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Mixing Technique of Different Soil Amendments as a Way to Improve a Newly Cultivated Sandy Soil

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MIXING as a qualitative and quantitative technique has been adopted to reclaim a newly cultivated soil at El Khattara location, El Sharkiya Governorate. The used organic sources were ; composted town refuse (TR), chicken manure (CH), and sludge (SL), while tafla (TF) was used as a natural conditioner. The rates of addition ranged between 0 to 12.5 tons/fed , by treated mathematical tetra factorial computer model.

The applied treatments were tested for two successive vegetative seasons as corn crop in summer and wheat in winter with one addition before corn plantation only . The achieved results can be summarized as follows;

Corn crop (1 *st* cultivation season) : a-There are at least 2 best mixing treatments; namely , (10:2. 5:5:5) ton/fed, and (12.5:2.5:2.5:5) ton/fed, from SL, TR, CH and TF, respectively, b-Both includes the highest SL, lowest TF and moderate or lowest TR and CH levels, c-Both indicate a complementary effect among all materials , and d-Both indicate favourable effect on most soil and plant properties.

Wheat crop (2*nd* cultivation season on residual effect): a- There are at least 4 best mixing treatments ; namely (0 :2.5 : 10: 15), (0:0:12.5:15), (0:0 :10 :20) and (0:5:7.5 :15) ton /fed, from SI, TR, CH and TF , respectively, b- None include sludge treatment indicating temporary effect of this manure, c- On contrary , all of them have at least the moderate level of either CH or TF indicating some how

durable manure and good couple for such soils, and d- TR involved in the same best treatments, but in second degree compared with the former ones. Generally, the findings spotlight on the importance of using a mixure of the existed conditioning materials in the site by means of adding some durable materials like TR and other soft materials like SI or CH. The used ratios could be used as a guide for adopting this technique in such site, or similar ones.

Investment ratio (IR) calculations: a- The maximum values came from using few quantities of TF, b- Combinations of little quantities of organic manures (SL, TR, and CH) gave the highest IR values, and c- Mixing technique between TF and organic manure by small amounts (mostly < 6.25 ton/fed) enhanced IR values.

Keywords: Mixing technique, Soil amendments, Sandy soil, Organic manure, Tafla.

Egypt is one of the countries which sufferes from rapidly increase of human population. So, several horizontal and vertical expantion projects have been established in many selected areas to meet this problem depending on their agricultural potentialities. El-Khattara experimental farm, Faculty of Agriculture, Zagazig University, represents the newly reclaimed soil of El-Sharkiya Governorate which mainly characterized by : light texture, weak structure, very low organic matter, water retention, and nutrient contents. Many soil applications were carried out to solve the soil deficits of this area or other similar ones, such as mixing or spraying butumenous emulsion, hydrogels, manures and clay additions (Tester, 1990). This work aims to study the effect of using sludge, town refuse, chicken manure, and tafla, either alone or mixed in combinations by various ratios according to a tetra factorial computer model (Moussa and Youssef, 1992), on El-Khattara sandy soil. Philosophy of mixing amendments was tested previously by several works of El-Sersawy (1997) and El-Sersawy *et al.* (1998) as the target is to complement the advantages of such amendments in unique treatment. Maize and wheat are considered the most important cereal crops for both human and animal in Egypt. At present, Egypt consumes more than 7.0 and

5.0 million tons of maize and wheat per year. The real production of maize and wheat is estimated to be about 5.0 and 3.0 million tons only, respectively. The remaninder has to be imported. Thus, it is important to increase the cultivated area in the newly reclaimed soils up to maximum production.

Material and Methods

A field experiment was carried out at the experimental station of Faculty of Agriculture, Zagazig University, El-Khattara, which is sandy area, was selected to study the comparative effect of sludge (SL), town refuse (TR), chicken manure (CH) and tafla (TF). Treatments were applied once only before the first season (corn crop) at rates derived from a tetra factorial computer model (Moussa and Youssef ,1992). The total experimental units were 19 treatments, with 4 replicates including 4 individual application from all used materials by the rate of 2% as maximum while the rest were mixed by various rates. The physical and chemical data of applied materials and original soil samples are shown in Tables 1 and 2.

Soil measurements

Field determination

Mechanical strengh as shear strength and penetration resistance were evaluated after harvesting of wheat crop.

Physical analysis

The collected disturbed soil samples were analysed for : particle size distribution according to Kilmer and Alexander (1949), hydraulic conductivity according to Singh (1980), available mositure and aggregates distribution according to Singh (1980), heat capacity according to Partington (1954), and percentages of water stable aggregates > 0.8 mm in diameter (chosen to express soil erodibility %).

Chemical analysis

Disturbed soil samples were analysed for saturation percentage, electrical conductivity (EC), soluble cations & anions according to Richards (1954) and ogranic carbon according to Jackson (1958) .

TABLE 1 . Some physical, mechanical and chemical properties of El Khattara sandy soil and tafla.

Characters	Sandy soil	Tafla
Particle size distribution		
Sand %	86.3	34.35
Silt %	6.3	40.83
Clay %	7.4	24.82
Textural class	Loamy Sand	Loam
Fc . w/w %	1.87	46.32
W. p w/w %	0.26	27.56
Am. w/w %	1.61	18.76
Heat capacity cal/g	0.1600	0.1760
Mechanical properties		
Penetration resistance kg/cm^2	13.8	-
Shear strength kg/cm^2	21.4	-
Chemical properties		
EC ds/m	2.9	15.6
PH	7.24	7.45
C%	0.35	0.29
OM%	0.6	0.49
C/N	0.45	0.38
N%	0.77	0.76
$CaCo_3$%	0.1	-
Soluble cations and anions in Saturated extract meq/L		
Na+	23	130.05
K+	0.5	0.31
Ca++	4.3	22.88
Mg++	1.8	7.8
Cl-	12	120.8
HCO3-	2.16	1.8
CO3--	0.00	0.00
SO4--	15.44	38.44

TABLE 2 . Some physical and chemical characteristics of the applied manures.

Characters	Sludge	Town refuse	Chicken manure
Physical properties			
F.C. w/w %	81.8	58.34	85.72
W.P. w/w %	55.08	40.07	58.01
A.m. w/w %	26.72	19.27	27.61
Heat capacity cal/g	0.2140	0.1800	0.2230
Chemical properties			
PH	7.29	7.04	7.43
C%	25.04	21.16	26.17
OM%	43.07	36.39	45.01
C/N	13.39	17.06	11.84
N%	1.87	1.24	2.21
P ppm	18.9	17.5	19.2
K ppm	145	118	151

Plant analysis

After harvesting of the two crops, the grain and straw yield were determined and the grain was digested by a rapid wet digestion and N,P and K contents determined according to Thomas *et al.* (1967).

Results and Discussion

The main target of amending the new sandy soil is to ameliorate their properties either physically or chemically or both . Data in Table 3 show some soil physical and chemical properties which improved after corn crop season owing to addition of materials used.

Physical characters

Availble moisture, hydraulic conductivity, heat capacity and soil erodibility gave a highly significant correlation with cereal crop yield. The best treatments were 2.05%, 0.7 cm/hr, 0.26 Cal /g and 19.91% for combination treatment (12.5: 2.5: 2.5:5) ton/fed, from SL, TR, CH, and TF respectively. The regression equations which show these relations were $y=-51.04 +3406x_1$,$y=28.31-18.68 x_2$, $y= -18.51+ 35.57 x_3$ and $y =-14.8+1.81x_4$, where y is the grain yield (Ardab /fed), and (x_1, x_2, x_3 and x_4) are available moisture, hydraulic conductivity, heat capacity and soil erodibility, respectively. These results stood in agreement with those of Zachar (1982), Mark (1993) and El-Sersawy *et al.* (1998).

Chemical characters

Table 3 shows some significant parameters such as organic matter content (O.M) , electrical conductivity (EC) and soluble cations and anions mostly (Na, Cl and HCO_3) which gave the values of 1.76%, 2.21 dsm^{-1}, 320.42 meq/ 100g soil , 0.13 meq/100g soil and 0.13 meq/100g soil as the maximum values were with the combination treatment (12.5:2.5:2.5:5) with regression equations: $y= -4.007+12.35x_1$, $y= 5.55+5.037 x_2$, $y=4.45+0.031 x_3$, $y= 7.75+ 58.95 x_4$ and $y= -10.49 +244.54 x_5$ for (O.M), EC, Na, Cl and HCO_3 respectively, where y is the cereal crop (Ardab/fed.), and x_1 (O.M %), x_2 (EC) dsm^{-1}, x_3 (Na meq/100g soil), x_4 (Cl meq /100 g soil) and x_5 (HCO_3 meq /100g soil).These results stood in agreement with those of Obi and Ebo (1995) and Bohne *et al*. (1996).

Some yield parameters for corn crop

Yield parameters as biological yield, N% and N,P and K uptake were studied under soil treatment conditions owing to the physical and chemical amelioration. Table 4 shows that the combination treatment (12.5:2.5:2.5:5) gave the maximum values of bilogical yield, grain and cob yields by the values (3.61,2.74 and 0.87) ton /fed in sequence. Also, the same table declares that the values of N% and N,P and K nutrients uptake were (3.08%, 84.51, 3.84 and 3.75) uptake kg/fed for combination treatment (12.5:2.5:2.5:5) from SL, TR, CH and TF respectively and the regression equations which show these relations were $y = 0.968 + 4.09 x_1$, $y = - 3.036 + 0.14 x_2$, $y = 4.45+ 2.9 x_3$ and $y = 1.03 + 3.36 x_4$, where y is grain yield (ardab/fed), and (x_1, x_2, x_3 and x_4) are N% and N, P and K nutrients uptake kg/fed respectively. These results stood in agreement with El-Sersawy (1997) and El-Kassas *et al.* (1997).

Some Soil Physical, Chemical and Mechanical Characters after Wheat Crop

It is important to note that in winter season there was no more additions to the soils.

Physical characters

Table 5 reveals that the values of 1.94 w/w% 1.23 cm/l 0.29 cal/ g and 18.38% for available moisture, hydraulic conductivity , heat capacity and soil erodibility %, respectively, for the combination treatment (0:0:10:20) ton/fed from SL, TR, CH, and TF by the same sequence, with regression equation of $y= -21.19 + 14.86x_1$, $y= 20.41 + 10.88 x_2$, $y = 0.082 = 23.32 x_3$ and $y=-1.48 + 0.46 x_4$, where y is grain yield (ardab/fed.) and x_1, x_2,x_3 and x_4, are available moisture % , hydraulic conductivity cm/hr, heat capacity cal/g and soil erodibility %. These results stood in agreement with those of Nath and Sarma (1992) and Khalil *et al.* (1997).

Chemical characters

The same table declares that the values of O.M % , EC, $ds.m^{-1}$ (Na, Cl, HCO_3) meq/100g soil have highly significant relationship with grain yield. These values are 1.52% , 2.08 dSm^{-1},263.12,0.15 and 0.14 meq/100g soil concerning the used materials SL, TR, CH, and TF by the rates (0:0:10:20) ton/fed, respectively. The regression equations which represent these relations are $y=- 1.08 + 5.71 x_1$, $y = 0.408 + 4.13 x_2$, $y = -2.26 + 0.04 x_3$, $y=3.08 + 26.23 x_4$ and $y = - 5.21 + 48.33 x_5$, where y is grain yield (ardab/fed) and x_1, x_2 ,x_3,

TABLE 3 . Some soil physical and chemical characters after corn crop as affected by different combinations of sludge (SL), town refuse (TR), chicken manure (CH) and tafla (TF).

Treatment No	Organic manures and tafla Tons/fed				Available Moisture %	Hydraulic Conductivity Cm/hour	Heat Capacity Cal/g	Difficult-Erodibility > 0.8 mm %	OM %	Na Meq/100g soil	Cl Meq/100g soil	HCO^3 Meq/100g soil	EC DSm
	SL	TR	CH	TF									
1	20	0	0	0	1.81	0.85	0.20	17.15	1.08	113.95	0.02	0.08	0.87
2	0	20	0	0	1.68	0.93	0.17	10.14	0.87	111.25	0.03	0.08	0.95
3	0	0	20	0	1.83	0.78	0.22	18.48	1.21	132.11	0.05	0.1	0.98
4	0	0	0	40	1.61	1.31	0.19	10.77	0.59	139.26	0.06	0.07	0.96
5	5	5	5	10	1.82	0.9	0.23	12.35	1.26	174.48	0.08	0.09	1.38
6	10	10	0	0	1.80	0.98	0.21	11.56	1.23	273.48	0.06	0.08	1.01
7	10	0	10	0	1.95	0.74	0.26	19.24	1.66	314.9	0.11	0.11	1.74
8	10	0	0	20	1.81	0.84	0.22	11.13	1.25	179.2	0.01	0.08	0.66
9	0	10	10	0	1.85	0.82	0.23	12.79	1.3	289.9	0.06	0.09	1.05
10	0	10	0	20	1.89	0.79	0.24	14.15	1.35	306.56	0.11	0.09	1.53
11	0	0	10	20	1.92	0.76	0.24	15.74	1.58	316.87	0.12	0.1	1.63
12	12.5	2.5	2.5	5	2.05	0.7	0.26	19.91	1.76	320.42	0.13	0.13	2.21
13	2.5	12.5	2.5	5	1.89	0.79	0.24	13.51	1.35	228.56	0.06	0.09	1.34
14	2.5	2.5	12.5	5	1.94	0.75	0.26	18.49	1.61	296.85	0.06	0.11	1.30
15	2.5	2.5	2.5	25	1.88	0.83	0.24	13.17	1.33	275.42	0.08	0.09	1.17
16	6.25	6.25	6.25	2.5	1.82	1.08	0.21	12.02	1.23	233.55	0.03	0.08	0.63
17	6.25	6.25	1.25	12.5	1.84	0.87	0.23	12.47	1.34	230.08	0.13	0.09	2.11
18	6.25	1.25	6.25	12.5	1.82	1.09	0.20	10.62	1.32	224.57	0.09	0.09	1.68
19	1.25	6.25	6.25	12.5	1.97	0.80	0.23	13.24	1.35	231.78	0.09	0.1	1.24
Correlation coefficient With grain yield					** 0.945	** -0.771	** 0.905	** 0.812	** 0.899	** 0.575	** 0.589	** 0.937	** 0.618
Computed optimum combination #					4:1:2:1 5:1:1:1	2:1:4:2 1:0:5:2	4:1:2:1 3:1:3:1	12.5:2.5:2.5:5	4:1:2:1	3:1:3:1	4:1:2:1	5:1:1:1	5:1:1:1

Moussa and Youssef (1992)

TABLE 4. Some *Zea maize* characters as affected by different combinations of sludge, town refuse, chicken manure and tafla treatments.

Treatment No	Organic manures and tafla tons Fed $^{-1}$				Grain yield Ardab / fed. #	Corn cob Ton / fed.	Biological Yield Ton / fed.	N %	N Uptake kg/ Fed.	P Uptake kg/ Fed.	K Uptake kg/ Fed.
	SL	TR	CH	TF							
1	20	0	0	0	9.17	0.55	1.83	3.29	42.37	2.32	1.93
2	0	20	0	0	6.3	0.56	1.44	2.07	18.26	1.15	1.32
3	0	0	20	0	13.92	0.65	2.6	2.28	44.36	1.56	3.11
4	0	0	0	40	5.55	0.40	1.18	1.75	13.47	1.23	1.08
5	5	5	5	10	10.9	0.62	2.15	2.46	37.54	1.98	2.13
6	10	10	0	0	8.05	0.37	1.5	2.31	26.03	1.8	1.69
7	10	0	10	0	17.05	0.79	3.18	3.43	81.87	4.77	3.1
8	10	0	0	20	9.2	0.43	1.3	3.36	43.27	2.57	1.93
9	0	10	10	0	11.65	0.55	2.18	2.73	45.48	2.66	2.66
10	0	10	0	20	13.7	0.64	2.56	2.73	52.36	2.68	3.07
11	0	0	10	20	15	0.69	2.79	2.94	61.74	2.1	3.56
12	12.5	2.5	2.5	5	19.6	0.87	3.61	3.08	84.51	3.84	3.57
13	2.5	12.5	2.5	5	13.7	0.62	2.54	2.52	48.33	3.64	3.07
14	2.5	2.5	12.5	5	16.8	0.78	3.13	2.55	59.97	3.99	3.99
15	2.5	2.5	2.5	25	12.6	0.59	2.35	2.66	46.92	2.29	2.46
16	6.25	6.25	6.25	2.5	10.5	0.49	1.96	2.73	40.13	2.35	2.2
17	6.25	6.25	1.25	12.5	11.1	0.51	2.06	2.8	43.51	3.13	2.64
18	6.5	1.25	6.25	2.5	10.4	0.48	1.94	2.73	39.75	2.77	2.04
19	1.25	6.25	6.25	12.5	15.4	0.6	2.48	2.94	55.15	2.81	2.44
Correlation coefficient with grain yield						** 0.898	** 0.897	** 0.485	** 0.948	** 0.756	** 0.956
Computed optimum combination ##					4:1:2:1	4:1:2:1	4:1:2:1	5:0:2:1 4:0:2:2	4:1:2:1	4:0:4:0	2:1:4:1 1:1:5:1

are ardab of corn grains = 0014 Ton

TABLE 5. Some soil physical, chemical and mechanical characters after wheat crop as affected by different combinations of sludge, town refuse, chicken manure and tafla.

Treatment No	Organic manures and tafla Tons fed^{-1}				Available Moisture %	Hydraulic Conductivity Cm/hour	Heat Capacity Cal/g	Difficult-Erodibility > 0.8 mm %	OM %	Na Meq/100g soil	Cl Meq/100g soil	HCO_3 Meq/100g soil	EC dSm^{-1}	Shear Strength kg/cm^2	Penetration Resistance kg/cm^2
	SL	TR	CH	TF											
1	20	0	0	0	1.74	1.34	0.14	17.07	0.94	154.17	0.03	0.1	0.86	30.33	.12
2	0	20	0	0	1.66	1.43	0.18	8.81	0.67	141.98	0.02	0.1	0.71	28.7	10
3	0	0	20	0	1.81	1.3	0.18	18.62	1.07	156.46	0.04	0.1	0.89	32.3	17
4	0	0	0	40	1.48	1.81	0.19	14.55	0.33	127.58	0.04	0.1	0.76	24.6	14.75
5	5	5	5	10	1.77	1.41	0.27	12.47	1.18	198.95	0.07	0.09	1.06	31.3	17.5
6	10	10	0	0	1.79	1.38	0.23	12.62	1.2	183.4	0.07	0.09	.94	33.2	25.5
7	10	0	10	0	1.65	1.45	0.25	10.96	1.01	186.43	0.03	0.09	0.81	32.3	24.6
8	10	0	0	20	1.80	1.36	0.18	12.72	1.21	220.92	0.08	0.11	1.53	33.3	25.5
9	0	10	10	0	1.82	1.33	0.16	13.21	1.27	236.82	0.08	0.13	1.47	34.0	26.0
10	0	10	0	20	1.89	1.28	0.28	17.62	1.31	263.12	0.03	0.1	1.97	35.1	27.5
11	0	0	10	20	1.94	1.23	0.29	18.38	1.52	254.28	0.15	0.14	2.08	37.2	29.5
12	12.5	2.5	2.5	5	1.93	1.26	0.26	17.87	1.45	246.94	0.15	0.12	1.47	34.3	26.75
13	2.5	12.5	2.5	5	1.88	1.39	0.24	17.37	1.29	230.23	0.14	0.12	1.32	33.0	25.25
14	2.5	2.5	12.5	5	1.85	1.31	0.25	17.28	1.25	249.06	0.10	0.12	1.26	32.7	24.75
15	2.5	2.5	2.5	25	1.76	1.43	0.26	15.44	1.02	160.32	0.11	0.1	0.88	32.0	24.0
16	6.25	6.25	6.25	2.5	1.65	1.58	0.24	10.76	0.99	216.48	0.11	0.1	0.91	31.4	23.7
17	6.25	6.25	1.25	12.5	1.9	1.27	0.24	17.91	1.32	226.86	0.15	0.11	1.48	34.6	27.0
18	6.25	1.25	6.25	12.5	1.86	1.32	0.25	17.42	1.28	217.91	0.14	0.11	1.29	33.7	25.0
19	1.25	6.25	6.25	12.5	1.82	1.40	0.24	13.09	1.24	210.51	0.14	0.12	1.26	32.48	24.5
					**	**	**	**	**	**	**	**	**	**	**
Correlation coefficient With grain yield					0.885	-0.74v	0.517	0.720	0.814	0.971	0.62	0.711	0.843	0.794	0.659
Computed optimum combination #					0:2:3:3 0:1:4:3	3:0:6:2	0:0:4:4	0:0:10:20	0:2:3:3 0:1:4:3	0:3:2:3	4:2:1:3 3:3:1:3	0:0:4:4	0:2:3:3	0:1:4:3	0:2:3:3

Moussa and Youssef (1992)

x_4 , and x_5, are the O.M %, EC dS.m $^{-1}$ and (Na, CL and HCO_3) meq/100g soil, respectively. These results stood in agreement with those of Tester (1990) and Mater *et al.* (1995) .

Mechanical strength

Values of mechanical strength expressed as shear strength and penetration resistance in kg/cm^2 are illustrated in the same table which show the values of (37.2kg/cm^2) and (29.5 kg/cm^2) for the combination treatment (0:0:10:20) ton/ fed from SL, TR, CH, and TF, respectively with regression equations y =-13.48 + 0.58 x_1 and y = -0.006 +0.236 x_2 where y is cereal crop (ardab/fed) and x_1, x_2 are shear strength and penetration resistance in kg/cm^2, respectively. These results stood in agreement with Davies (1985), Tester (1990), and Bouthaina *et al.* (1997).

Wheat yield characters

Table 6 shows the values of 1.38 ton/fed, 5.19 ton/and 2.69 ton/fed for cereal crop , straw yield and biological yield as a result of addition (0:0:10:20) ton /fed from SL, TR, CH and TF respectively, also the table declares the values 3.22% and (44.77,2.11,2.48) for N% and N,P and K uptake for the combination treatment (0:0:10:20) ton/fed from the used materials respectively with regression equations, y = 0.26+1.88 x_1,y = 1.49+ 0.17 x_2, y = 0.926 + 3.32 x_3 and y = 0.56 + 3.28 x_4 where y is grain yield (ardab/ fed) and x_1,x_2,x_3 and are x_4 N% and N,P and K nutrients uptake (kg/fed). These results stood in agreement with Abdel-Magid *et al.* (1995) and El-Fakhrani and Abdel-Magid (1997) .

Surveing the Best Treatments over the Research Work

The main reason from this surveying is to know the best treatment for favourable effects on soil and plant properties. Through surveying in Table 7 there are some of the best treatments come from the applied ones and others are derived from the used computer model as follows:

Corn crop

There are at least 2 best treatments (12.5:2.5 :2.5 :5) and (10 :2.5 : 5:5) from Sl, TR, CH and TF, tons/fed, respectively. All of them include a high level from (SL), a lowest one from (TF) and moderate or lowest level from (TR) and (CH). Both affected at least five soil and plant characters.

TABLE 6. Some wheat characters as affected by different combinations of sludge, town refuse, chicken manure and tafla.

Treatment No	Organic manures and tafla tons Fed^{-1}				Grain yield # Ardab / fed.	Straw yield ## Stalk / fed.	Biological Yield Ton / fed.	N %	N Uptake kg/ Fed.	P Uptake kg/ Fed.	K Uptake kg/ Fed.
	SL	TR	CH	TF							
1	20	0	0	0	3.46	2	1.02	3.08	15.75	0.92	0.76
2	0	20	0	0	3.19	1.25	0.79	1.86	8.45	0.86	0.82
3	0	0	20	0	5.53	2.84	1.54	2.73	22.64	1.45	1.56
4	0	0	0	40	2.71	1.34	0.74	1.61	6.54	1.03	0.82
5	5	5	5	10	4.11	2.55	1.25	2.87	17.69	1.08	1.1
6	10	10	0	0	4.27	2.81	1.34	2.38	15.24	0.92	1.09
7	10	0	10	0	3.71	2.59	1.20	2.94	16.36	0.84	1.04
8	10	0	0	20	4.3	2.41	1.25	3.01	19.41	0.88	1.07
9	0	10	10	0	5.71	3.52	1.74	2.87	24.58	0.92	1.55
10	0	10	0	20	7.4	3.48	1.98	2.66	29.52	1.61	2.02
11	0	0	10	20	9.27	5.19	2.69	3.22	44.77	2.11	2.48
12	12.5	2.5	2.5	5	8.16	5.33	2.56	3.4	41.97	2.01	2.32
13	2.5	12.5	2.5	5	7.04	3.14	1.76	3.15	33.26	1.98	1.91
14	2.5	2.5	12.5	5	6.52	2.97	1.72	3.46	34.4	2.12	1.92
15	2.5	2.5	2.5	25	3.86	1.46	0.94	2.24	12.96	1.11	1.01
16	6.25	6.25	6.25	2.5	3.32	1.21	0.80	2.94	14.64	0.97	0.93
17	6.25	6.25	1.25	12.5	7.73	3.82	2.11	2.36	38.95	2.21	2.49
18	6.25	1.25	6.25	12.5	6.66	3.16	1.79	2.66	26.57	1.57	1.66
19	1.25	6.25	6.25	12.5	5.67	3.91	1.83	2.38	20.24	1.01	1.51
Correlation coefficient wit grain yield						** 0.899	** 0.899	** 0.478	** 0.968	** 0.874	** 0.980
Computed optimum combination ###					0:0:5:3	5:1:1:1	0:0:5:3	1:1:5:1	0:0:5:3	1:1:5:1	0:0:5:3

are ardab of wheat grains = 150 kg.
#are stalk of wheat straw = 250kg.
#Moussa and Youssef (1992)

Wheat crop

There are four best treatments namely ; (0 : 2.5 : 10 : 15), (0 : 0 : 12.5 : 15), (0 : 0 : 10 : 20) and (0:5: 7.5 : 15), from the alone mentioned amendments, in sequence, No one of them includes sludge but all of them have at least a moderate level of either (CH) or (TF) and (TR) is involved in some best treatments but in small amounts.

Economical Study

Economical assessment for any research consider is an important parameter which is determined by the ratio of cost output and input as investment ratio. Tables 8 and 9 illustrate the investment ratios for corn and wheat seasons.

Corn crop

There are 15 treatments of experimental treatments above the national investment ratio of ARE (1.0LE/1.0LE cost), and the highest one is (12.5:2.5:2.5:5) which gave IR (2.15) comparing to the other treatments. The computed value shows that IR 2.1.

Wheat crop

The second season and residual effect of soil amendments resulted with seven combination successed treatments which are above the national investment ratio of ARE (1.18 LE/1.0 LE costs) and the maximum value of IR (1.83) came from a combination treatment (0:0:10:20). On the other side, the computed value shows IR (1.84). Results indicate that the maximum value of IR came from using a few quantity of tafla. Comparing the other researches and using combination treatments of little quantities of SL, TR and CH gave the same best IR.

TABLE 7. List of the best treatment for two seasons.

Character	Corn crop season	Wheat crop season
Available moisture	(10:2.5:5:5) or (12.5:2.5:2.5:5)	(0:5:7.5:15) or (o:2.5:10:15)
Hydraulic Conductivity	(5:0:10:10) or (2.5:0:12.5:10)	(0:0:15:10)
Heat Capacity	(10:2.5:5:5) or (7.5:2.5:7.5:5)	(0:0:10:20)
Soil erodibility	(12.5:2.5:2.5:5)	(0:0:10:20)
Organic matter	(10:2.5:5:5)	(0:2.5:10:15) or (0:5:7.5:15)
EC dsm^{-1}	(12.5:2.5:2.5:5)	(0:5:7.5:15)
Na meq / 100g soil	(7.5:2.5:7.5:5)	(0:7.5:5:15)
Cl meq / 100g soil	(10:2.5:5:5)	(10:5:2.5:5) or (7.5:7.5:2.5:5)
HCO_3 meq / 100g soil	(12.5:2.5:2.5:5)	(0:0:10:20)
Biological yield	(10:2.5:5:5)	(0:0.10:20) or (0:0:12.5:15)
Grain yield	(10:2.5:5:5)	(0:0:2.5:15)
Corn cob / Wheat straw	(10:2.5:5:5)	(12.5:2.5:2.5:5)
N %	(12.5:0:5:5) or (10:0:5:10)	(2.5:2.5:12.5:5)
N uptake Kg/Fed.	(10:2.5:5:5)	(0:0:12.5:15)
P uptake Kg/Fed.	(10:0:10:0)	(2.5:2.5:12.5:5)
K uptake Kg/Fed.	(5:2.5:10:5) or (2.5:2.5:12.5:5)	(0:0:12.5:15)
Shear strength Kg/cm^2		(0:2.5:10:15)
Penetration resistance Kg/cm^2		(0:5:7.5:15)

TABLE 8. Economical evaluation (on ascending order) for corn treatments in El-Khattara soil.

Treatment No	Organic manures and tafla ton fed^{-1}				Input	Out put	Investment Ratio IR
	SL	TR	CH	TF	LE	LE	LE/ILE costs
4	0	0	0	40	1221	639.6	0.52
2	0	20	0	0	1081	753.5	0.70
6	10	10	0	0	981	873.1	0.89
8	10	0	0	20	1051	999.6	0.95
18	6.25	1.25	6.25	12.5	1093.5	1228.4	1.03
16	6.25	6.25	6.25	2.5	1058.5	1140.7	1.08
5	5	5	5	10	1091	1213.1	1.11
9	0	10	10	0	1131	1267.3	1.12
17	6.25	6.25	1.25	12.5	1068.5	1203.8	1.13
1	20	0	0	0	881	1028	1.17
15	2.5	2.5	2.5	25	1156	1369.3	1.18
19	1.25	6.25	6.25	12.5	1143.5	1449.1	1.27
3	0	0	20	0	1181	1512.3	1.28
10	0	10	0	20	1151	1488.5	1.29
11	0	0	10	20	1201	1626	1.35
13	2.5	12.5	2.5	5	1086	1483.3	1.36
14	2.5	2.5	12.5	5	1136	1824	1.6
7	10	0	10	0	1031	1850.8	1.8
12	12.5	2.5	2.5	5	986	2117.6	2.15
*	10	2.5	5	5	1023.5	2149.95	2.1

* Computed treatment

National recorded IR (1993-1994) for corn (Zea maize) = 1.00 LE (Minstry of Agriculture and Land Reclamation).

TABLE 9. Economical evaluation (on ascending order) for wheat crop on residual effect of experimental treatments.

Tretment No	Organic manures and tafla ton fed^{-1}				Input	Out put	Investment Ratio IR
	SL	TR	CH	TF	LE	LE	LE/ILE costs
4	0	0	0	40	621	324.6	0.52
2	0	20	0	0	621	369	0.59
16	6.25	6.25	6.25	12.5	621	380	0.61
1	20	0	0	0	621	426	0.69
15	2.5	2.5	2.5	25	621	444.4	0.72
7	10	0	10	0	621	474.6	0.76
5	5	5	5	10	621	513	0.83
8	10	0	0	20	621	536.4	0.86
6	10	10	0	0	621	539.4	0.87
3	0	0	20	0	621	666.6	1.0
9	0	10	10	0	621	711.8	1.15
19	1.25	6.25	6.25	12.5	621	723.4	1.16
14	2.5	2.5	12.5	5	621	770.8	1.24
18	6.25	1.25	6.25	12.5	621	792.4	1.28
13	2.5	12.5	2.5	5	621	829.6	1.34
10	0	10	0	20	621	879.2	1.42
17	6.25	6.25	1.25	12.5	621	925.8	1.49
12	12.5	2.5	2.5	5	621	1029.2	1.66
11	0	0	10	20	621	1134.6	1.85
*	0	0	12.5	15	621	1143.2	1.84

* Computed treatment

National recorded IR (1993-1994) for wheat yield = 1.18 L.E (Minstry of Agriculture and Land Reclamation).

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تقنية خلط أنواع مختلفة من المصلحات العضوية كوسيلة لإصلاح أرض رملية حديثة الاستزراع

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استخدم تكنيك خلط المصادر العضوية نوعيا وكميا لإصلاح أرض رملية حديثة الاستخدام فى محطة التجارب الخاصة بكلية زراعة الزقازيق بمنطقة الخطارة. المصادر المستخدمة هى : قمامة المدن المكمورة ، مخلفات الدواجن والحمأة وقد استخدمت الطفلة كمحسن طبيعى غير عضوى . تراوحت معدلات الخلط بين صفر و ٥ر١٢٪ باستخدام موديل رياضى رباعى على الحاسب الآلى .

وقد استخدمت المعاملات لزراعة موسمين زراعيين متتاليين عليها بحيث أضيفت مرة واحدة فقط قبل زراعة محصول الذرة صيفا وزرع القمح شتاء على المتبقى منها فى الأرض . والنتائج المتحصلة يمكن ترتيبها كما يلى :

أولا : محصول الذرة

(أ) هناك على الأقل معاملتان متتميزتان وهما : (٠:١٠ر٢:٥:٥)

و (٥ . ١٢: ٥ . ٢: ٥ . ٢: ٥) من الحماة والقمامة ومخلفات الدواجن والطفلة على الترتيب .

(ب) كلتا المعاملتين تحتويان على أعلى نسبة حماة وأقل نسبة طفلة مع نسب متوسطة أو قليلة من مخلفان الدواجن والقمامة .

(جـ) كلتا المعاملتين توضحان الأثر المجتمع للمواد المستخدمة كلها .

(د) كلتا المعاملتين توضحان تأثير تحسن فى خصائص التربة والنبات .

ثانيا محصول القمح

(أ) هناك على الأقل ٤ معاملات متميزة هى : (صفر : ٥ . ٢: ١٥:١٠) و (صفر : صفر : ٥ . ١٢ : ١٥) و (صفر : صفر : ١٠ : ٢٠) و (صفر : ٥: ٥ . ٧ : ١٥) من مخلفات الحماة والقمامة والدواجن والطفلة على الترتيب .

(ب) لاتحتوى أى منها على الحماة مشيرة إلى التأثير المؤقت للحماة كمعاملة محسنة للتربة .

(جـ) كلها تحتوى على مستوى متوسط من مخلفات الدواجن أو الطفلة مشيرة إلى الأثر المتبقى لها فى الأرض .

(د) كلها تحتوى على نسبة قليلة من القمامة مشيرة إلى ثباتها مع الوقت نسبيا.والنتائج توضح أثر وأهمية تقنية الخلط للمحسنات المتواجدة بأى منطقة حيث تعطى بدائل جيدة تصلح للتطبيق فى أى منطقة وذلك بخلط محسنات مؤقتة التأثير مع أخرى متحملة للظروف حيث تصلح النسب المستخدمة كمؤشر للاستخدام عند التطبيق .

ثالثا : نسب الاستثمار

(أ) أعلى قيم تحصلت من استخدام أقل كمية من الطفلة .

(ب) استخدام كميات قليلة من كافة الأنواع أعطت أعلى قيم لنسبة الاستثمار .

(جـ) خلط الطفلة بالأسمدة العضوية بكميات صغيرة (أقل من ٢٥ . ٦ ٪) تعظم قيم الاستثمار.