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The Use of A Three-Factor Computer Program in The Evaluation of Compost, Farmyard Manure and Sheep Manure and Its Impacts on some Soil Chemical Properties.

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ABSTRACT

Two field experiments were conducted on clayey soil during the two seasons (winter 2017/2018 using wheat and summer 2018 using maize) at El-Gemmeiza Agricultural Research Station, El-Gharbia Governorate to evaluate some natural organic amendments on improving some soil chemical properties and macronutrients status (N PK) and their availability for plants. Furthermore, economical analysis was done to determine the economical treatment. The experiments were designed in a randomized complete block design with three replicates. Thirteen treatments having different compost, farmyard manure and sheep manure were used to cover all possible combinations as well as control (without any addition). The results were shown in a triangle diagram using a special computer program. Results can be summarized as follows: All treatments play a positive role on reducing soil pH, soluble Na, SAR values, Ex Na and ESP and progressive increasing in soil EC, soluble cations and anions, total soluble salts, O.C, C/N ratio and significantly increases in Ex Ca, Mg, K and CEC at the two soil depths (0-20 and 20-40 cm) in the two seasons compared with the control and clearly enhanced total macronutrients status of the investigated soil. Economical analysis indicate that the highest net income value (11960.06LE Fed^{-1}) was incorporated with combination consists of 50% C and 50% Sh. Therefore, it is more useful to use those treatments (compost, FYM and sheep manure) and their combination to get a markedly improve in both chemical properties and macronutrients, which reflect on plants growth incorporated with high net revenue.

***Keywords**:* Compost, farmyard manure, sheep manure and soil chemical properties.

INTRODUCTION

Low soil fertility due to monoculture cereal production systems, inadequate fertiliszer application, biomass removal, soil erosion, nutrient losses through runoff and leaching are recognised as some of the major causes for declining crop production in developing countries Negassa *et al.* (2007). Moyin-Jesu and Ogochukwu (2014) also reported that the organic materials applied have beneficial residual effects on soil properties which are in line with growing concern of using environment friendly fertilizer. Bhatt *et al.* (2019) showed that improvement and maintenance of soil fertility and sustaining crop production are of worldwide importance.

Changes in fertility are caused by several factors including imbalanced fertilizer use, acidification, alkalinity and decline in soil organic matter, intensive cropping system. Oladele *et al.* (2019) found that combination of biochar and N fertilizer increased soil fertility and chemical status such as N, P, K, Ca, CEC in the top 10 cm depth of the soil. Ojha *et al.* (2014) reported that soil properties like pH, EC, organic carbon are mostly influenced by application of 21 t ha^{-1} FYM. Least change in pH observed in residual level 10.5 t ha^{-1} of FYM. Mahmoud *et al.* (2009) found that the compost of plant residues was higher in saturation percent, lower in C/N ratio, pH and EC increased, accumulation of organic C, N and P more than application of N mineral fertilizers, but compost combined with application of N mineral fertilizers was the best management system for increasing soil fertility, and decrease the cost of N mineral fertilizers. Atere and Olayinka (2012) reported that the mean values of soil pH and available P for the two plantings were significantly ($p<0.05$) higher in both water hyacinth compost and water hyacinth compost + N and P than the control. The mean values of exchangeable cations (Na, Ca and Mg) were also significantly higher in water hyacinth compost than the control. Water hyacinth composted with N and P was a better source of nutrients for soybean production than their individual applications. Moyin-Jesu (2015) showed that the use of the various organic fertilizers (poultry manure, wood ash and rice bran) increased soil N, P, K, Ca, Mg, and O.M contents compared to control. According to Sarwar *et al.* (2008) the increase in Ca and Mg with compost application could be due to the reaction of organic acids with $CaCO_3$ and Mg salts, the increase could also be from the addition of Ca from the compost itself as it has high content of Ca. Martí *et al.* (2016) suggested that pig manure and compost increased the organic matter content, soil levels of phosphorous and potassium and microbial activity. It also improved the mineralization processes of carbon and nitrogen, as well as some enzymatic functions and crop yield. Furthermore, the application of either compost, or pig manure, was associated with human health risks due to heavy metal exposure. Wapa and Sodangi (2017) reported

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that cow dung and poultry droppings either singly or in combination with mineral nitrogen fertilizer significantly improved soil pH, total nitrogen organic carbon content, CEC, organic matter fractions and increased maize yield. Asap *et al*. (2018) reported that soil pH, total P, available P and water soluble P increased in treatments with 75% and 50%, of 5 t h^{-1} biochar. Also, the chicken litter biochar increased soil CEC and exchangeable cations (K, Ca, Mg and Na) by using of 75% and 50% of 5 t ha^{-1}. Pratap *et al.* (2016) suggested that soil chemical properties viz. EC, organic carbon and available NPK showed a significant change, the pH values showed gradually decreases with increase farmyard manure application. Bouajila and Sanaa (2011) reported that application of farmyard manure and household wastes compost resulted in significant increase of organic carbon, with the compost treatment being the most efficient. Their result showed that the application of household wastes compost and farmyard manure improved an organic carbon (1.74% and 1.09%, respectively) compared with control (0.69%). Tordoff *et al*. (2000), Mendez and Maier (2008) obtained that the use of organic amendments can improve the soil structure, water holding capacity (WHC), CEC and nutrient status, which encourage the reestablishment of the vegetation cover on contaminated sites and reduces surface erosion. Hafidi *et al*. (2012) reported that integrated use of crop residue mixed farmyard manure and inorganic sources of nutrients along with bio fertilizers proved better untried management option for higher yield, soil health and net returns from maize-wheat cropping system. Rizk *et al.* (2016) recorded that soil pH values were decreased with all treatments, while the reverse trend was observed for electrical conductivity, cation exchange capacity and soluble ions. The available nutrients were significantly increased with sheep manure application of all treatments. Abdel-Fattah (2012) showed that all treatments decreased soil EC, pH, SAR, and ESP compared with control. Rice straw compost showed a relatively greater effect on reducing EC, pH, SAR and ESP compared with water hyacinth compost. El-Maddah *et al*. (2015) and El-Sodany *et al*. (2016) obtained that the addition of some organic soil amendments, i.e., farmyard manure, sheep manure, rabbit manure and pigeon manure, alone and their combinations led to slightly decreased soil pH and progressive increased soil salinity (EC). Also, soluble cations and anions slightly increased except soluble Na, Ex. Na and ESP decreased. On the other hand, TSS, Exchangeable Ca, Mg, K, CEC, organic carbon and C/N ratio were increased with all added amendments compared with the control. Mahmood *et al*. (2017) showed that manure efficacy regarding morphological indices of maize was found as poultry manure > sheep manure > farmyard manure when applied with chemical fertilizers. Further, C: N ratio, soil organic carbon and total NPK increased, while soil pH was decreased with the integrative application of organic manures with chemical fertilizer application. Hence, organic manures can be applied with chemical fertilizers in organic carbon depleted arable soils to improve soil properties and crop productivity. Dhaka *et al*. (2012) integrated nutrient management involves the integrated use of mineral fertilizers together with organic manure in suitable combination compliments and each other to optimize input use and maximize production and sustain the same without impairing the crop quality or soil health. It enables gainful utilization of organic wastes.

Therefore, this study was carried out to evaluate the effects of some natural organic enhancements on improving some soil chemical properties. Furthermore, economical analysis was done by calculating the net revenue to determine the economical treatment.

MATERIALS AND METHODS

Two field experiments were conducted at El-Gemmeiza Agricultural Research Station, El-Gharbia Governorate during the two consecutive growing seasons (winter season 2017/2018 using wheat plants and summer season 2018 using maize plants) to study the effects of compost, farmyard manure and sheep manure on improving some soil chemical properties and the status of macronutrients (N, P and K) and their availability for plants. Some soil chemical properties of the experimental soil before planting in the first and second seasons are presented in Table (1-a) and analysis results of the used natural soil amendments are shown in Table (1-b).

Table 1-a. Initial physical and chemical properties of the used soil in the first and second seasons.

Properties		First season		Second season		Properties		First season		Second season	
Soil depth, cm		0-20	20-40	0-20	20-40	Soil depth, cm		0-20	20-40	0-20	20-40
Particle size distribution, %	Coarse sand	3.32	3.21	3.32	3.21	Organic matter (O.M., %)		2.72	2.32	2.74	2.36
	Fine sand	15.26	15.12	15.26	15.12	Organic carbon (O.C., %)		1.578	1.348	1.591	1.371
	Silt	34.23	33.86	34.23	33.86	Total nitrogen (T.N., %)		0.145	0.129	0.146	0.133
	Clay	47.19	47.81	47.19	47.81	C/N ratio		10.88	10.45	10.9	10.31
Texture class		Clayey	Clayey	Clayey	Clayey	Total P (T.P., %)		0.03	0.028	0.029	0.029
Soil pH, 1:2.5 (suspension)		7.76	7.87	7.73	7.83	Total K (T.K., %)		0.383	0.378	0.406	0.413
Soil EC, dSm^{-1}		2.53	2.84	2.61	2.96	Exchangeable cations (meq / 100 g soil)	Ca	22.73	22.27	22.77	22.55
Soluble ions, meq l^{-1}	Ca^{++}	7.18	7.79	7.32	7.97		Mg	16.14	16.31	16.32	16.42
	Mg^{++}	5.84	6.72	6.19	6.99		Na	4.4	4.49	4.57	4.64
	Na^{+}	12.08	13.71	12.36	14.43		K	1.34	1.5	1.25	1.38
	K^{+}	0.24	0.21	0.24	0.22	CEC (meq / 100 g soil)		44.61	44.57	44.91	44.99
	HCO_3^{-}	4.22	4.44	4.89	5.19	TSS, %		0.12	0.13	0.13	0.14
	CL^{-}	11.79	13.06	12.02	13.6	SAR		4.73	5.09	4.76	5.28
	SO_4^{--}	9.33	10.93	9.2	10.82	ESP		9.86	10.07	10.18	10.31

Table 1-b. Some characteristics of different used organic amendments.

Properties	Compost ,C	Farmyard manure, FYM	Sheep manure, Sh
Density (g cm^{-3})	0.59	0.53	0.32
pH (1:10 manure: water)	7.39	7.42	7.15
EC, dS m^{-1}(1:10 manure:water)	3.19	1.34	7.92
Ca, %	0.84	0.98	2.26
Mg, %	0.29	0.4	2.44
Na, %	0.27	0.28	1.18
Available Fe, ppm	1215	36	26
Available Zn, ppm	83.15	20.55	5.7
Available Mn, ppm	72.8	51.83	3.85
Available Cu, ppm	31.25	10.63	6.95
Ash, %	66.33	70.08	65.78
Organic matter, %	33.67	29.92	34.22
Organic carbon, %	19.53	17.35	19.85
Total N, %	1.78	0.63	1.98
C/N ratio	10.97	27.54	10.03
Total P, %	0.95	0.041	0.82
Total K, %	1.6	0.514	2.042

*** Organic matter (O.M.) = Organic carbon (O.C.) X 1.724 (Waksman, 1952)**

The factors involved in this study were three factors, computer model Moussa (1991) using compost (X_1), farmyard manure (X_2) and sheep manure (X_3) respectively. The level of each factor amounts to 100% of its maximum value located on the heads of the triangle and decreases gradually when moving from the concerned head towards the opposite side at which the level reaches to zero.

The amounts of the added soil amendments were calculated on basis the total N% in each amendment, therefore the maximum rate of compost, farmyard manure and sheep manure were 4.213, 11.905 and 3.788 ton fed^{-1} in the first season and 6.742, 19.048 and 6.061 ton fed^{-1} in the second one, respectively. The triangle is divided into ten sections each denotes 10%, therefore the triangle consists of 66 intersection (combinations) cover all the possible combinations of compost, farmyard manure and sheep manure. Thirteen intersection treatments from the triangle were chosen to carry out those experiments, Table (1-c) and Figs. (1 and 2), beside the control (treatment No. 14) where no amendments were used.

Table (1-c) The chosen combinations of organic amendments.

Treatment No.	Relative fractional as unit			Amount of organic amendments, Ton fed^{-1}					
				First season			Second season		
	X_1	X_2	X_3	Compost ,C	Farmyard manure, FYM	Sheep manure , Sh	Compost ,C	Farmyard manure, FYM	Sheep manure, Sh
1	100	0	0	4.213	0.000	0.000	6.742	0.000	0.000
2	0	100	0	0.000	11.905	0.000	0.000	19.048	0.000
3	0	0	100	0.000	0.000	3.788	0.000	0.000	6.061
4	50	50	0	2.107	5.953	0.000	3.371	9.524	0.000
5	50	0	50	2.107	0.000	1.894	3.371	0.000	3.031
6	0	50	50	0.000	5.953	1.894	0.000	9.524	3.031
7	33.3	33.3	33.3	1.403	3.964	1.261	2.245	6.343	2.018
8	66.6	16.6	16.6	2.806	1.976	0.629	4.490	3.162	1.006
9	16.6	66.6	16.6	0.699	7.929	0.629	1.119	12.686	1.006
10	16.6	16.6	66.6	0.699	1.976	2.523	1.119	3.162	4.037
11	44.4	44.4	11.1	1.871	5.286	0.420	2.993	8.457	0.673
12	44.4	11.1	44.4	1.871	1.321	1.682	2.993	2.114	2.691
13	11.1	44.4	44.4	0.468	5.286	1.682	0.748	8.457	2.691

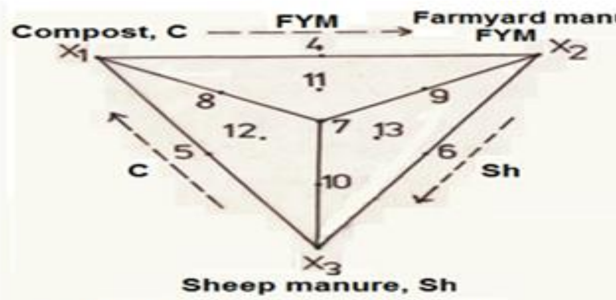

Fig. (1): Location of the thirteen chosen treatments on the triangle diagram

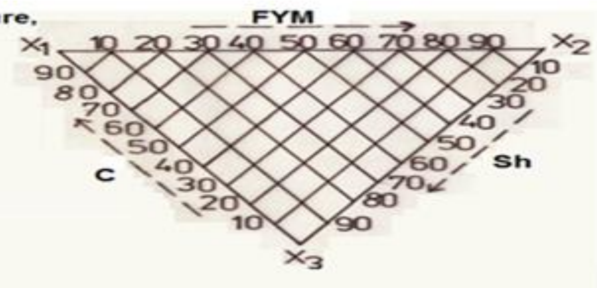

Fig. (2): Guide for the amendments combination of each point ton fed^{-1}

The plot area of the experiments was 42 m^2 (6 X 7 m) in a randomized complete block design with three replicates. The addition of soil amendments were added and homogenously mixed with the 0–20 cm surface layer before sowing in the first and second seasons. Wheat grains (Giza 168 variety) were planted on 16^{th} in the first season (2017/2018) at the rate of 60 Kg fed^{-1}, while maize grains (*Zea mays*, three-way cross, Giza 329) were planted on 7 th june in the second one (2018) at the rate of 15 Kg fed^{-1}. The normal cultural practices of El-Gemmeiza Research Station were adopted. The normal agricultural practices except those under study were carried out as usual for each crop according to the recommendations of El-Gemmeiza Research Station.

At harvesting of each growing season, soil samples (0-20 and 20-40 cm depths) were collected from each plot. The collected soil samples were air-dried, ground and passed through 2 mm sieve and stored for chemical analysis.

Soil pH in soil water suspension (1: 2.5) and soil electrical conductivity (EC, dSm^{-1}) in soil paste extract were measured. Soluble cations and anions were determined in soil paste extract using the methods described by Page *et al.* (1982).

Sodium Adsorption Ratio (SAR) was calculated as:

$$\text{SAR} = \frac{Na^{+}\ meql^{-1}}{\sqrt{\frac{Ca^{++} + Mg^{++}\ meql^{-1}}{2}}}$$

Total soluble salts, % were calculated according to the following equation:

$$\text{T.S.S., \%} = \frac{EC\ dSm^{-1} \times 0.064 \times SP}{100}$$

where: **SP = Saturation percentage**

Cation exchange capacity (CEC, meq 100g soil^{-1}) was determined using sodium acetate solution 1.0 N with pH 8.2, exchangeable cations (meq 100g soil^{-1}) were displaced using 1.0 N ammonium acetate solution. Exchangeable sodium percentage (ESP, %) was calculated according to the following equation:-

$$ESP,\ \% = \frac{Ex.\ Na\ meq100\ g.soil^{-1}}{CEC\ meq100\ g.soil^{-1}} \times 100$$

Organic matter was determined by Walkely and Black method according to Black (1965). Total NPK of the soil were determined according to Hesse (1971). Total nitrogen by macro-Kjeldahel method, total phosphorus calorimetrically using ascorbic acid and total potassium by flame photometer method.

Economic evaluation was done to compare between different treatments to state which one is the best. The test was executed according to the price of the yield (4000 LE ton^{-1}) of wheat grain and (1000 LE ton^{-1}) of wheat straw in the first season and (2105 LE ton^{-1}) maize grain in the second season, as well as the cost of different treatments including the price of the addition treatments and the price of labor they added, which was calculated considering conventional method of estimating both fixed and variable costs.

The collected data were passed through the computer program to receive results represented on the triangle at the same site of the concerned combined treatments. The maximum value will be represented by number 10 and printed in a place form which the combination treatment resulted, other figures will shown values related to the maximum one. Moreover, the computer output shows the average value, correlation coefficient, fisher criterion, coefficient determination, maximum and minimum values.

RESULTS AND DISCUSSION

1- Some Soil Chemical Properties Affecting by Different Addition of Soil Amendments.

1- Soil reaction (pH), Electrical Conductivity (EC), Soluble Cations and Anions.

The results in Tables (2and3) show that the applied organic soil amendments as individual or combined with others play a positive role on reducing soil pH and increasing in soil EC, soluble cations and anions at the two soil depths (0-20 and 20- 40cm) in the two seasons compared with the control. The lowest pH values were 7.49 and 7.56 decreased by 3.60 and 3.94% under the control at (0-20 and20- 40cm) soil depths, respectively in the first season and were 7.45 and 7.51 decreased by 3.75 and 4.21% at the two soil depths, respectively in the second season for the treatment consists of 50% C and 50% Sh. This may be due to the produced organic acids by decomposition of organic substances in the added amendments. These results revealed that there is no wide variation between the different treatments on soil pH values because the magnitude of pH change depends on many soil properties, including buffering capacity and length of time after the application of organic matter. Similar findings were also reported by Abdel- Fattah (2012), El- Maddah *et al* (2015) and El-Sodany *et al* (2016).

Concerning soil salinity data presented in Tables (2 and 3) showed that the different treatments gave different effects on (EC, dSm^{-1}), soluble cations and anions, sodium adsorption ratio (SAR) and total soluble salts (TSS) of the soil at the end of the two growing seasons at the two soil depths (0-20 and 20-40 cm). It could be concluded that soil EC values were increased in the two seasons compared with the control. The lowest EC values were (2.59, 2.92) and (2.67, 3.03 dSm^{-1}) slightly increased by (1.97, 2.46) and (1.91, 2.02%) over the control at the two soil depths in the two seasons, respectively which recorded by the treatment consists of 50% of both C and Sh, respectively. The highest EC values were (3.07, 3.47) and (3.16, 3.57 dSm^{-1}) at the two seasons, for the treatment consists by 1/3 of C, FYM and Sh, These increases in soil EC values over the control may be due to the high content of these amendments of available elements (Table 1-b). These results are in line with those reported by Mahmoud *et al.* (2009), Ojha *et al.* (2014) and Oladele *et al.* (2019).

From Fig. (3), it can be noticed that the highest EC value was 3.08 dSm^{-1} obtained by number 10 which consists of 40, 40 and 20% of C, FYM and Sh, respectively, while the lowest one was 2.59 dSm^{-1} for the treatment consists of 60% C and 40% Sh respectively. Also, the results indicate that the three single treatments (C, FYM and Sh) gave 80, 80 and 90% of the maximum EC values for every treatment, where they were 2.72, 2.75 and 2.84 dSm^{-1}, respectively, at the surface soil layer (0-20 cm) in the first season.

2- Sodium Adsorption Ratio (SAR) and Total Soluble Salts (TSS)

Data presented in Tables (2 and 3) show that SAR decreased with all experiment treatments compared with the control at (0-20 and 20- 40cm) soil depths in the two seasons. While, total soluble salts (TSS) were slightly increased, where the lowest SAR values were (3.61, 3.85) and (3.67, 4.09) decreased by (23.68, 24.20) and (22.90,22.54%) compared to the control at the two soil depths in the two seasons, respectively, these results reveal that the treatment consists of 50% C and 50% Sh led to decrease in SAR greater than the other treatments in the two seasons. These results are in agreement with those of Sarware *et al* (2008) they found that the increase in Ca^{++} and Mg^{++} with compost application could be attributed to the reaction of organic acids with $CaCO_3$ and Mg salts.

Table 2. Effect of different combinations of compost, farmyard manure and sheep manure on some soil chemical properties in the first season (winter 2017/2018).

Treatment No.	pH, 1:2.5 (susp.)	EC, dSm^{-1}	Cations, $meql^{-1}$				Anions, $meql^{-1}$			SAR	TSS, %
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{--}		
					0-20 cm						
1	7.57	2.72	8.64	7.36	10.91	0.28	3.70	13.10	10.40	3.86	0.14
2	7.58	2.75	8.68	7.38	11.17	0.28	3.79	13.28	10.44	3.94	0.14
3	7.61	2.84	9.10	7.54	11.52	0.29	3.93	13.58	10.93	3.99	0.14
4	7.64	2.92	9.36	7.77	11.73	0.32	3.97	13.67	11.54	4.01	0.15
5	7.49	2.59	8.40	7.18	10.07	0.25	4.01	12.19	9.69	3.61	0.12
6	7.52	2.65	8.44	7.23	10.56	0.27	3.93	12.53	10.03	3.77	0.13
7	7.66	3.07	9.75	8.15	12.45	0.34	4.72	13.93	12.04	4.16	0.16
8	7.54	2.69	8.51	7.36	10.75	0.27	3.75	12.98	10.16	3.82	0.13
9	7.53	2.67	8.49	7.31	10.68	0.27	3.70	12.77	10.28	3.80	0.13
10	7.56	2.70	8.62	7.31	10.82	0.28	4.30	12.77	9.97	3.83	0.14
11	7.63	2.88	9.11	7.76	11.60	0.30	3.79	13.51	11.46	3.99	0.15
12	7.60	2.78	8.70	7.45	11.32	0.28	3.85	13.11	10.81	3.98	0.14
13	7.50	2.61	8.33	7.14	10.35	0.26	3.88	12.39	9.81	3.72	0.13
Control	7.77	2.54	7.19	5.86	12.08	0.25	4.22	11.92	9.25	4.73	0.12
					20-40 cm						
1	7.65	3.09	9.68	8.45	12.48	0.26	3.95	14.53	12.39	4.15	0.15
2	7.66	3.11	9.68	8.60	12.58	0.26	4.15	14.53	12.44	4.16	0.15
3	7.70	3.20	10.10	8.59	13.03	0.27	4.29	14.82	12.89	4.26	0.16
4	7.73	3.32	10.50	8.93	13.47	0.31	4.25	15.30	13.66	4.32	0.17
5	7.56	2.92	9.43	8.15	11.42	0.23	4.32	13.29	11.62	3.85	0.14
6	7.60	3.01	9.54	8.24	12.03	0.25	4.12	13.86	12.08	4.04	0.15
7	7.74	3.47	10.78	9.43	14.12	0.32	4.73	15.87	14.05	4.44	0.18
8	7.62	3.04	9.55	8.32	12.25	0.26	3.97	14.31	12.09	4.10	0.15
9	7.61	3.03	9.57	8.30	12.14	0.26	3.89	14.17	12.21	4.06	0.15
10	7.63	3.05	9.55	8.34	12.35	0.26	4.53	14.06	11.90	4.13	0.15
11	7.71	3.24	10.15	8.76	13.25	0.28	4.07	15.25	13.12	4.31	0.16
12	7.68	3.16	9.79	8.77	12.79	0.27	4.21	14.65	12.77	4.20	0.16
13	7.58	2.95	9.53	8.10	11.63	0.23	4.11	13.52	11.87	3.92	0.14
Control	7.87	2.85	7.82	6.76	13.73	0.22	4.44	13.11	10.99	5.08	0.13

Table 3. Effect of different combinations compost, farmyard manure and sheep manure on some soil chemical properties in the second season (summer 2018).

Treatment No.	pH, 1:2.5 (susp.)	EC, dSm^{-1}	Cations, $meql^{-1}$				Anions, $meql^{-1}$			SAR	TSS, %
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{--}		
					0-20 cm						
1	7.54	2.79	8.74	7.50	11.41	0.27	4.32	12.60	11.01	4.00	0.14
2	7.54	2.80	8.80	7.41	11.53	0.27	4.19	12.66	11.16	4.05	0.14
3	7.60	2.90	8.95	7.87	11.90	0.27	4.14	13.49	11.36	4.10	0.15
4	7.62	3.00	9.33	7.95	12.46	0.30	4.12	14.19	11.74	4.24	0.16
5	7.45	2.67	8.67	7.35	10.40	0.25	4.58	11.72	10.37	3.67	0.13
6	7.48	2.72	8.78	7.43	10.76	0.25	4.44	11.86	10.92	3.78	0.13
7	7.63	3.16	9.70	8.59	12.94	0.33	4.05	15.82	11.69	4.28	0.16
8	7.50	2.75	8.58	7.53	11.08	0.26	4.34	12.43	10.68	3.91	0.14
9	7.49	2.73	8.67	7.42	10.94	0.26	4.40	12.48	10.42	3.86	0.14
10	7.51	2.77	8.65	7.49	11.28	0.26	4.34	12.41	10.94	3.97	0.14
11	7.61	2.91	8.97	7.77	12.06	0.28	4.13	13.49	11.46	4.17	0.15
12	7.56	2.85	8.87	7.69	11.71	0.27	4.18	13.08	11.28	4.07	0.15
13	7.46	2.70	8.78	7.43	10.52	0.25	4.55	11.68	10.75	3.69	0.13
Control	7.74	2.62	7.35	6.21	12.39	0.24	4.89	12.05	9.23	4.76	0.13
					20-40 cm						
1	7.59	3.20	9.88	8.61	13.26	0.26	4.68	14.83	12.50	4.36	0.16
2	7.61	3.23	10.00	8.58	13.41	0.27	4.64	14.64	12.99	4.40	0.16
3	7.67	3.26	9.80	8.68	13.81	0.28	4.52	15.28	12.77	4.54	0.16
4	7.69	3.44	10.34	9.11	14.65	0.31	4.50	16.41	13.50	4.70	0.18
5	7.51	3.03	9.43	8.42	12.22	0.23	5.01	13.68	11.61	4.09	0.15
6	7.54	3.11	9.71	8.60	12.55	0.25	4.79	13.65	12.67	4.15	0.15
7	7.70	3.57	10.86	9.47	15.08	0.33	4.43	18.09	13.22	4.73	0.18
8	7.56	3.15	9.64	8.64	12.94	0.25	4.72	14.38	12.37	4.28	0.15
9	7.55	3.13	9.66	8.57	12.79	0.25	4.73	13.95	12.59	4.24	0.15
10	7.57	3.17	9.73	8.66	13.09	0.26	4.68	14.36	12.70	4.31	0.16
11	7.68	3.34	10.06	8.76	14.25	0.29	4.51	15.96	12.89	4.65	0.17
12	7.62	3.24	9.88	8.63	13.63	0.27	4.53	15.03	12.85	4.48	0.16
13	7.53	3.08	9.58	8.55	12.40	0.23	4.85	13.40	12.51	4.12	0.15

Data illustrated in Fig (4) show that the highest SAR value was 4.18 obtained by number 10 from the treatment consisting of 40,40 and 20% of C, FYM, Sh, respectively at (0-20cm) soil depth in the first season, while the three single treatments gave 90% of the maximum SAR values for every treatment equal to 3.86, 3.94 and 3.99 for C, FYM and Sh, respectively at surface soil layer (0-20cm) in the first season, these results observed that the single C treatment was greater than both the single FYM and the single Sh treatment on decreasing SAR. Similar results were obtained by Abdel-Fattah (2012) and Pratap *et al*. (2016).

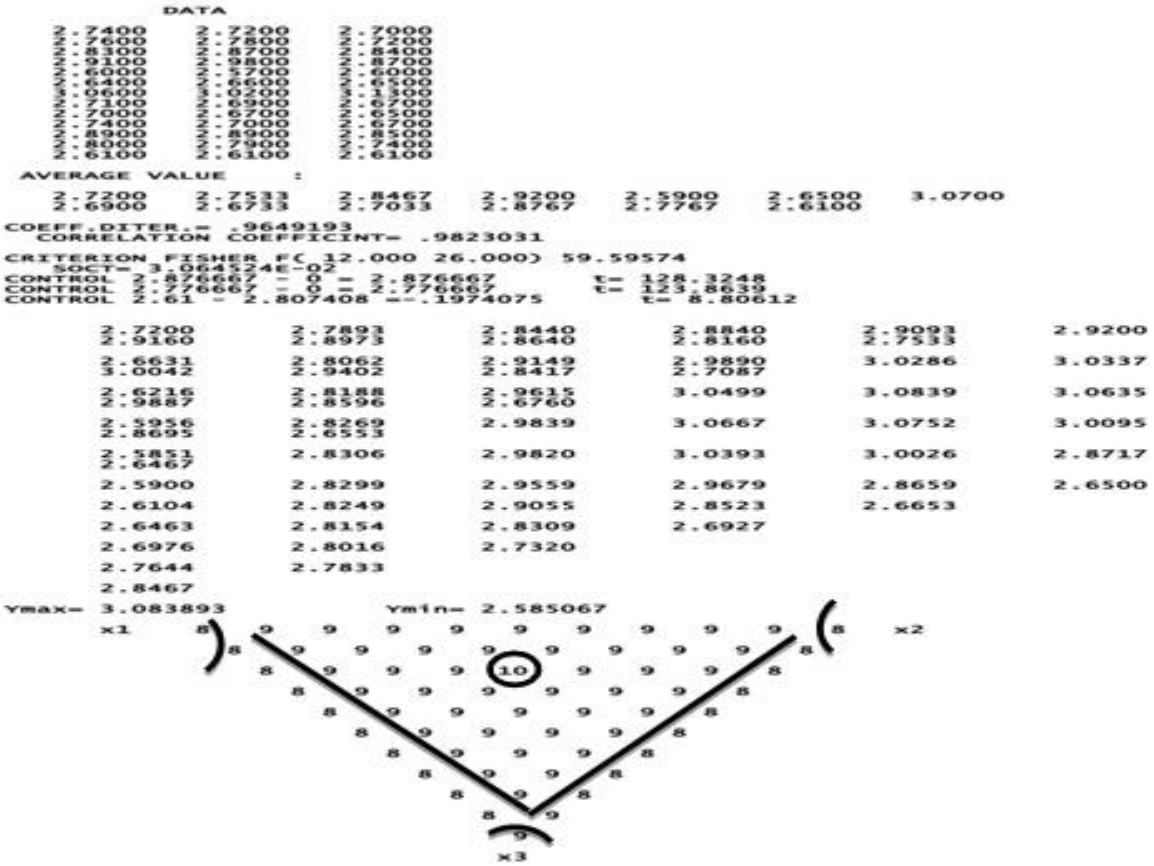

Fig .3. Soil EC, dSm^{-1} (0-20 cm) as affected by all possible combinations of compost, Farmyard manure and sheep manure after wheat plants in the first season.

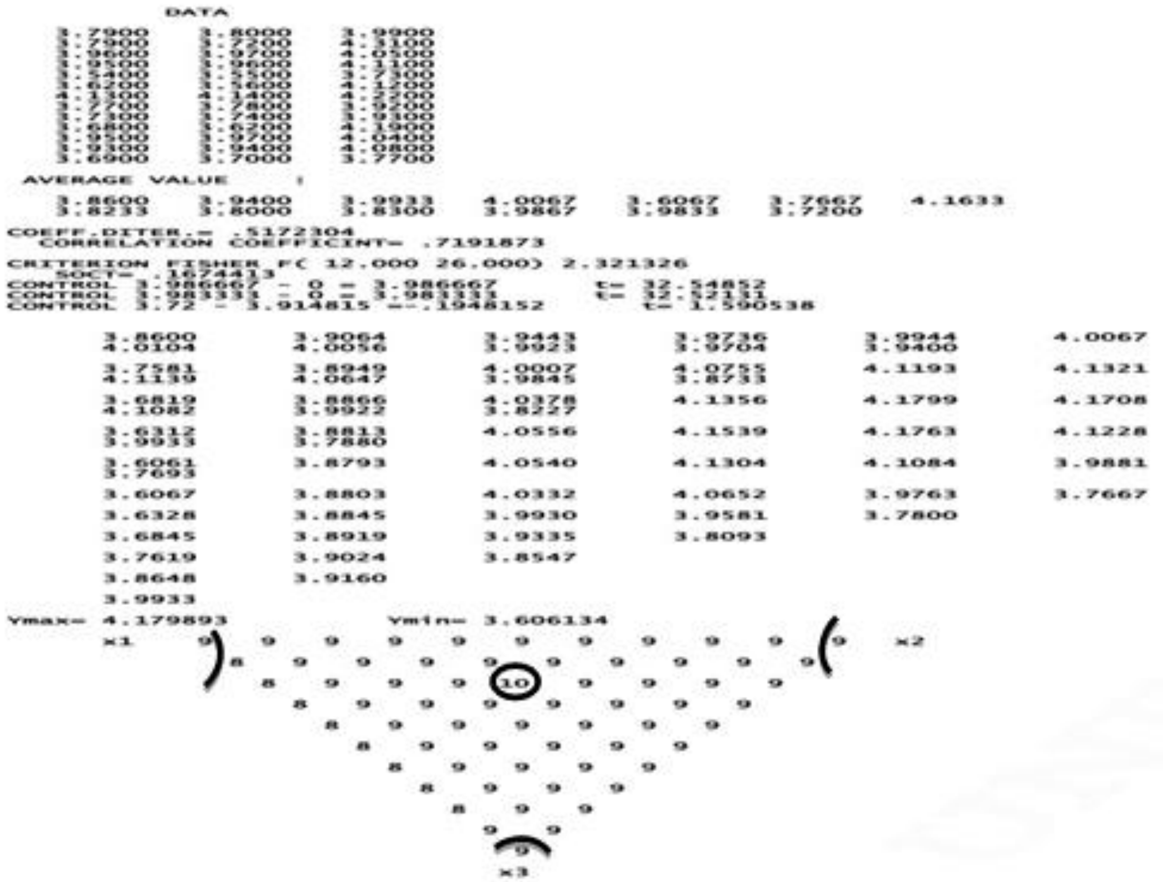

Fig .4. Sodium adsorption ratio (0-20 cm) as affected by all possible combinations of compost, farmyard manure and sheep manure after wheat plants in the first season

Concerning soluble cations and anions, the results in Tables (2 and 3) generally indicate that the soluble cations (Ca^{+2}, Mg^{+2}, Na^{+1} and k^{+1}) and soluble anions (HCO_3^{-1}, Cl^{-1} and SO_4^{-2}), slightly increased with all added treatments in the two soil depths at the end of the two seasons. Similar conclusion was obtained by El-Shouny (2006) who reported that the application of different rates of FYM to clay soil increased soluble cations and anions.

As for TSS%, Fig. (5) shows that the highest TSS value denoted by number 10 was 0.16% recorded by the treatment consists of 40% C, 40% FYM and 20% Sh equal to 1.685, 4.762 and 0.758 ton fed^{-1} of C, FYM and Sh, respectively for the surface layer in the first season. On the other hand, the lowest TSS value was 0.12% which recorded by the treatment consists of 50% C with 50% Sh and represented by number 7. Also, from the same Fig. (5), the three single treatments (C, FYM and Sh) respectively gave 80% of the maximum TSS values where they were 0.14% for both single treatment. The numbers located inside triangle showed interaction between the three combinations of soil amendments on TSS values which appear from the zone greater than 70%, while the number located on X, X_2 and X_2 X_3 side were greater than 80% of the maximum TSS values referred to positive interaction between dual combinations of C, FYM and FYM, Sh on their action upon TSS. These results are in line with those obtained by El-Maddah *et al*. (2015) and El-Sodany *et al*. (2016).

3- Exchangeable Cations, Cation Exhange Capacity (CEC) and Exchange Sodium Percentage (ESP).

The results in Tables (4 and 5) indicate that all added soil amendments (C, FYM and Sh) led to increase in exchangeable soil cations (Ca, Mg and K) and CEC, while exchangeable Na and ESP decreased compared to control at (0- 20 and 20- 40cm) soil depths in the two seasons. The highest CEC values were 45.75, 45.53 and 45.79, 45.59 meq100 g $soil^{-1}$ at the two soil depths in the two seasons, respectively for the treatment consists of 50% C and 50% Sh equal to 2.107 ton fed^{-1} C and 1.894 ton fed^{-1} Sh in the first season and were 3.371 ton fed^{-1} C and 3.031 ton fed^{-1} Sh in the second season. On the other hand, the lowest exchangeable Na were 2.23, 2.72 and 2.70, 2.67 maq100g $soil^{-1}$ and the lowest ESP values were 4.87, 5.97 and 5.89, 5.86% at the two soil depths in the two seasons, respectively for the same treatment. These results may be attributed to the organic matter, which led to improve soil structure, reduce soil pH and the ability of absorbing soil nutrients as a cause to increase CEC. Similar results were obtained by Tordoff *et al*. (2000), Mendez and Maier (2008), Rizk *et al*. (2016) and Oladele *et al*. (2019).

The results in Figs (6 and 7) indicate that the highest CEC value was 45.75 meq100g $soil^{-1}$ at (0-20cm) soil depth in the first season and was 45.59 meq100g $soil^{-1}$ at (20- 40 cm) soil depth in the second season, that appeared by number 10, which its treatment consists of 60% C and 40% Sh in the two seasons, while the three individual treatments (C,FYM and Sh) were 90% of the maximum CEC values for each individual treatment at (0-20 cm) soil depth in the first season and at (20- 40cm) soil depth in the second season, where the highest CEC value was 45.37 meq100g $soil^{-1}$ at (0-20cm) soil depth in the first season and was 45.29 meq 100g $soil^{-1}$at (20-40cm) soil depth in the second one for the individual C treatment. These results reveal that individual C treatment was more effective than FYM or Sh on increasing CEC values, thus the individual treatments could be arranged in the order: C > FYM > Sh.

Table 4. Effect of different combinations of compost, farmyard manure and sheep manure on exchangeable cations in the first season (winter 2017/2018).

Treatment No.	Exchangeable cations, meq100g $soil^{-1}$								CEC, meq100g $soil^{-1}$		ESP, %	
	Ca		Mg		Na		K					
	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm
1	23.90	23.02	17.28	17.41	2.50	2.99	1.69	1.71	45.37	45.13	5.51	6.62
2	23.81	23.13	17.30	17.29	2.55	3.02	1.61	1.66	45.27	45.10	5.63	6.70
3	23.50	22.94	17.38	17.17	2.62	3.17	1.58	1.59	45.07	44.86	5.80	7.05
4	23.59	22.92	17.06	16.99	2.71	3.23	1.48	1.56	44.84	44.70	6.04	7.22
5	24.07	23.54	17.57	17.30	2.23	2.72	1.88	1.97	45.75	45.53	4.87	5.97
6	24.04	23.42	17.42	17.28	2.40	2.85	1.75	1.80	45.61	45.35	5.26	6.29
7	23.51	22.89	17.02	16.95	2.74	3.31	1.42	1.55	44.70	44.69	6.12	7.41
8	23.96	23.27	17.43	17.27	2.45	2.92	1.69	1.76	45.54	45.22	5.39	6.45
9	24.05	23.37	17.39	17.21	2.42	2.90	1.73	1.79	45.59	45.27	5.32	6.42
10	23.91	23.23	17.39	17.23	2.48	2.97	1.69	1.72	45.47	45.15	5.45	6.58
11	23.48	22.95	17.26	17.07	2.67	3.20	1.53	1.58	44.94	44.80	5.95	7.14
12	23.67	22.96	17.35	17.31	2.58	3.10	1.59	1.62	45.19	44.99	5.72	6.89
13	24.06	23.44	17.51	17.37	2.33	2.81	1.80	1.84	45.70	45.46	5.11	6.19
Control	22.74	22.27	16.15	16.32	4.40	4.49	1.35	1.50	44.64	44.58	9.87	10.08

Table 5. Effect of different combinations compost, farmyard manure and sheep manure on exchangeable cations in the second season (summer 2018).

Treatment No.	Exchangeable cations, meq100g $soil^{-1}$								CEC, meq100g $soil^{-1}$		ESP, %	
	Ca		Mg		Na		K					
	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm
1	23.55	23.60	17.15	17.20	3.04	2.94	1.67	1.55	45.41	45.29	6.69	6.49
2	23.57	23.54	17.15	17.12	3.06	2.99	1.59	1.53	45.38	45.18	6.74	6.61
3	23.47	23.47	17.01	17.06	3.16	3.06	1.54	1.50	45.17	45.11	7.00	6.79
4	23.39	23.30	17.02	17.01	3.25	3.13	1.40	1.48	45.06	44.92	7.20	6.97
5	24.13	23.92	17.07	17.25	2.70	2.67	1.89	1.76	45.79	45.59	5.89	5.86
6	23.84	23.77	17.15	17.20	2.90	2.83	1.75	1.66	45.63	45.45	6.34	6.23
7	23.34	23.21	16.95	16.89	3.36	3.30	1.32	1.44	44.97	44.84	7.48	7.36
8	23.56	23.70	17.22	17.19	2.98	2.88	1.70	1.60	45.47	45.37	6.56	6.34
9	23.76	23.75	17.13	17.18	2.93	2.85	1.72	1.63	45.55	45.41	6.44	6.28
10	23.52	23.63	17.24	17.23	3.00	2.89	1.69	1.58	45.45	45.33	6.59	6.38
11	23.40	23.42	17.06	17.01	3.18	3.08	1.46	1.49	45.10	45.01	7.04	6.85
12	23.51	23.51	17.10	17.10	3.10	3.03	1.56	1.52	45.27	45.15	6.85	6.71
13	23.94	23.78	17.19	17.31	2.81	2.75	1.79	1.69	45.72	45.53	6.13	6.04
Control	22.78	22.55	16.33	16.43	4.57	4.44	1.26	1.38	44.93	44.80	10.16	9.91

From data in Figs (8 and 9) it is found that the three single treatments (C, FYM and Sh) gave 80, 90 and 90% of the maximum ESP values equal to 5.51, 5.63 and 5.81%, respectively at (0-20 cm) soil depth in the first season (Fig. 8) and were 80, 80 and 90% of the maximum ESP values equal to 6.49, 6.61 and 6.79% for (C, FYM and Sh) respectively at (20-40 cm) soil depth in the second season (Fig. 9). The highest ESP values were 6.23% at (0-20 cm) soil depth in the first season and 7.41% at (20-40 cm) soil depth in the second season denoted by number 10 which its treatment consists of 40, 40, 20% of C, FYM, Sh, respectively. On the other hand, the lowest ESP values were 4.87 and 5.86 at the previous soil depths in the two seasons, respectively, this appear from the compound treatment of 60% C and 40% Sh for the same depths and seasons. These results may be attributed to improvement of physical and chemical soil properties as a result of organic matter decomposition. These results are in agreement with those obtained by Sarwar *et al*. (2008), Mahmoud *et al*. (2009), Abdel-Fattah (2012) and Martí *et al*. (2016).

4- Total Macronutrients (NPK), Organic Carbon (O.C) and C/N ratio.

The results in Tables (6 and 7) show that (total NPK, O.C and C/N ratio) increased with applied of all treatments compared with the control at (0-20 and 20-40 cm) soil depths at the end of the two growing seasons, where the highest values of total (NPK), O.C and C/N ratio were achieved by the treatment consists of 50% C and 50% Sh, equal to 2.107 ton fed^{-1} C and 1.894 ton fed^{-1} Sh for wheat plants in the first season and were 3.371 ton fed^{-1} C and 3.031 ton fed^{-1} Sh for maize plants in the second season, while the lowest values of the same characters achieved by the treatment consists of 1/3 from each of (C, FYM and Sh).The maximum values of total soil N were 0.164, 0.147 and 0.165, 0.152% in the two soil depths, 0-20 and 20-40 cm, respectively at the end of the two growing seasons, where the increases were 12.33, 13.95% in the first season and 12.24, 14.29% in the second one, over the control. Regarding the phosphorus and potassium concentrations in soil, they take the same trend as nitrogen, where results indicate that application amendments led to an increase in soil P and K concentrations at the two seasons compared with the control. The maximum values of them were (0.049, 0.494) and (0.044, 0.490%) for the two soil depths, respectively at the end of the first season and were (0.042, 0.491) and (0.041, 0.496%), in the second season for the same depths. These results show that it may be practical to apply these soil amendments to soil to increase NPK concentrations in the soil and thereby enhanced its availability to crops.

The highest O.C% values were 2.012 and 1.739% increased by 26.14 and 28.43% over the control at (0-20 and 20-40 cm) soil depths, respectively in the first season and were 1.916 and 1.665% increased by 19.30 and 21.53% over the control at (0-20 and 20-40 cm) soil depths, respectively in the second one, while the highest C/N ratio were 12.28 and 11.79 increased by 12.76 and 12.72% over the control at (0-20 and 20-40 cm), respectively in the first season and were 11.63 and 10.94 increased by 6.70 and 6.01% over the control at (0-20 and 20-40 cm) soil depths, respectively in the second season.

Data in Figs (10 and 11) show that the three single treatments (C, FYM and Sh) gave 90% of the maximum C/N values equal to 12.06, 12.04 and 11.89, respectively at (0-20 cm) soil depth in the first season (Fig. 10) and were 10.72, 10.70 and 10.67, respectively at (20-40 cm) soil depth in the second season (Fig. 11). This means that the highest values of C/N ratio were recorded for the single C treatment, while the lowest one obtained with the single Sh treatment. The highest C/N values were 12.28 and 10.94 at (0-20 cm) in the first season and (20-40 cm) in the second one, respectively obtained by number 10 which consists of 60% C and 40% Sh equal to 2.528 and 1.515 ton fed^{-1} in the first season and were 4.050 and 2.424 ton fed^{-1}, respectively in the second season. These results may be due to high content of O.C and NPK in soil by adding organic matter from the amendments and its decomposition resulting high content of these elements. These results are in agreement with those reported by Bouajila and Sanaa (2011), El-Maddah *et al*. (2015), El-Sodany *et al*. (2016) and Mahmood *et al*. (2017).

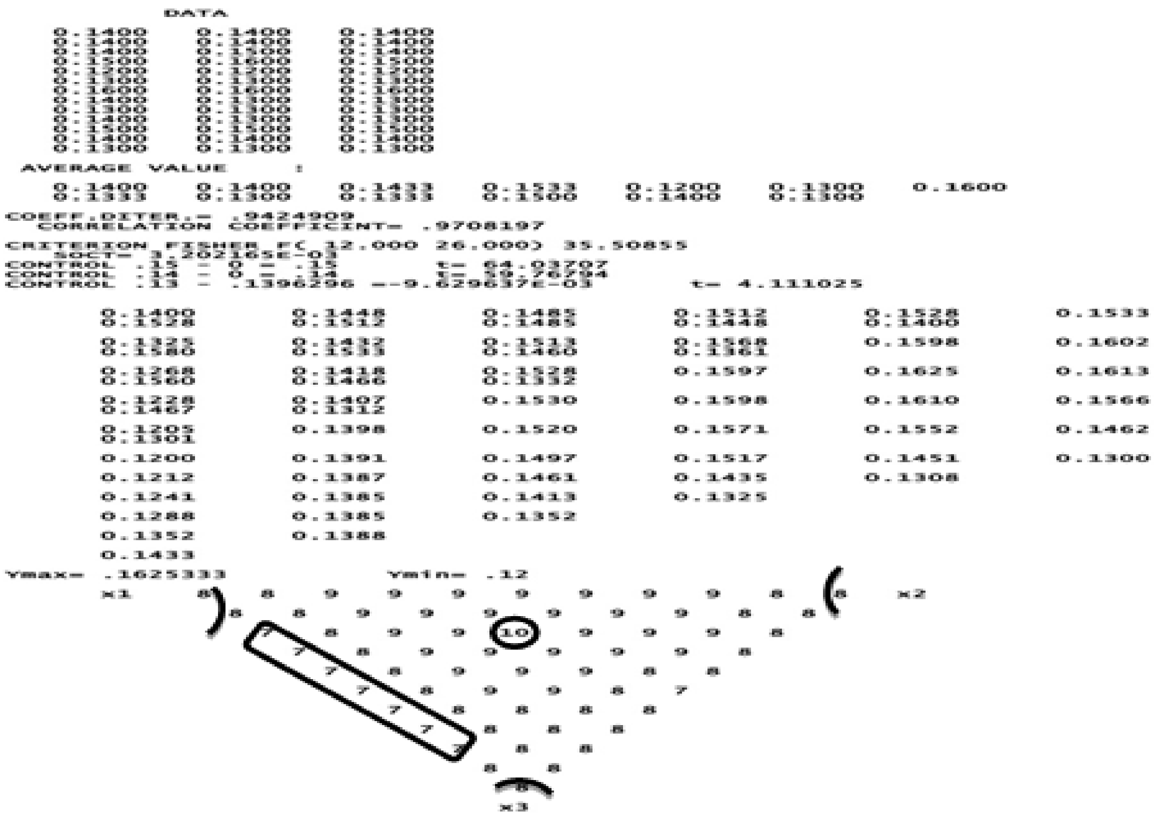

Fig.5. Total soluble salts (TSS,%) 0-20 cm as affected by all possible combinations of compost, farmyard manure and sheep manure after wheat plants in the first reason.

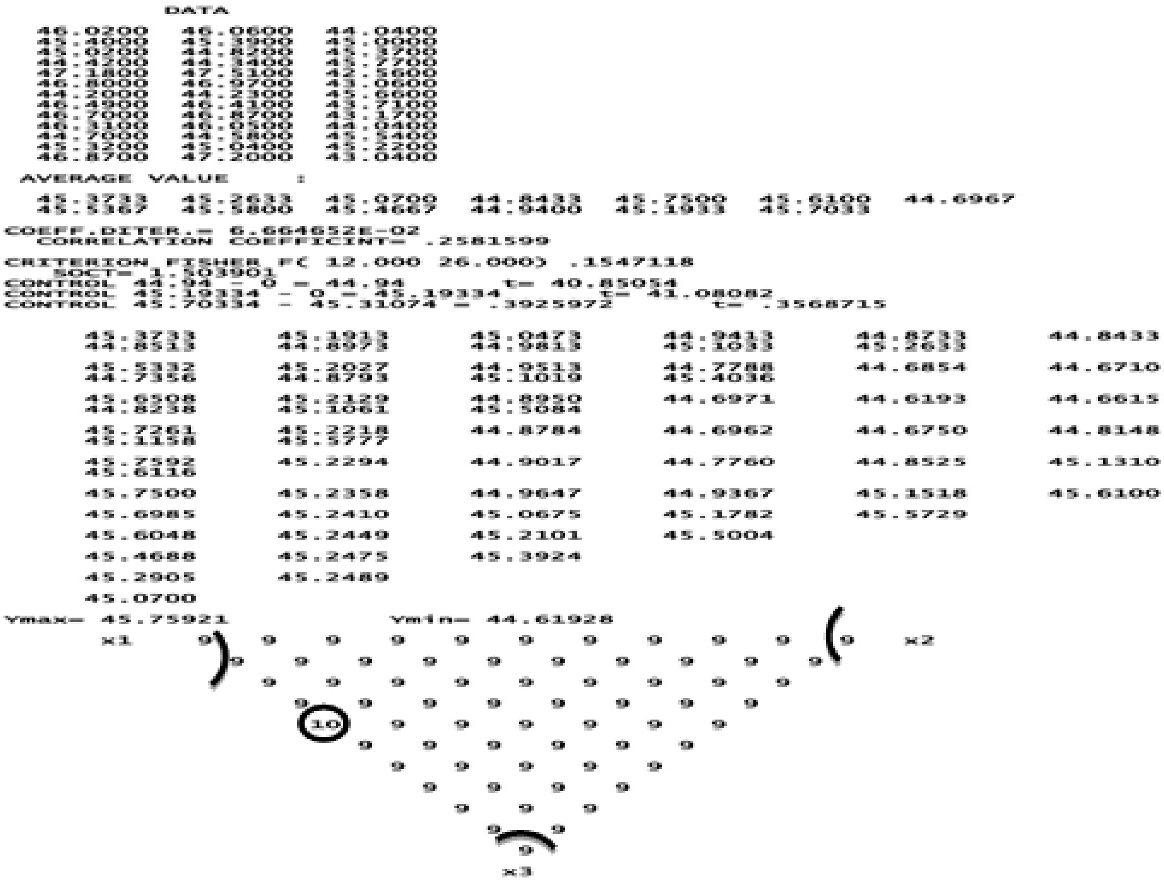

Fig.6. Cation exchange capacity (CEC meq 100g soil^{-1}) 0-20 cm as affected by possible combinations of compost, farmyard manure and sheep manure after wheat plants in the first season.

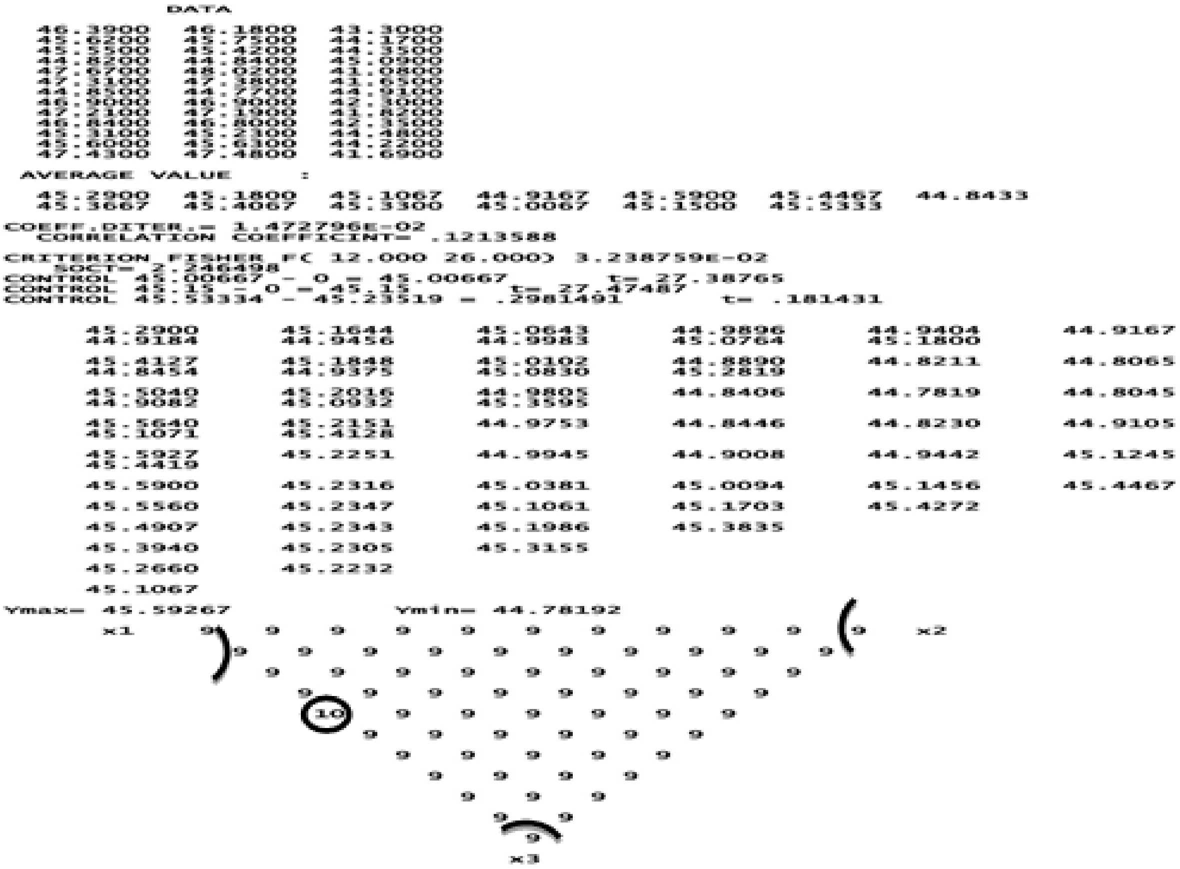

Fig.7. Cation exchange capacity (CEC meq 100g soil^{-1}) 20-40 cm as affected by possible combinations of compost, farmyard manure and sheep manure after maize plants in the second season.

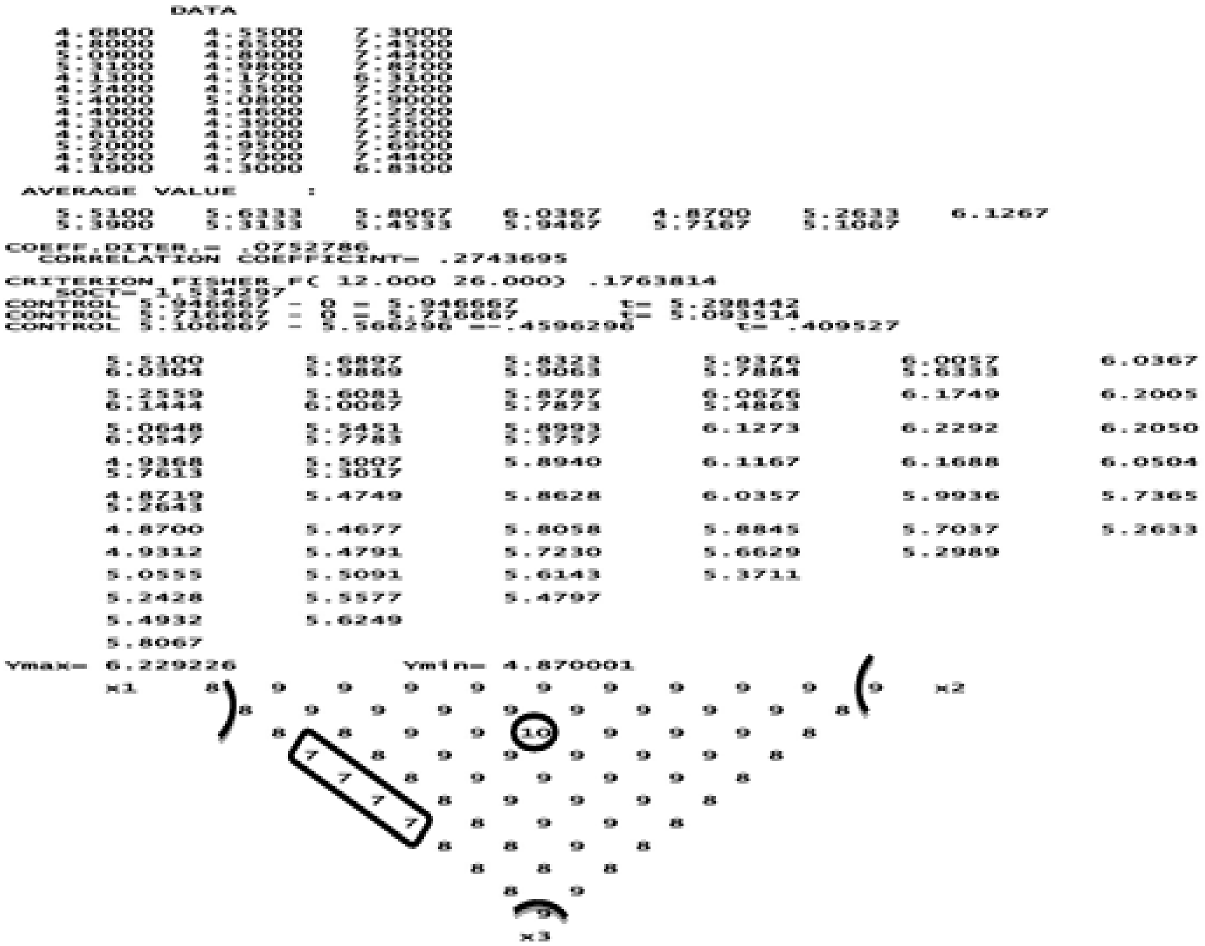

Fig.8. Exchangeable sodium percentage (ESP,%) 0-20 cm as affected by possible combinations of compost, farmyard manure and sheep manure after wheat plants in the first season.

Table 6. Effect of different combinations of compost, farmyard manure and sheep manure on soil macronutrients and C/N ratio in the first season (winter 2017/2018).

Treatment No.	Total macronutrients, %						Organic carbon, O.C, %		C / N ratio	
	N		P		K					
	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm
1	0.156	0.141	0.041	0.037	0.457	0.457	1.877	1.607	12.06	11.38
2	0.155	0.140	0.041	0.037	0.453	0.456	1.866	1.591	12.04	11.33
3	0.153	0.136	0.039	0.036	0.439	0.440	1.822	1.526	11.89	11.26
4	0.151	0.135	0.038	0.034	0.410	0.414	1.789	1.505	11.84	11.19
5	0.164	0.147	0.049	0.044	0.494	0.490	2.012	1.739	12.28	11.79
6	0.161	0.146	0.045	0.040	0.486	0.483	1.967	1.695	12.18	11.61
7	0.149	0.132	0.034	0.031	0.403	0.395	1.764	1.476	11.82	11.18
8	0.158	0.143	0.042	0.038	0.467	0.469	1.924	1.650	12.15	11.55
9	0.160	0.145	0.043	0.040	0.478	0.478	1.948	1.684	12.17	11.60
10	0.157	0.142	0.042	0.038	0.463	0.464	1.893	1.613	12.09	11.40
11	0.152	0.135	0.039	0.035	0.436	0.433	1.799	1.519	11.85	11.22
12	0.154	0.136	0.040	0.036	0.446	0.446	1.845	1.540	11.99	11.30
13	0.162	0.147	0.046	0.042	0.491	0.489	1.979	1.716	12.22	11.66
Control	0.146	0.129	0.031	0.028	0.385	0.379	1.595	1.354	10.89	10.46

Table 7. Effect of different combinations of compost, farmyard manure and sheep manure on soil macronutrients and C/N ratio in the second season (summer 2018).

Treatment No.	Total macronutrients, %						Organic carbon, O.C, %		C / N ratio	
	N		P		K					
	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm
1	0.160	0.146	0.037	0.036	0.464	0.471	1.838	1.564	11.45	10.72
2	0.159	0.145	0.037	0.035	0.463	0.466	1.817	1.551	11.41	10.70
3	0.156	0.143	0.036	0.035	0.457	0.464	1.780	1.522	11.38	10.67
4	0.154	0.141	0.033	0.032	0.430	0.437	1.744	1.500	11.32	10.65
5	0.165	0.152	0.042	0.041	0.491	0.496	1.916	1.665	11.63	10.94
6	0.163	0.149	0.040	0.038	0.486	0.492	1.879	1.608	11.51	10.79
7	0.150	0.134	0.032	0.030	0.427	0.432	1.695	1.429	11.31	10.64
8	0.161	0.148	0.039	0.037	0.474	0.481	1.863	1.588	11.54	10.75
9	0.163	0.149	0.039	0.037	0.483	0.489	1.865	1.599	11.48	10.77
10	0.162	0.147	0.038	0.037	0.470	0.475	1.850	1.579	11.43	10.74
11	0.155	0.142	0.035	0.033	0.454	0.462	1.769	1.515	11.39	10.66
12	0.157	0.143	0.036	0.035	0.460	0.464	1.791	1.525	11.38	10.68
13	0.164	0.150	0.040	0.039	0.490	0.495	1.895	1.627	11.58	10.82
Control	0.147	0.133	0.030	0.029	0.407	0.414	1.606	1.370	10.90	10.32

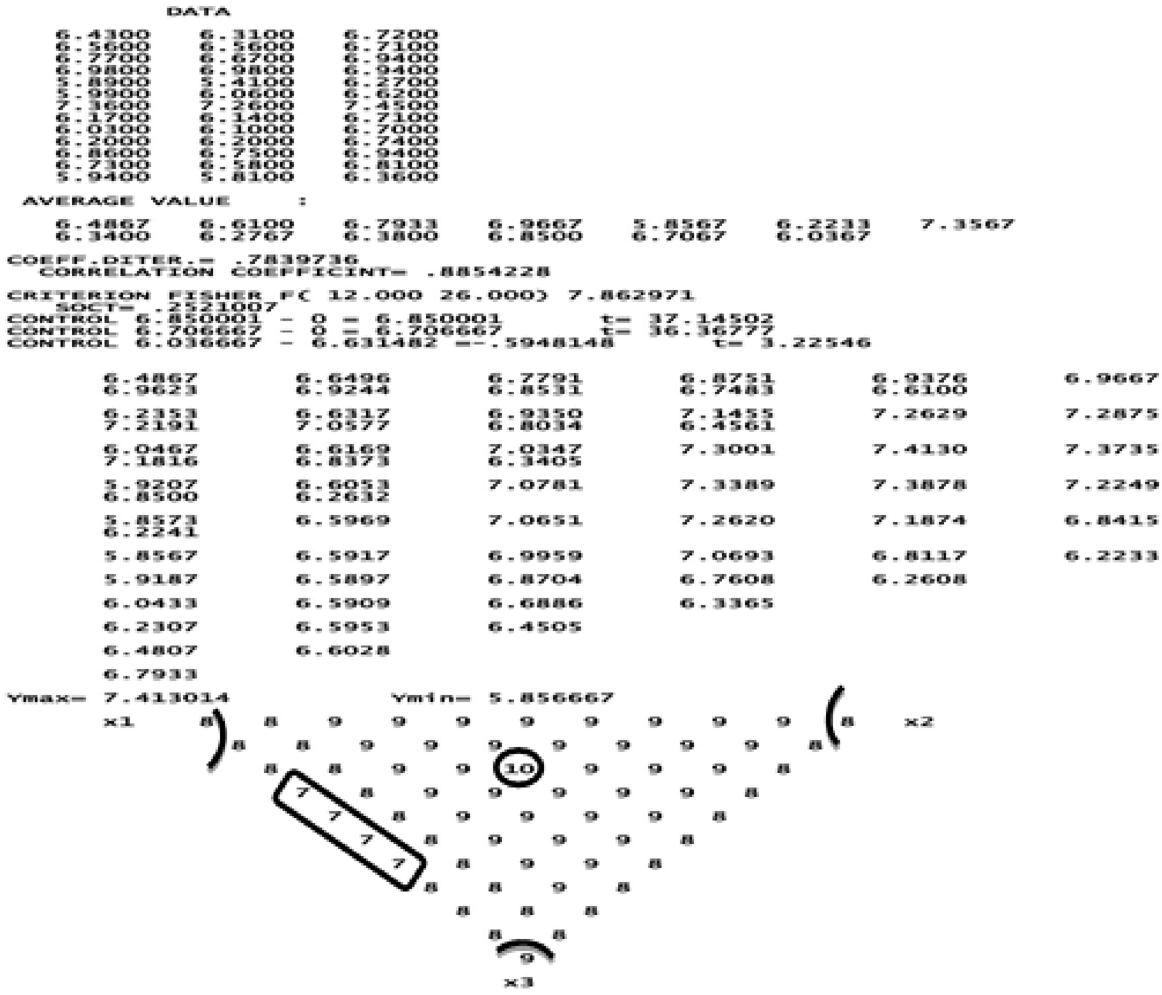

Fig.9. Exchangeable sodium percentage (ESP,%) 20-40 cm as affected by possible combinations of compost,farmyard manure and sheep manure after maize plants in the second

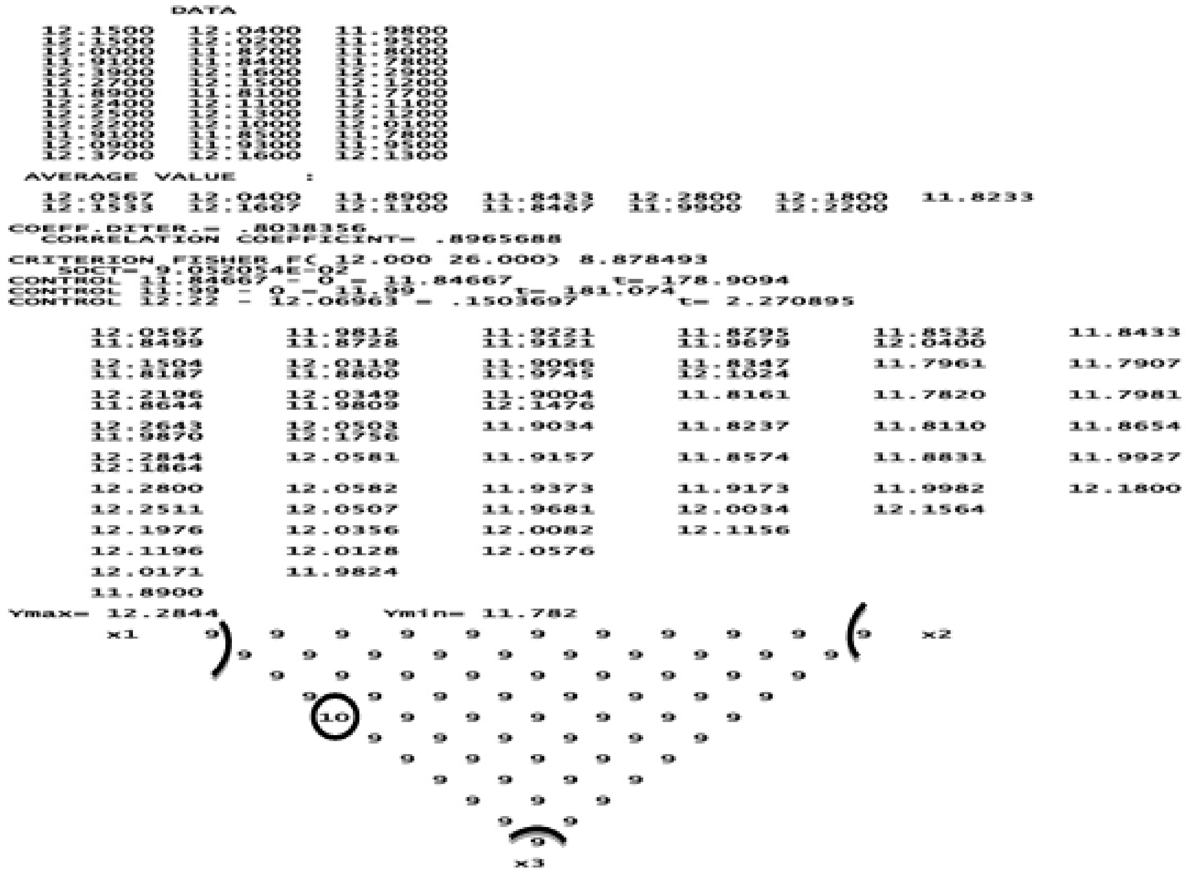

Fig.10. C/N ratio (0-20 cm) as affected by possible combinations of compost, farmyard manure and sheep manure after wheat plants in the first reason.

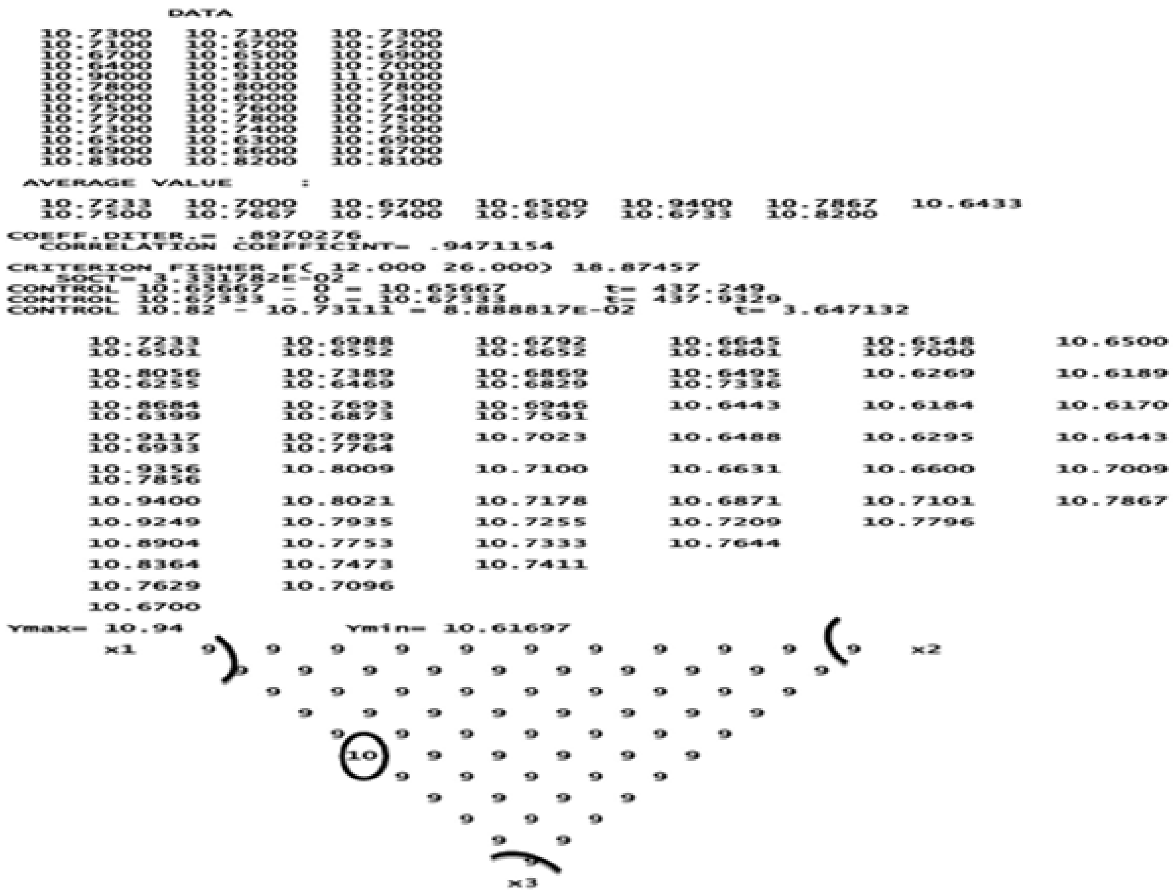

Fig.11.C/N ratio (20-40 cm) as affected by possible combinations of compost, farmyard manure and sheep manure after maize plants in the second season.

2- Economical analysis:

The results in Table (8) show that the highest net revenue value (11960.06 LE fed^{-1}) was incorporated with the combination consists of 50% C and 50% Sh equal to 2.107 and 1.894 ton fed^{-1} respectively, in the first season and were 3.371 and 3.031 ton fed^{-1} respectively in the second one, which was the best treatment and should be recommended due to a relative high net revenue comparing to other treatments. This may be due to this treatment was recorded the highest values of yield in the first and second seasons, consequently high net profit. Also, it can be noticed that the net revenue values were increased by using all different treatments comparing with the control. Similar results were obtained by Hafidi *et al.* (2012), Dhaka *et al.* (2012), Wapa and Sodangi (2017). Finally, from the obtained data, it could be concluded that the application of organic soil amendments (C, FYM and Sh) led to improve chemical soil properties; therefore, this study recommends the use of organic amendments under such conditions of these soils.

Table .8. The net revenue * (LEfed^{-1} .) due to different treatments through the two growing seasons under study.

Treatment No.	Increasing yield Tonfed^{-1}.			Total yield price, LEfed^{-1}.			Total cost of soil conditioner	Net revenue LEfed-1.
	Wheat grain	Wheat straw	Maize grain	What grain	Wheat straw	Maize grain		
1	1.5000	2.0410	1.5300	6000.00	2041.00	3220.65	2519.65	8742.00
2	1.4490	2.0070	1.4450	5796.00	2007.00	3041.73	2940.54	7904.19
3	1.3520	1.8990	1.3620	5408.00	1899.00	2867.01	1536.44	8637.57
4	1.1890	1.9180	1.1710	4756.00	1918.00	2464.96	2730.09	6408.86
5	1.8670	2.3080	2.0010	7468.00	2308.00	4212.11	2028.05	11960.06
6	1.6910	2.1420	1.7610	6764.00	2142.00	3706.91	2238.49	10374.42
7	1.0100	1.7110	1.1590	4040.00	1711.00	2439.70	2329.88	5860.82
8	1.6200	2.0630	1.6790	6480.00	2063.00	3534.30	2421.27	9656.03
9	1.6660	2.0790	1.6920	6664.00	2079.00	3561.66	2631.71	9672.95
10	1.5800	2.0670	1.5630	6320.00	2067.00	3290.12	1929.66	9747.45
11	1.3060	1.8910	1.3210	5224.00	1891.00	2780.71	2594.87	7300.84
12	1.4060	2.0320	1.4090	5624.00	2032.00	2965.95	2127.31	8494.64
13	1.7380	2.2220	1.8000	6952.00	2222.00	3789.00	2267.46	10695.54
Control	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00

*** = (Yield of treatment - control) - the cost of the treatment**

The price of yield and the costs of different treatments were calculated as subsidized price of 2017 and 2018.

REFERENCES

Abdel-Fattah, M.K. (2012) Role of gypsum and compost in reclaiming saline-sodic soils. J. Agric. and Veterinary Sci., 1 (3): 30–38.

Asap, A.; A.O. Haruna; N.M.A. Majid and M. Ali (2018) Amending triple superphosphate with chicken litter biochar improves phosphorus availability. Eurasian J. Soil Sci., 7(2): 121–132.

Atere, C.T. and A. Olayinka (2012) Effect of organo-mineral fertilizer on soil chemical properties, growth and yield of soybean. Afric. J. Agric. Res., 7(37): 5208–5216.

Bhatt, M.; A.P. Singh; V. Singh; D.C. Kala and V. Kumar (2019) Long-term effect of organic and inorganic fertilizers on soil physico-chemical properties of a silty clay loam soil under rice-wheat cropping system in Tarai region of Uttarakhand. J. Pharmacognosy and Phytochemistry. 8(1): 2113–2118.

Black, C.A. (Ed.) (1965) Methods of Soil Analysis. Parts 1 and 2. Amer. Soc. Agron. No. 9, Madison, Wisconsin USA.

Bouajila, K. and M. Sanaa (2011) Effects of organic amendments on soil physico-chemical and biological properties. J. Mater. Environ. Sci., 2 (1): 485–490.

Dhaka, B.R.; N. Chawla and A.R.K. Pathan (2012) Integrated nutrient management on performance of wheat (*Triticum aestivum* L.). Annals of Agrc. Res., 33(4): 214–219.

El-Maddah, E.I.; M. El-D. El-Sodany and A. A. Mahmoud (2015) Evaluation of some soil conditioners by tetra-factorial computer model and their effects on some soil chemical properties and its productivity. Int. J. Chem. Tech. Res., 8(9): 54–83.

El-Shouny, M.M (2006) The effect of some soil amendments on soil properties and wheat production in salt affected soils. Minufiya. J. Agric. Res., 31(4): 1105-1117.

El-Sodany, M. El-D.; E.I. El-Maddah; Samia M.S. El-Kalawy and M.A.B. El-Sherief (2016) Effect of compost rates at different depths on some chemical properties and productivity of soils. J. Soil Sci. and Agric. Eng., Mansoura Univ., 7(7): 447–459.

Hafidi, M.; S. Amir; A. Meddich; A. Jouraiphy; P. Winterton; M. El Gharous and R. Duponnois (2012) Impact of applying composted biosolids on wheat growth and yield parameters on a calcimagnesic soil in a semi-arid region. Afr. J. Biotechnol., 11(41): 9805–9815.

Hesse, P.P. (1971) "A Text Book of Soil Chemical Analysis" –John- Murray (pupils.), London Great Britan.

Mahmood, F; I. Khan; U. Ashraf; T. Shahzad; S. Hussain; M. Shahid; M. Abid and S. Ullah (2017) Effects of organic and inorganic manures on maize and their residual impact on soil physico-chemical properties. J. Soil Sci. and Plant nutrition. 17(1): 22–32.

Mahmoud, E; N.A. El-Kader; P. Robin; N. Akkal-Corfini and L.A. El-Rahman (2009) Effects of different organic and inorganic fertilizers on cucumber yield and some soil properties. World J. Agric. Sci., 5(4): 408–414.

Martí, E.; J. Sierra; M. Mari; C. Ortiz; N. Roig; M. Nadal and J.L. Domingo (2016) Long-term amendment of soils with compost and pig manure: effects on soil function, production and health risk assessment. Inter soc. for horti sci., 11(46): 199–212.

Mendez, M.O. and R.M. Maier (2008) Phytoremediation of mine tailings in temperate and arid environments. Reviews in Environ. Sci. Biotech., 7(1): 47–59.

Moussa, K.F. (1991) Evaluation of the relative affinities of exchangeable cation in the alluvial soil of El-Sharkiya governorate. Zagazig J. Agric. Res., 18(4):1151–1160.

Moyin-Jesu E.I. and A.I. Ogochukwu (2014) Comparative evaluation of different organic fertilizer effects on soil fertility, leaf chemical composition and growth performance of coconut (*Cocos nucifera*) seedlings. Inter. J. Plant Soil Sci., 3(6): 737–750.

Moyin-Jesu, E.I. (2015) Use of different organic fertilizers on soil fertility improvement, growth and head yield parameters of cabbage (Brassica oleraceae L). Inter. J. Recycl. Org. Waste Agric., 4: 291–298.

Negassa, W; F. Getaneh; A. Deressa and B. Dinsa (2007) Integrated use of organic and inorganic fertilizers for maize production. Utilization of diversity in land use systems: Sustainable and organic approaches to meet human needs. A paper presented on Inter. Res. on Food Security, Natural Resource Manag. and Rural Development Conference, 2007, October 9-11, Witzenhausen, Germany.

Ojha, R.B.; S.C. Shah; K.R. Pande and D.D. Dhakal (2014) Residual effect of farmyard manure on soil properties in spring season, Chitwan, Nepal. Inter. J. Sci. Res. Agric. Sci., 1(8): 165–171.

Oladele, S.; A. Adeyemo; M. Awodun; A. Ajayi and A. Fasina (2019) Effects of biochar and nitrogen fertilizer on soil physicochemical properties, nitrogen use efficiency and upland rice (Oryza sativa) yield grown on an Alfisol in Southwestern Nigeria. Inter. J. Recycling of Organic Waste in Agri., 8(3): 295–308.

Page, A.L.; R.H. Miller and D.R. Keeney (1982) "Methods of Soil Analysis". Part 2. Chemical and Microbiological properties. Second Edition. Madison, Wisconsin, USA.

Pratap, D.; J. Singh; R. Kumar; O. Kumar and K.S. Rawat (2016) Effect of micro-nutrients and farm yard manure on soil properties and yield of maize (Zea mays l.) in lower Indo-Gangetic Plain of Uttar Pradesh. J. Appl and Natural Sci,. 8(1): 236–239.

Rizk, A.H.; A.M. Mashhour; E.E. Abd- ElHady and M.M. Sherif (2016) Effect of organic and inorganic residues on sandy soil properties and plant growth. Middle East J. of Agri., 5(1): 117–122.

Sarwar, G.; H. Schmeisky; N. Hussain; S. Muhammad; M. Ibrahim and E. Safdar (2008) Improvement of soil physical and chemical improvement with compost application in rice-wheat cropping system. Pak J. Bot., 40(1): 275–282.

Tordoff, G.M.; A.J.M. Baker and A.J. Willis (2000) Current approaches to the revegetation and reclamation of metalliferous mine wastes. Chemosphere. 41 (1-2): 219–228.

Waksman, S.A. (1952) "Soil microbiology". Jon Willy and Sons. Inc, New York, Copyright.

Wapa, J.M. and I.A. Sodangi (2017) Comparative study of cow dung and poultry droppings with or without mineral fertilizer on some soil chemical properties and yield of maize in semi-arid sub-region, Nigeria. Inter. J of Agri. and Biosci., 6(2): 108–113.

استخدام برنامج كمبيوتر ثلاثى العوامل لتقييم الكمبوست والسماد البلدى وسماد الغنم وتأثيرهم على بعض الخصائص الكيميائية للتربة.

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أجريت تجربتان حقليتان على أرض طينية خلال موسمين متعاقبين، الموسم الشتوى 2018/2017 باستخدام نباتات القمح، والموسم الصيفى 2018 باستخدام نباتات الذرة فى محطة البحوث الزراعية بالجميزة محافظة الغربية لتقييم تأثير بعض المحسنات العضوية الطبيعية (كمبوست، سماد بلدي، سماد الغنم)على تحسين بعض الخواص الكيميائية والمحتوي الكلي لبعض العناصر الكبرى (NPK) للنبات بالإضافة إلى اجراء التقييم الإقتصادى لتحديد المعاملة الاقتصادية. وقد صممت التجربة بنظام قطاعات كاملة العشوائية ذات ثلاثة مكررات وقد اشتملت التجربة على ثلاثة عشر معاملة لتغطية كل التوافقات المحتملة للكمبوست والسماد البلدى وسماد الغنم بالإضافة إلى معاملة المقارنة (بدون أى اضافات) وذلك باستخدام نموذج الحاسب الآلى ثلاثى العوامل. ويمكن تلخيص النتائج المتحصل عليها كالآتى:- لعبت كل المعاملات دوراً ايجابياً فى انخفاض رقم حموضة التربة والصوديوم الذائب، نسبة الصوديوم المدمص وزيادة قيم ملوحة التربة، الكاتيونات والأنيونات الذائبة، الأملاح الكلية الذائبة، الكاتيونات المتبادلة، السعة التبادلية الكاتيونية، الكربون العضوي ونسبة الكربون إلى النيتروجين مقارنة بمعاملة الكنترول فى العمقين موضع الدراسة خلال موسمي النمو. - أدت كل المعاملات إلى تحسن واضح فى حالة المغذيات الكبرى (نيتروجين- فوسفور – بوتاسيوم) فى التربة. -وضح التحليل الاقتصادى أن أعلى صافى دخل هو 1196.06 جنيه للفدان نتيجة استخدام معاملة مكونة من 50% كمبوست مع 50% سماد غنم. -لذلك فمن المفيد استخدام هذه المعاملات (كمبوست وسماد بلدى وسماد غنم) ومخاليطها للحصول على تحسن واضح فى الخصائص الكيميائية للتربة ومغذيات التربة التى تنعكس على نمو النباتات وارتفاع الدخل الصافى.