{-1}); T_{13} = F.M + S.L (1:1) (6.7 Mg fed^{-1}) + V.C. (2.5 Mg fed^{-1})

Table (10): The effect of the studied treatments on the concentration of macronutrients and micronutrients in wheat straw.

Treatment	Dry yield (Mg Fed^{-1})	Conc. Macronutrients %			Conc. Micronutrients mg $k.g^{-1}$		
		N	P	K	Fe	Mn	Zn
Control	3.732	0.42	0.14	0.37	232.5	84.0	13.7
T_2	4.149	0.59	0.15	0.44	325.5	87.0	16.4
T_3	4.269	0.61	0.16	0.46	351.0	91.5	17.1
T_4	4.476	0.63	0.17	0.47	361.5	94.5	17.2
T_5	4.263	0.66	0.17	0.50	352.5	99.0	18.5
T_6	4.674	0.68	0.18	0.52	366.0	100.5	19.9
T_7	4.987	0.71	0.19	0.54	397.5	102.0	20.3
T_8	4.391	0.65	0.17	0.50	361.5	99.0	18.4
T_9	4.734	0.71	0.18	0.55	396.0	102.0	20.3
T_{10}	5.047	0.73	0.19	0.56	406.5	103.5	20.6
T_{11}	4.793	0.65	0.17	0.50	360.0	97.5	18.8
T_{12}	4.807	0.67	0.18	0.51	372.0	100.5	18.9
T_{13}	5.019	0.73	0.19	0.55	406.5	102.0	20.4
L.S.D. $_{0.05}$	0.093	0.019	0.004	0.013	10.76	1.46	0.473

T_1 = Control; T_2 = Magnetite (100 k.g fed^{-1}); T_3 = Magnetite (150 k.g fed^{-1}); T_4 = Magnetite (200 k.g fed^{-1}); T_5 = V.C. (2.5 Mg fed^{-1}); T_6 = V.C. (3.3 Mg fed^{-1}); T_7 = V.C. (4 Mg fed^{-1}); T_8 = F.M + S.L (1:1) (6.7 Mg fed^{-1}); T_9 = F.M + S.L (1:1) (10 Mg fed^{-1}); T_{10} = F.M + S.L (1:1) (13.3 Mg fed^{-1}); T_{11} = V.C. (2.5 Mg fed^{-1}) + Magnetite (100 k.g fed^{-1}); T_{12} = Magnetite (100 k.g fed^{-1}) + F.M + S.L (1:1) (6.7 Mg fed^{-1}); T_{13} = F.M + S.L (1:1) (6.7 Mg fed^{-1}) + V.C. (2.5 Mg fed^{-1})

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تأثير إنتاجية القمح في الاراضى المتوسطة الملوحة عند إستخدام الفيرموكمبوست والماجنتيت ومخلفات مصانع السكر

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الهدف الرئيسى لهذه الدراسة هو تقييم إستخدام بعض المصلحات العضوية [الفيرموكمبوست ومخلفات مصانع السكر(خليط من طين المرشحات وجير السكر ١: ١ وزن / وزن)] بالإضافة الى استخدام الماجنتيت (الحديد المغناطيسي) لتقليل التأثيرات الضارة الناجمة عن ملوحة مياه الرى على محصول القمح وجودته وعلاقة ذلك بتحسين بعض خواص التربة الطينية وكذلك تدعيم التكنيك المستحدث "الزراعة العضوية ولتحقيق هذا الهدف أجريت تجربة حقلية بقرية كوم أبو خلاد، مركزناصر، محافظة بنى سويف، جمهورية مصر العربية خلال الموسم الشتوي لعام٢٠١٥/٢٠١٤. وقد أستخدم مياه الصرف الزراعى (C3S1, ECiw = 2.08 dS/m and SAR = 7.12) كمصدر لرى أرض التجربة تحت نظام الرى.

وكانت معاملات التجربة الحقلية كالتالى:

١. الكنترول
٢. الماجنتيت (١٠٠ كجم/فدان)
٣. الماجنتيت (١٥٠ كجم/فدان)
٤. الماجنتيت (٢٠٠ كجم/فدان)
٥. الفيرموكمبوست (٢.٥ طن/فدان)
٦. الفيرموكمبوست (٣.٣ طن/فدان)
٧. الفيرموكمبوست (٤ طن/فدان)
٨. خليط من طين المرشحات وجير السكر ١: ١ وزن / وزن (٦.٧ طن/فدان)
٩. خليط من طين المرشحات وجير السكر ١: ١ وزن / وزن (١٠ طن/فدان)
١٠. خليط من طين المرشحات وجير السكر ١: ١ وزن / وزن (١٣.٣ طن/فدان)
١١. الماجنتيت (١٠٠ كجم/فدان) + الفيرموكمبوست (٢.٥ طن/فدان)
١٢. الماجنتيت (١٠٠ كجم/فدان) + خليط من طين المرشحات وجير السكر ١: ١ وزن / وزن (٦.٧ طن/فدان)
١٣. خليط من طين المرشحات وجير السكر ١: ١ وزن / وزن (٦.٧ طن/فدان) + الفيرموكمبوست (٢.٥ طن/فدان)

وقد تم إضافه هذه المعاملات مرة واحد قبل بدأ التجربة في القطع التجريبية كل على حده

من النتائج التي تم الحصول عليها من هذه التجربة يمكن إستنتاج أن:

١. أدت إضافة الماجنتيت (الحديد المغناطيسي، الفيرموكمبوست، مخلفات مصانع السكر الى تحسين الخواص الكيميائية والطبيعية للأراضى المتأثرة بالأملاح .

٢. أوضحت النتائج أن المعاملة (T_{10} = خليط من طين المرشحات وجير السكر ١: ١ وزن / وزن ١٣.٣ طن/فدان)، قد نتج عنها الانخفاض الأعلى في قيم الكثافة الظاهرية و التوصيل الكهربائي (EC) ونسبة الصوديوم المتبادل (ESP)، وعلى العكس زيادة كل من محتوى التربة من المادة العضوية و السعة التبادلية الكاتيونية (CEC) مما أدى إلى تحسين الخصائص الكيميائية للأراضى المتأثرة بالأملاح. بالإضافه الى زيادة كبيرة في المسامية الكلية و التوصيل الهيدروليكي، التي تجعل من السهل التخلص من الأملاح.

٣. أعطت المعاملة (T_{10} = خليط من طين المرشحات وجير السكر ١: ١ وزن / وزن ١٣.٣ طن/فدان (أعلى زيادة معنوية في محصول القمح).

٤. أوضحت النتائج أن أفضل ثلاث معاملات عمليا وإقتصاديا للتجربة الحقلية كانت على T_7, T_{13}, T_{10} حيث بلغت قيم الزيادة (٧٩.٣٤، ٦٦.٩١ ، ٦٥.٢٠) % مقارنة مع معاملة الكنترول.