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EFFECT OF SOME ORGANIC AND NATURAL CONDITIONERS ADDITION ON PHYSICAL AND CHEMICAL PROPERTIES OF SOIL, ITS NUTRITIONAL STATUS AND ZEA MAIS YIELD

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ABSTRACT

Two field experiments were carried out for two successive summer seasons at Ismailia Agric. Res. Station (ARC) El- Ismailia Governorate to study the effect of some organic and natural conditioners on physical (field capacity, wilting point and available water) and chemical properties of soil (pH, EC and availability of macronutrients), its nutritional status and yield and yield components of maize. The experiments were designed in a randomized complete block design with three replicates. Three forms of organic conditioners (compost, FYM and compost extract) were applied at two rates. Also two natural minerals (bentonite and dolomite) were applied at two rates each alone or both in combination.

Data indicated that values of FC, WP and AW increased significantly by increasing the rate of organic and natural conditioners. Compost treatments were superior in increasing values of FC, WP and AW at both seasons. Data also show a slight increase in soil moisture content in case of application of both bentonite and dolomite, the same trend was observed with bentonite combined with dolomite at both applied rates. Values of pH decreased with increasing the rates of organic conditioners but increased with increasing the rates of natural minerals at both tested seasons. Also, available N, P and K increased significantly with increasing the rate of organic manures (FYM, compost and compost extract) and minerals (bentonite, dolomite). High rate of organic conditioners (especially compost extract) or natural minerals (especially bentonite combined with dolomite) increased significantly macronutrients in soil for both growing seasons.

With regard to N, P and K contents in plant parts for maize, increased significantly with application of both organic and natural conditioners. N, P and K uptake increased gradually by increasing the rate of organic conditioners. Moreover, compost extract treatment was superior for increasing the uptake of macronutrients. Macronutrients uptake of maize straw and grain increased significantly with the application of natural conditioners alone (bentonite or dolomite) and/or in combination (bentonite + dolomite). This trend was more pronounced for dolomite.

The values of yield components increased significantly with the application of both organic and natural conditioners, also they increased gradually by increasing the rates of organic and natural conditioners. Compost extract treatment recorded the highest values of straw and grain yields. Natural mineral (bentonite and dolomite) application increased significantly yield components either they applied alone or both in combination. This finding was more pronounced in the case of dolomite treatment. On the other hand, the decreases of yield components were observed with increasing the rates of bentonite for both growing seasons.

INTRODUCTION

Most of the newly reclaimed soils in Egypt are sandy and calcareous soils that are of poor available nutrients. To increase their productivity, organic matter application plays an important role to retain the inorganic elements in complex and chelate forms. In this accord, organic manures are well established to be involved in fertilization of plants in almost worldwide, due to their beneficial effects on soil physico-chemical and biological characteristics, which in turn influence the growth and increase plants production (Youssef *et al*., 2001).

The utilization of agricultural wastes in producing organic fertilizers minimizes the environmental pollution and overcomes the organic matter deficiency. Recycling the agricultural wastes through composting process under aerobic conditions converts it to stabilized and useful compost product (Mona, 2003).

Compost that is mature and relatively free from contaminants, and has favorable physical and chemical properties, should enhance the plant growth. The importance of organic matter to Egyptian agriculture comes directly next to water importance (Awad, 1994). The benefit of this compost without chemical fertilizer demonstrated the validity and possibility of sustainable agronomic performance of Faba bean using locally available recycled organic materials (Abdelhamid *et al*., 2004).

Quedraogo and Zombre (2001) noted that the application of mature compost at reasonable rates improves plant growth, soil physical and chemical properties and increases available soil nutrient levels. Tayel et al. (1981) added that the soil conditioners increased N and K uptake by barley plants.

Farmyard manure has played an important role in the continuous supply of well-balance diets of nutrients to crops, and represents an important component of the nutrients cycle in agricultural ecosystems. Ghoudhary et al. (2004) showed that the application of FYM at a rate of 20 ton ha^{-1} improved the soil condition for plant growth by decreasing soil pH. Also, Ali et al. (2005) indicated that pH and EC values were slightly decreased with application FYM at rate of 2 or 3% to sandy soil after harvesting maize. Due to the aforementioned about suitable characteristics of sandy soil manure, several studies have assured the roles of organic amendments as an improving agent. The improvement of soil physical and chemical properties as well as nutrients status depends to a great extent on the rational use of organic materials as amendments. Wafaa *et al*. (2006) found that N, P and K contents in studied plant parts as well as yield components for both Tomato and Pea plants generally increased with application of organic manure (FYM and chicken manure) and natural minerals. Also, Tolessa and Friesen (2001) added that the growth and yield of Maize increased significantly with the application of FYM enriched with chemical fertilizer. This increase in grain yield reached up to 40% compared to conventional FYM, such increase in yield may be attributed to the nature and quality of enriched FYM, which supplies nutrients in a readily available form to plants; also, such FYM reacts

with native soil nutrients in a way that enhances their availability to crops. Moreover, Salib et al. (2002) found that application of FYM at a rate of 15 m^3/fed. was preferred for increasing P uptake by barely straw and K total content of both grains and straw ; each of mineral P and K fertilization was, however preferred for P total content of grains and whole plants. Heluf (2002) reported an increment of 0.47 t ha^{-1} in grain yield due to application of FYM during the first year over no FYM.

Bentonite is a natural deposits wide spread in different locations in Egypt and used for conditioning sandy soil. Fahim et al.(1994) indicated that the application shale for four years caused a slight improvement in both physical and chemical soil properties. Hamouda et al. (1999) added that addition of natural conditioners to sandy soils reveals improvement of their hydrophysical characteristics with improve crop yield. Seddik and Liala (2004) reported that adding bentonite with compost to sandy soil increased significantly total porosity, available water content, soil field capacity and peanut yield, contrary to bulk density and hydraulic conductivity, where their values were significantly decreased. El- Hady and El-Sherief (1988) mentioned that the application of bentonite at the rate of 9 % improved the physical and chemical properties of sandy soils. Yaseen (1989) found that shale can be used for improving moisture retentivity and fertility of sandy soils.

The objectives of the present study are to evaluate the response of Zea maize productivity, plant nutritional status and physical properties to the application of some organic and natural minerals (each alone and/or both in combination).

MATERIALS AND METHODS

Two field experiments were carried out at Ismailia Agriculture Research station (ARC) El-Ismailia Governorate during two summer successive seasons, with Maize (Zea maize L.cv Giza 10) to study the effect of some organic and natural conditioners on physical and chemical properties of soil, its nutritional status and Zea maize yield.

Some physical and chemical characteristics of the tested soil are shown in (Table 1), while rice straw compost, Farmyard manure, compost extract and natural minerals constituents' analysis are described in (Table 2).

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

Soil characteristics	Values
Particle size distribution %	
Coarse Sand	50.4
Fine Sand	40.4
Silt	3.20
Clay	6.00
Texture class	Sandy
Physical properties	
F.C %	8.20
W.P %	1.69
AV.W. %	6.51
Chemical properties	
$CaCO_3$ %	1.4
pH(Suspension 1: 2.5)	7.92
EC dS/m (saturated past extract)	0.37
Organic matter %	0.40
Soluble cations and anions (meq/l)	
Ca^{++}	0.95
Mg^{++}	0.89
Na^{+}	1.51
K^{+}	0.45
CO_3^{--}	1.42
HCO_3^{-}	-
Cl^{-}	1.02
SO_4^{--}	1.36
Available nutrients (ppm)	
N	85
P	15
K	30.6

Table (2): Some characters of compost, Farmyard manure (FYM), compost extract and some natural minerals

Determination	Compost	FYM	Compost extract	Bentonite	Dolomite
EC dS/m	6.61	4.20	6.0	8.99	2.89
pH	7.57	8.70	6.8	7.97	8.08
Organic matter %	56.64	28.8	-	-	-
Available nutrients (ppm)					
N	512	9800	23800	216	345
P	5033	600	24500	210	300
K	6319	21900	19600	951	956

The organic conditioners (rice straw compost and farmyard manure) were added at the rate of 10 and 20 m^3/ Fed. While compost extract was added at the rate of 100 and 200 Liter/ Fed. The natural minerals (bentonite and dolomite) were added individually or in combination (50 % bentonite and 50% dolomite) at two rates of 5 and 10 ton/fed. The organic and natural

conditioners were added by thoroughly mixing with the surface soil layer only before maize cultivation. All treatments received mineral fertilizers Ammonium sulfate (20 % N), Super phosphate (15% P_2O_5) and potassium sulfate (48% k_2O) at the partially recommended dose of maize. After maturity, maize plants were harvested by cutting just above soil surface. The yield of straw and grains of each plot were recorded. Samples of straw and grains were oven dried at 70°C, up to a constant dry weight, ground and prepared for digestion. Also, soil physical, chemical properties, organic and natural conditioners were determined according to Cottenie et al. (1982). Data obtained were subjected to statistical analysis according to Snedecor and Cochran (1982). The experiment was designed in a randomized complete block design with three replicates.

RESULTS AND DISCUSSION

1- Influence of organic and natural conditioners on some soil physical and chemical characteristics.

A-physical characteristics

1- Soil moisture characteristics:

Data presented in Table (3) indicated that addition of organic (FYM, compost and compost extract) and natural conditioners (bentonite, dolomite) increased significantly Field capacity (FC), wilting point (WP) and available water (AW) as compared to soil without any conditioners (control) in both growing seasons. Also, results revealed that the values of FC, WP and AW increased significantly by increasing the rate of organic conditioners. Moreover, compost treatments were superior in increasing values of FC, WP and AW as compared to FYM, compost extract or control (without any conditioners).

This is due to the increasing of the decomposition rate of organic matter by time and the indirect effect of organic matter on soil biochemical and physical properties. These results are in good agreement with those obtained by Taster (1990) and Wafaa (2006).

On the other hand, data showed a slight increase in soil moisture content in case of application of both bentonite and dolomite. Data also, revealed the same trend observed with the application of bentonite combined with dolomite at both tested rates.

In conclusion, the present results could suggest that high rate of rice straw compost recorded high values of soil moisture content (FC, WP and AW) as compared to control and/or the other applied treatments for both seasons.

Table (3): Effect of some organic and natural conditioners on soil moisture constants in the experimental soil

Treatments	Field capacity %	Wilting point %	Available water %

	First season	Second season	First season	Second season	First season	Second season
Control	**6.55**	**7.00**	**1.36**	**1.60**	**5.19**	**5.40**
Compost 1	12.9	14.2	2.50	3.00	10.4	11.2
Compost 2	14.2	15.3	2.70	3.40	11.5	11.9
FYM 1	10.4	11.2	2.03	2.60	8.37	8.60
FYM 2	11.2	12.6	2.21	3.00	8.95	9.60
Compost extract 1	7.93	8.70	1.53	1.65	6.40	7.05
Compost extract 2	7.77	8.50	1.63	1.80	6.14	6.70
M	**10.73**	**11.75**	**2.10**	**2.58**	**8.63**	**9.18**
Bentonite 1	8.50	9.60	1.86	2.21	6.64	7.39
Bentonite 2	9.60	10.3	1.97	2.40	7.63	7.90
Dolomite 1	7.00	7.80	1.66	1.74	5.34	6.06
Dolomite 2	7.60	8.40	1.80	1.90	5.80	6.50
Bentonit+ Dolomit1	8.43	9.30	1.74	1.92	6.69	7.38
Bentonit+ Dolomit2	9.23	10.0	1.87	2.16	7.36	7.84
M	**8.39**	**9.23**	**1.82**	**2.06**	**6.58**	**7.18**
LSD(0.05) Treatments	**0.141**	**0.361**	**0.222**	**0.466**	**0.211**	**0.526**
Rates	**0.012**	**0.028**	**0.022**	**0.029**	**0.019**	**0.035**
T*R	**0.199**	**0.318**	**0.254**	**0.328**	**0.215**	**0.395**

B-chemical characteristics

1- Soil reaction (pH)

Data presented in Table (4) indicated that values of pH decreased with increasing the rates of organic conditioners but increased with increasing the rates of natural minerals at both tested seasons. Data also, revealed that application of compost extract and the second rate of rice straw compost had slightly decreased pH values as compared to control treatment in both growing seasons. This result may be due to the production of organic acids, which formed as a result of organic matter decomposition (Ali et al., 2003, Gehan, 2006 and Wafaa, 2006).

2- Availability of macronutrients:

Concerning macronutrients availability in soil, at both seasons, data in Table (4) indicated that adding both organic and natural mineral conditioners increased available N, P and K in soil in both growing seasons as compared to the control treatments. Also, results showed that available N, P and K had increased significantly with increasing the rate of organic manures (FYM, compost and compost extract) and minerals (bentonite, dolomite). The same obtained results had recorded by Wong et al. (1999). Moreover, compost extract treatments (rates one and two) were superior in increasing available N, P and K as compared to other conditioners (FYM, compost and minerals) or control. This is due to the application of organic manures to sandy soil, which resulted in reducing pH values and increasing the total soluble salts and soluble ions (Khalifa and Hassan, 2000 and Wafaa, 2006).

Due to natural minerals, data revealed that (bentonite + dolomite) at both applied rates increased significantly available macronutrients in soil either they applied alone or both in combination. Moreover, increasing rates of natural minerals caused an increasing in available N, P and K in soil at both growing seasons. This may be due to indirect effect of natural minerals on soil physical properties and availability of macro nutrients.

The above mentioned results revealed that, the application of high rate of organic manures (especially compost extract)or natural minerals (especially bentonite combined with dolomite) increased significantly macronutrient in soil for both growing seasons.). In fact available N, P and K in soil were positively affected by the application of organic conditioner as compared to the natural minerals conditioners.

Table (4): Effect of some organic and natural conditioners on available macronutrients (ppm) in the experimental soil

Treatments	First season				Second season			
	pH	Available macronutrients (ppm)			pH	Available macronutrients (ppm)		
		N	P	K		N	P	K
Control	**8.00**	**140.0**	**18.0**	**29.0**	**8.12**	**137.1**	**17.0**	**30.0**
Compost 1	8.19	165.5	24.4	46.8	8.50	170.3	26.2	48.2
Compost 2	7.80	205.0	31.9	83.6	7.90	212.1	33.4	82.1
FYM 1	8.50	154.6	20.3	33.2	8.70	163.4	22.7	40.3
FYM 2	8.24	177.0	27.3	62.4	8.32	173.2	28.2	64.2
Compost extract 1	7.68	203.0	28.2	72.2	7.50	205.3	30.2	74.4
Compost extract 2	7.62	211.5	34.0	85.6	7.40	220.1	36.0	92.3
M	**8.01**	**186.10**	**27.68**	**63.97**	**8.05**	**190.73**	**29.45**	**66.92**
Bentonite 1	8.12	148.8	22.4	39.0	8.00	147.1	23.2	40.1
Bentonite 2	8.25	149.6	21.2	41.0	8.22	150.2	24.8	42.3
Dolomite 1	8.11	142.0	24.0	42.0	8.13	150.2	25.0	43.2
Dolomite 2	8.15	145.0	25.1	43.6	8.19	160.1	27.0	44.1
Bentonit+ Dolomit1	8.10	162.0	18.8	42.8	8.14	169.3	19.0	46.4
Bentonit+ Dolomit2	8.12	170.2	19.1	46.0	8.23	175.0	21.0	49.2
M	**8.14**	**152.93**	**21.77**	**42.40**	**8.15**	**158.65**	**23.33**	**44.22**
LSD(0.05) Treatments	**0.118**	**2.902**	**3.179**	**3.148**	**0.325**	**4.415**	**1.576**	**3.439**
Rates	**0.007**	**0.220**	**0.252**	**0.282**	**0.032**	**0.253**	**0.159**	**0.441**
T*R	**0.078**	**2.512**	**7.311**	**3.214**	**0.363**	**2.885**	**1.821**	**5.041**

1-Influence of organic and natural conditioners on macronutrients uptake and yield components (Straw and Grains) of maize.

a. Macronutrients uptake

With respect to macronutrients uptake of straw and grain data illustrated in Table (5) showed that maize values of nutrients N, P and K uptake increased significantly with the application of both organic and natural conditioners as compared to control treatment. Data also, revealed that N, P and K uptake values increased gradually by increasing the rate of organic conditioners. Moreover, compost extract treatment was superior for increasing the uptake of macronutrients as compared to the control and the other applied organic conditioners. These results agree with those reported by Negm et al. (2002) who indicated that compost supply was significantly effective in increasing absorbed macro elements by different parts of Zea maize plants.

Regarding the application of natural minerals results indicated that macronutrients uptake of straw and grain increased significantly with the application of natural conditioners alone (bentonite or dolomite) and/or both in combination (bentonite + dolomite), this trend was more pronounced for dolomite as compared to the other natural conditioners. Data also, mentioned that N, P and K uptake increased gradually by increasing the rate of natural conditioners. On the other hand, N, P and K uptake decreased by increasing the rate of bentonite, the same obtained results were recorded by Sadik (1984) who mentioned that bentonite has a low effect on uptake of N, P and K by plants.

Table (5): Effect of some organic and natural conditioners on macronutrients uptake of maize straw (Kg/ Fed)

Treatments	Uptake of macronutrients in Straw (Kg/ Fed.)					
	First season			Second season		
	N	P	K	N	P	K
Control	**17.3**	**9.9**	**37.1**	**17.7**	**10.2**	**52.8**
Compost 1	52.8	33.1	188.4	64.9	35.4	175.6
Compost 2	133.3	66.6	364.1	157.5	75.4	401.2
FYM 1	39.1	22.7	115.9	49.3	25.7	137.5
FYM 2	77.5	37.1	236.8	85.5	42.0	263.7
Compost extract 1	108.8	57.8	303.7	145.2	65.8	345.0
Compost extract 2	158.3	87.4	443.2	174.3	96.7	470.6
M	**94.97**	**50.78**	**275.35**	**112.78**	**56.83**	**298.93**
Bentonite 1	23.5	14.0	86.8	24.0	18.1	94.5
Bentonite 2	17.2	10.8	68.7	14.2	9.3	56.6
Dolomite 1	46.4	23.7	197.0	47.5	24.6	184.4
Dolomite 2	62.2	29.2	226.0	59.7	31.4	235.5
Bentonit+ Dolomit1	39.2	19.4	148.0	44.2	23.5	167.2
Bentonit+ Dolomit2	49.6	26.1	184.3	49.1	28.6	173.9
M	**39.68**	**20.53**	**151.8**	**39.78**	**22.58**	**152.02**
LSD(0.05)Treatments	**3.227**	**2.683**	**9.986**	**6.175**	**2.430**	**10.93**
Rates	**0.369**	**0.240**	**0.795**	**0.670**	**0.295**	**1.227**
T x R	**4.209**	**2.705**	**9.079**	**7.611**	**3.372**	**14.01**

Table (6): Effect of some organic and natural conditioners on macronutrients uptake of maize grains (Kg/ Fed)

Treatments	Uptake of macronutrients in Grains (Kg/ Fed.)					
	First season			Second season		
	N	P	K	N	P	K
Control	**24.7**	**7.4**	**14.2**	**27.2**	**7.9**	**17.3**
Compost 1	45.9	21.8	27.3	47.8	22.0	31.9
Compost 2	81.0	44.6	58.8	79.3	42.1	62.0
FYM 1	42.4	21.2	26.2	35.8	17.6	23.3
FYM 2	61.8	29.9	36.6	63.9	31.3	51.8
Compost extract 1	66.9	32.6	49.9	67.3	34.0	54.5
Compost extract 2	96.3	56.2	84.2	100.0	56.0	93.5
M	**65.72**	**34.38**	**47.17**	**65.68**	**33.83**	**52.83**
Bentonite 1	29.4	14.7	28.3	37.9	18.4	35.9
Bentonite 2	16.6	10.4	14.7	28.0	11.4	24.9
Dolomite 1	41.3	18.0	37.0	48.4	19.8	42.5
Dolomite 2	52.3	24.6	47.2	57.8	25.6	47.9
Bentonit+ Dolomit1	22.0	10.3	19.3	25.8	8.4	21.3
Bentonit+ Dolomit2	34.2	13.5	29.0	46.5	17.9	43.3
M	**32.63**	**15.25**	**29.25**	**40.73**	**16.92**	**35.97**
LSD(0.05)Treatments	**2.98**	**4.175**	**4.86**	**7.25**	**3.462**	**5.98**
Rates	**0.35**	**0.502**	**0.48**	**3.12**	**0.320**	**0.64**
T*R	**4.00**	**5.733**	**5.48**	**8.15**	**3.632**	**5.96**

b. Straw and Grain yields

With respect to maize straw and grain yields, data illustrated in Table (7) showed that values of yield components increased significantly with the application of both organic and natural conditioners as compared to control treatment. The same obtained results are in good agreement with those obtained by Wafaa et al. (2006). Also, results indicate that yield components of maize increased gradually by increasing the rates of organic and natural conditioners. Moreover, compost extract treatment had recorded the highest values of straw and grain yields as compared to those given by the other organic conditioners. The same obtained results recorded by Wong et al. (1999) who found that the yield of Zea maize was higher in soils receiving compost amendment as compared to FYM.

Regarding the applied natural mineral, results indicated that yield components increased significantly by adding the natural conditioner (bentonite and dolomite) either they applied alone or in combination. This behavior was more pronounced in the case of dolomite treatment. Moreover, yield components increased significantly by increasing the

rates of natural minerals .On the other hand, the decrease of yield component was observed with increasing the rates of bentonite for both growing seasons. This may be due to the accumulation of salts as a result of increasing the use of bentonite (Gouda, 1984). Organic conditioners were superior for increasing yield component as compared to natural minerals.

Table (7): Effect of some organic and natural conditioners on maize yield components

Treatments	Yield (Ton/Fed.)			
	First season		Second season	
	Straw	Grains	Straw	Grains
Control	**3.20**	**1.69**	**3.00**	**1.78**
Compost 1	8.26	2.62	8.44	2.66
Compost 2	11.90	3.62	12.50	3.50
FYM 1	6.67	2.57	6.49	2.16
FYM 2	8.43	3.05	9.00	3.20
Compost extract 1	11.33	3.33	11.90	3.40
Compost extract 2	12.66	4.01	13.00	4.00
M	**9.88**	**3.20**	**10.22**	**3.15**
Bentonite 1	3.50	1.89	3.69	2.31
Bentonite 2	2.86	1.12	2.40	1.73
Dolomite 1	7.24	2.68	7.32	2.95
Dolomite 2	8.19	3.15	8.41	3.28
Bentonit+ Dolomit1	5.44	1.40	5.97	1.61
Bentonit+ Dolomit2	6.35	2.01	6.30	2.87
M	**5.59**	**2.04**	**5.68**	**2.46**
LSD(0.05)Treatments	**0.02**	**0.293**	**0.025**	**0.370**
Rates	**0.03**	**0.030**	**0.043**	**0.040**
T*R	**0.45**	**0.392**	**0.049**	**0.453**

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تـأثير إضـافة بعـض المحسـنات العضـوية والطبيعيـة علـى الخـواص الطبيعيـة والكيماوية للتربة والحالة الغذائية لها وانعكاس ذلك على محصول الذرة.

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أجريت تجربتين حقليتين على نبات الذرة بمحطة البحوث الزراعية بالإسماعيلية(مركز البحوث الزراعية) خلال موسمين متتاليين بهدف دراسة تأثير إضافة المحسنات العضوية والمعادن الطبيعية سواء أضافتها بصورة منفردة أو مجتمعة وتأثيرها على الخواص الطبيعية والكيماوية للتربة وانعكاس ذلك على الحالة الغذائية و الإنتاجية لنبات الذرة. وقد صممت التجربة في قطاعات كاملة العشوائية وقدأضيف السماد البلدي و الكمبوست بمعدلين (10و20 م3/ف) ومستخلص الكمبوست بمعدلين (100و200 لتر/ف) كما أستخدم نوعين من المعادن الطبيعية (البنتونيت والدولوميت) بمعدلين(5 و10 طن /ف) وتم أضافتهم بصوره منفردة أو مجتمعه. أوضحت النتائج أن زيادة معدل الإضافة للمحسن العضوي والمعدني أدى إلى زيادة معنوية في بعض الخواص الطبيعية للأرض (السعة الحقلية – الماء الميسر- معامل الذبول) و كان لإضافة الكمبوست الأثر الأكبر في زيادة تحسن الصفات المائية للأرض (السعة الحقلية – الماء الميسر-معامل الذبول) في كلا الموسمين. وكان هناك تحسن طفيف في المحتوى الرطوبى مع(إضافة البنتونيت +الدولوميت). إضافة المحسنات العضوية أدى إلي انخفاض واضح في قيمة الرقم الهيدروجيني وكان الانخفاض يزيد بزيادة معدل الإضافة، وعلي العكس من ذلك أدى إضافة المعادن الطبيعية إلى رفع قيمة الرقم الهيدروجيني وكان هذا الارتفاع يزيد بزيادة معدل الإضافة. كذلك أظهرت النتائج زيادة معنوية عالية في تيسر العناصر الكبرى (نيتروجين وفوسفور وبوتاسيوم) بزيادة معدل الإضافة للمحسنات العضوية (سماد بلدي وكمبوست ومستخلص كمبوست) والمعادن الطبيعية (البنتونيت -الدولوميت) بالمقارنة بالكنترول. وكان لإضافة مستخلص الكمبوست والكمبوست أفضل الأثر علي زيادة تيسر هذه العناصر بالمقارنة بباقي المحسنات العضوية. أما عن المعادن الطبيعية فكان لخلط البنتونيت مع الدولوميت تأثيرا ايجابيا معنويا علي زيادة تيسر العناصر الكبرى في كلا الموسمين.وقد سجلت أعلي قيمة لامتصاص العناصر الكبرى من خلال إضافة المحسنات العضوية والمعدنية بالمقارنة بالكنترول.وكان هذا الامتصاص يزيد في القش والحبوب بزيادة معدل الإضافة للمحسن العضوي وبصفة خاصة لمستخلص الكمبوست والمحسن المعدني وبخاصة الدولوميت . وقد سجلت أعلي قيمة للمحصول (قش وحبوب)بإضافة المحسن العضوي والمعدني وكانت هذه الزيادة تدريجية بزيادة معدل الإضافة وكانت أفضل المعاملات معاملة مستخلص الكمبوست يليها الكمبوست والدولوميت. ولقد لوحظ انخفاض في المحصول بزيادة معدل الإضافة لمعدن البنتونيت في كلا الموسمين.