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EFFECT OF ACID AND BASE STIMULATION OF SOME TYPES OF COMPOST ON SOME SOIL PHYSICAL PROPERTIES

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ABSTRACT

A filed experiment was conducted at Bahtim agricultural research station, Kalubia Governorate, Egypt, during two successive seasons, summer 2019 and winter 2019/2020 to study the effect of acid and base compost pretreatment on some soil physical properties and sorghum (*Sorghum bicolor, cv.* Giza 15) productivity and barley (*Hordeum vulgare L.*, cv. Giza 123), productivity. Two separated incubation experiments were established, the first one was rice straw and corn straw pretreated by 5 % sulphuric acid then incubated for three weeks, whereas the second experiment was the rice straw and corn straw pretreated by 2 % potassium hydroxide then incubated for four weeks. At the end of incubation period, the first experiment was neutralized by both calcium carbonate and ammonium hydroxide to produce four different types of composted materials; composted rice straw neutralized by calcium carbonate 1B, composted rice straw neutralized by ammonium hydroxide 2B, composted corn straw neutralized by calcium carbonate 3B and composted corn straw neutralized by ammonium hydroxide 4B. In contrast, the second experiment was neutralized by both sulphuric acid and citric acid to produce another four types of compost; composted rice straw neutralized by sulphuric acid 1C, composted rice straw neutralized by citric acid 2C, composted corn straw neutralized by sulphuric acid 3C and composted corn straw neutralized by citric acid 4C. The eight pre-treated types of composts in addition to untreated rice straw 1A and untreated corn straw 2A were incorporated with soil by 0.5 kg m^{-2} to study their effects on soil physical properties and sorghum and barley productivity compared to control (soil without compost addition).

The results indicated that all treatments increased dry and water stable aggregates as compared to control. The treatment 2B (rice straw treated by sulphuric acid and neutralized by ammonium hydroxide) was the best treatment in increasing dry and water stable aggregates. Also, the values of hydraulic conductivity and total porosity were significantly increased in all treatments compared to control. The highest values of hydraulic conductivity and total porosity were recorded in the treatment 2B followed by 4B. Also, the added treatments significantly decreased values of bulk density compared to control. The least value of bulk density was recorded in the treatment 2B. The addition of composted amendments had a significant impact on soil moisture constants (field capacity, wilting point and available water) when compared to control values. The best addition that increased field capacity and available water was 2B, followed by 2C then 4B. Also, all of the treatments led to a significant increase in sorghum and barley yields as compared to control. The treatment 2B was the best treatment in increasing sorghum and barley yield compared to control. The increase in sorghum and barley yields may be attributed to that using of acid base pre-treated compost enhanced improvement of soil physical properties that led to increase in sorghum and barley yields.

INTRODUCTION

Compost use is one of the most important factors, which contribute to increased productivity and sustainable agriculture. In addition, compost can solve the problem faced on farmers with decreasing fertility of their soil. Due to soil fertility problems, crops returns often decrease and the crops are more susceptible to pest and disease because they are in bad condition **(Madeleine et al., 2005)**.

Mineral fertilization provides readily available nutrients for plant growth; however, it does not contribute to improve soil physical condition. Organic matter inputs through organic amendment, in addition to supplying nutrients, improve soil aggregation and stimulate microbial diversity and activity **(Shiralipour et al., 1992; Carpenter-Boggs et al., 2000)**. Applications of manure increases soil organic matter content and this results in increase in water holding capacity, porosity, infiltration capacity, hydraulic conductivity and water-stable aggregation and decreased bulk density **(Haynes and Naidu, 1998)**.

Compost consists of the relatively stable decomposed organic materials resulting from the accelerated biological degradation of organic materials under controlled, aerobic conditions **(Paulin and Peter, 2008)**. The decomposition process converts potentially toxic or putrescible organic matter into a stabilized state that can improve soil properties for plant growth.

By incorporation of compost into the soil, aggregate stability increases most effectively in clayey and sandy soils. Positive effects can be expected by well humified (promoting micro-aggregates), as well as fresh, low-molecular OM (promoting macro-aggregates). Macro-aggregates are mainly stabilized by fungal hyphen, fine roots, root hair and microorganisms with a high portion of easily degradable polysaccharides **(Amlinger et al., 2007)**. **Brown and Cotton (2011)** have observed that soil bulk density followed a predictable pattern with decreased bulk density at increasing rate of compost. This decrease was due to the organic fraction produced from compost decomposition is much lighter in weight than the mineral fraction in soils, As a result, increases in the organic fraction decrease the total weight and bulk density of the soil.

There is a strong negative correlation (R = – 0.81) between bulk density and organic matter content of the soil, an increase in soil organic matter content causing a decrease in bulk density of the soil. **Hemmat et al. (2010)** also found a negative correlation (R = – 0.75) between bulk density and soil organic carbon. The decrease in bulk density can be achieved by mixing organic material of compost into the soil **(Civeira, 2010)**.

Soil structure can be improved by the binding between soil compost and clay particles viacation bridges and through stimulation of biological activity and root growth **(Gao et al., 2010)**. Effect of compost includes increasing water field capacity and plant water availability **Farrell and Jones (2009)**. **Malik et al. (2014)** found that compost application gave higher values for field capacity mainly because the integrated use of nutrients improved the soil aggregates and pores spaces which allowed the free movement of water within the soil thereby, increasing the moisture content at field capacity. **Mbagwu (1989)** noted that organic wastes incorporated into the soil at the rate of 10% increased the total porosity by 23 %. Also, **Esmaeil (2018)** found increase in total porosity as a result of compost application.

Barley is one of the world's main cereals, ranking fourth in production after wheat, maize and rice **(FAO, 2013)**. Sorghum is the fifth most important cereal crop in the world after wheat, maize, rice, and barley **(FAO STAT, 2012)**. Sorghum is an important annual cereal crop grown for both grain and palatable green forage production. Additionally to sorghum as a food crop, there are possibilities of other alternative uses of sorghum such as feed for dairy animals, novel foods, industrial uses, processed foods starch, beverages and ethanol **(Taylor et al., 2006)**.

Ali et al. (2017) found a significance improvement in barley productivity as a result of compost application to the soil. Also, compost application to the soil has a positive effect on sorghum productivity; it improves plant growth, productivity and yield **Abd El-Mageed et al. (2018)**. Supplying organic matter to the soil will improve the soil content nutrients after mineralization of the organic matter and will increase the availability of nutrients for plants; subsequently, the uptake of nutrients will be increased and the growth and productivity of plants will be improved **(Hartley et al., 2010)**.

This study aims to estimate the effect of acid and base compost pretreatment on some soil physical properties and sorghum and barley productivity.

MATERIALS AND METHODS

A field experiment was established for two successive seasons, summer 2019 and winter 2019/2020 at Bahtim agricultural research station, Kalubia Governorate, Egypt, located at 30° 8’31.316” N latitude and 31°16’53.714” E Longitude, to study the effect of acid and base compost pretreatment on some soil physical properties as well as Sorghum yield (*Sorghum bicolor*, *cv.* Giza 15) and their residual effect on barley yield (*Hordeum vulgare L.*, cv. Giza 123).

Soil sampling:

Surface soil samples (0-30 cm depth) before planting as well as after harvesting, were collected from the experimental plots, air dried, crushed and sieved through 2 mm sieved holes, and analyzed for some chemical and physical properties. The main properties of soil samples before planting are illustrated in Table (1).

The soil samples were air dried and analyzed for some physical and chemical characteristics. The total soluble salts (EC) were determined in soil paste extract as dS m^{-1} **(Jackson, 1973)**. Soil organic matter content (%) and pH were analyzed according to the methods described by **Cottenie et al. (1982)**.

Table (1): Some properties of the studied soil before planting.

PH (1:2.5)	EC dS m^{-1}	O.M (%)	Particle size distribution				
			Sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Textural Class
7.72	1.95	1.15	11.25	15.75	34.50	38.50	Clay loam

H.C cm h^{-1}	B.D g cm^{-3}	T.P (%)	Soil moisture constants (%)		
			F.C	W.P	A.W
3.28	1.42	40.87	36.45	16.10	20.35

Dry aggregates diameters (mm)						
10.0-2.0	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.125	0.125-0.063	<0.063
35.10	25.15	13.85	6.51	5.02	7.05	7.32

Wet aggregates diameters (mm)						
10.0-2.0	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.125	0.125-0.063	Total (TSA)
9.80	9.62	6.98	3.24	2.15	3.12	34.91

Particle size distribution was carried out by the pipette method described by **Gee and Bauder (1986)** using sodium hexameta phosphateas a dispersing agent. Soil bulk density was determined using the undisturbed soil column according to **Richards (1954)**. Hydraulic conductivity (H.C) was determined according to **Klute (1986)**. Total soil porosity was calculated as percentage from the obtained values of real and bulk densities **(Richards, 1954)**. Stability of dry aggregates was determined according to the method of **Richards (1954)**. Stability of water stable aggregates was determined using the wet sieving technique described by **Yoder (1936)** and modified by **Ibrahim (1964)**.

The soil moisture constants (field capacity, available water and wilting point) for each treatment was prepared by using the pressure plate apparatus **(Klute, 1986)**, the available water was calculated by the subtraction of water content at Field capacity and wilting point.

Preparation of compost:

Two separated incubation experiments, the first was 20 kg of each rice straw and corn straw pre-treated by 130 L of 5 % sulphuric acid then incubated for 3 weeks whereas the second experiments was another 20 kg of both the rice straw and corn straw pre-treated by 130 L of 2 % potassium hydroxide then incubated for 4 weeks. At the end of incubation period, the first experiment was neutralized by both calcium carbonate and ammonium hydroxide to produce four different types of composted materials; composted rice straw calcium carbonate 1B, composted rice straw ammonium hydroxide 2B, composted corn straw calcium carbonate 3B, and composted corn straw ammonium 4B. While the second experiment was neutralized by both sulphuric acid and citric acid to produce another four types of compost ; composted rice straw sulphuric 1C, composted rice straw citric 2C, composted corn straw sulphuric 3C and composted corn straw citric 4C. The eight pre-treated types of composts in addition to untreated rice straw 1A and untreated corn straw 2A were incorporated with soil by 0.5 kg m^{-2} to study their effects on soil physical properties and sorghum and barley productivity compared to control. Some properties of the applied composts are shown in Table (2).

Table (2): Some properties of the applied composts.

Straw type	EC dS m^{-1} (1:5) (Manure: water Extract)	pH (1:10) (Manure: water suspension)	Water holding capacity (%)	Bulk density (g cm^{-3})
1A	1.95	7.36	161	0.28
2A	1.92	7.33	163	0.30
1B	5.21	7.32	224	0.35
2B	5.02	7.30	228	0.36
3B	5.19	7.33	222	0.38
4B	5.13	7.34	223	0.39
1C	5.19	7.37	222	0.34
2C	5.16	7.35	225	0.34
3C	5.30	7.39	221	0.37
4C	5.28	7.36	224	0.38

Experimental design:

A complete randomized block design experiment was carried out with plot sizes measuring 3 m X 3.5 m with three replicates in clay loam soil during two successive seasons (summer 2019 and winter 2019/2020), at the agricultural research station farm in Bahtem, Kalubia Governorate, Egypt. Sorghum was selected as an indicator crop to evaluate the effect of modified types of compost as soil amendment materials then followed by planting barley to study the residual effect of these conditioner materials. The treatments were as follows:

Control: Untreated soil.
1A: Rice straw added to the soil without treatment.
2A: Corn straw added to the soil without treatment.
1B: Rice straw treated by sulphuric acid and neutralized by calcium carbonate.
2B: Rice straw treated by sulphuric acid and neutralized by ammonium hydroxide.
3B: Corn straw treated by sulphuric acid and neutralized by calcium carbonate.
4B: Corn straw treated by sulphuric acid and neutralized by ammonium hydroxide.
1C: Rice straw treated by KOH and neutralized by sulphuric acid.
2C: Rice straw treated by KOH and neutralized by citric acid.
3C: Corn straw treated by KOH and neutralized by sulphuric acid.
4C: Corn straw treated by KOH and neutralized by citric acid.

All of compost types were added to the plots and incorporated by soil at rate (0.5 kg m^{-2}). Phosphorus and potassium were applied with a rate of 23.25 kg P_2O_5 fed^{-1} and 24 Kg K_2O fed^{-1} in the forms of superphosphate (15.5 % P_2O_5) and potassium sulfate (48 % K_2O), respectively, before planting. While, nitrogen was applied as ammonium nitrate (33.5% N) at a rate of 100 Kg N fed^{-1}, in two equal doses after complete germination and even before the emergence of spikes. Sorghum grains (*Sorghum bicolor, cv.* Giza 15) were sown at the rate of 7 Kg fed^{-1}. After sorghum crop harvest, barley (*Hordeum vulgare L.*, cv. Giza 123) was grown without compost treatment to study the residual effect of the treatments on the next yield. The rate of barely seeds was 60 kg fed^{-1}.

Statistical Analysis:

The data of this study were statistically analyzed through analysis of variance (ANOVA) and least significant difference (LSD) at 0.05 probability level to make comparison among treatment means according to **Gomez and Gomez (1984)**.

RESULTS AND DISCUSSION

Soil aggregates:

Dry stable aggregates:

Soil structure is defined by size and spatial distributions of particles, aggregates and pores in soils. The volume of solid soil particles and the pore volume influences air balance and root penetration ability.

It is clear from the data illustrated in Table (3) that the dominant diameters were 10.0-2.0 and 2.0-1.0 mm, they recorded higher percentages than the other diameters. These variations may be related to the agro management practices and environmental conditions. All treatments caused an increase in weights of 10.0-2.0 and 2.0-1.0 diameters than control. As a general view, the acid digested compost induced an increase in these diameters than in the base digested compost. The highest increase was found in the treatment 2B (rice straw treated with sulphuric acid then neutralized by ammonia hydroxide), followed by the treatment 4B (corn straw treated with sulphuric acid then neutralized by ammonia hydroxide), while the lowest increase was found in the treatment 2A (corn straw added without acid or base treatment). Similar results were obtained by **Rasool et al. (2007)** who concluded that application of organic matter promotes flocculation of clay minerals, which is essential for the aggregation of soil particles and play an important role in erosion control. The added organic matter aid to glues the tiny soil particles together into larger stable aggregates, increasing bio pores spaces which increase soil air circulation necessary for growth of plants and microorganisms. It is clear also that the added treatments had increased the stable aggregates with high diameters (10.0-2.0 and 2.0-1.0 mm) in the first season more than its residual effect in the second season.

Water stable aggregates (WSA):

As shown in Table (4), it is clear that the diameter 2.0-1.0 was the dominant, while 0.25-0.125 mm recorded the lowest diameter of water stable aggregates. All treatments caused an increase in the values of total water stable aggregates compared to control. It can be concluded that the increase in WSA in the first season was more than that occurred in the second season. The treatment 2B recorded the highest water stable aggregates, followed by 4B then 1B, while the treatment 1A caused the lowest increase in the weight of water stable aggregates. These results are in agreement with those of **Fliessbach et al. (2000)** who reported that organic soil management improved the soil structure by increasing soil aggregate .Also, this increase in WSA may be described to the sulfur resulted from digestion by sulphuric acid which is an agent of accelerating soil micro-organisms that led to better aggregation. In addition, the beneficial effect of organic matter resulted from compost digestion which causes the improvement of soil aggregation **Lanza and Spallaci (1970)**. These findings are coincided with those of and **Haynes and Naidu (1998)**.

Table (3): Distribution fractions (%) of dry stable sieved aggregates as affected by the studied treatments

Treatment	After first season							After second season						
	> 2.0 ml	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.125	0.125-0.063	< 0.063	> 2.0 ml	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.125	0.125-0.063	< 0.063
Control	36.25	26.00	13.58	6.28	4.62	6.07	7.20	34.54	25.61	12.59	6.41	5.01	6.41	9.43
1 A	41.25	24.58	14.00	4.45	4.47	4.17	7.08	40.31	27.25	11.16	5.32	6.34	4.81	4.81
2 A	38.12	25.00	14.36	6.16	5.55	4.55	6.26	35.60	25.55	13.91	4.63	7.23	5.28	7.80
1 B	48.12	23.26	13.55	3.09	3.44	4.01	4.53	44.91	24.72	15.03	3.23	5.36	2.83	3.92
2 B	50.48	24.00	11.35	1.25	4.55	4.99	3.38	47.34	22.67	14.25	3.24	5.72	3.76	3.02
3 B	45.99	20.00	13.58	3.58	4.00	3.58	9.27	44.62	19.41	12.00	5.32	7.21	4.54	6.90
4 B	48.85	21.95	13.51	3.21	3.49	3.20	5.79	45.85	20.47	15.36	2.68	5.53	3.29	6.82
1 C	44.48	25.58	14.12	3.14	3.58	4.01	5.09	40.81	22.76	16.38	4.80	6.41	4.72	4.12
2 C	47.62	23.35	14.02	3.02	3.85	3.38	4.76	44.28	20.49	17.42	2.70	7.47	2.30	5.34
3 C	42.25	23.58	14.06	4.39	4.51	4.13	7.08	40.69	23.48	19.41	5.82	5.03	3.15	2.42
4 C	44.56	24.89	14.32	3.25	3.59	3.25	6.14	41.93	22.65	16.72	4.25	4.78	5.26	4.41

Table (4): Water stable aggregates as affected by the studied treatments

Treatment	After first season							After second season						
	> 2.0 ml	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.125	0.125-0.063	Total	> 2.0 ml	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.125	0.125-0.063	Total
Control	9.72	9.99	7.15	4.02	1.85	3.06	35.79	9.72	9.99	7.15	4.35	1.85	3.06	36.12
1 A	10.69	11.56	8.25	6.04	1.82	2.45	40.81	9.17	12.51	7.94	6.02	1.34	1.80	38.78
2 A	8.31	11.20	9.82	3.86	1.90	3.62	38.71	8.03	10.87	10.14	4.13	2.64	1.84	37.65
1 B	10.46	13.51	10.27	8.67	2.54	4.87	50.32	11.70	13.72	8.82	9.03	3.18	2.29	48.74
2 B	5.20	10.49	11.65	15.81	6.76	4.25	54.16	9.13	14.78	10.69	11.70	4.38	1.68	52.36
3 B	12.80	13.05	9.42	7.73	2.19	2.96	48.15	11.53	12.61	10.37	5.85	3.10	3.46	46.92
4 B	11.17	8.91	10.45	10.03	5.21	4.64	51.41	10.68	12.49	9.65	8.94	4.83	2.93	49.52
1 C	4.64	13.69	13.29	7.71	2.13	4.06	45.52	6.13	13.37	12.70	7.42	2.36	1.67	43.65
2 C	7.57	14.75	11.61	8.56	2.60	4.31	49.40	8.05	13.47	10.81	9.52	2.94	2.04	46.83
3 C	9.38	13.21	9.82	3.84	1.86	2.62	40.73	7.38	13.96	10.62	3.12	2.02	1.84	38.94
4 C	5.45	13.53	13.00	7.95	2.25	4.02	46.20	8.94	14.50	11.84	4.27	2.98	2.22	44.75

Hydraulic conductivity (H.C):

Hydraulic conductivity refers to the rate at which water flows through soil. For instance, soils with well-defined structure contain a large number of macro pores, cracks, and fissures which allow for relatively rapid flow of water through the soil. The ability of soil to transmit water depends on the porosity and the arrangement of soil particles. It is clear from the data in Table (5) that all treatments significantly increased the values of hydraulic conductivity as compared to control. This variance was due to that these treatments helped in improvement of soil aggregates that led to a large number of macro pores that improve water flow through soil layers. It can be deduced the added treatments had increased hydraulic conductivity values in the first season than that happened by the residual effect of these treatments in the second season. The acid digested straws (B treatments) had increased hydraulic conductivity values compared to base digested straws (C treatments) and non-treated straws (A treatments) compared to control. The highest values of hydraulic conductivity were found in rice straw treated by sulphuric acid and neutralized by ammonia (2B) while the lowest values were for the untreated corn straw (2A). These results were agreed with those of **Eusufzai et al. (2007**) who found a significant increase in hydraulic conductivity values of soil amended with rice compost.

Bulk density (B.D):

Compost application generally influences soil structure in a beneficial way by lowering soil density due to the admixture of low density organic matter into the mineral soil fraction. This positive effect has been detected in most cases and it is typically associated with an increase in porosity because of the interactions between organic and inorganic fractions **(Amlinger et al., 2007)**. It is clear from the data in Table (5) that the lowest values of bulk density were recorded in acid digested straws followed by base digested straws then non-digested straws then control (untreated plots). Also it can be noticed that treatments 2B and 4Bwere the best in decreasing soil bulk density. They decreased the value of bulk density from 1.40 g cm^{-3} of control to 1.15 and 1.18 g cm^{-3}, respectively. This decrease in the bulk density was due to that using rice straw compost led to production of high contents of organic matter to the soil that causes formation of stable aggregates units, this could cause increases in the total soil volume and decreases in the values of soil bulk density. These results are confirmed with the results of **Zhao et al. (2019)** and **Brown and Cotton (2011)**, who observed that compost application influences soil structure in a beneficial way by lowering soil density as a result for the admixture of low density organic matter into them in eral soil fraction. In addition, the organic fraction is much lighter in weight than the mineral fraction in soils. Accordingly, the increase in the organic fraction decreases the total weight and bulk density of the soil.

Total porosity (T.P):

Total soil porosity is an index of the relative volume of pores in soil. It is a special formula which explains the relationship between both the soil real and bulk densities. Compost increases the portion of meso- and macro-pores because of an improved aggregation and stabilization of soil significantly initiated by various soil organisms **(Liu et al., 2007)**. As shown in Table (5), there was a significant increase in values of total porosity in all treatments as compared to control. The organic matter produced from acid treated straw compost improved soil aggregation, it increased formation of macro aggregates that led to formation of macro pores and increase the total porosity. The best treatment caused improvement in total porosity was 2B, it has a value of total porosity 49.32 % and 47.21 % in the first and second seasons, respectively. While the lowest increase in total porosity was found in the soil treated by 2A (42.66 % and 42.16 % in the first and second seasons, respectively). These results are in agreement with that of **Esmaeil (2018)** who deduced a significant increase in total porosity values as a result of compost application to soil.

Table (5): Hydraulic conductivity, bulk density and total porosity in the studied soil as affected by different treatments

	After first season			After second season		
	H.C (cm h^{-1})	B.D (g cm^{-3})	T.P (%)	H.C (cm h^{-1})	B.D (g cm^{-3})	T.P (%)
Control	3.36^{d}	1.40^{d}	41.37^{d}	3.35^{c}	1.40^{c}	41.12^{c}
1 A	4.31	1.29	43.21	4.06	1.34	42.75
2 A	4.17	1.35	42.66	4.12	1.37	42.19
Mean	4.24^{c}	1.32^{c}	42.94^{c}	4.09^{b}	1.36^{c}	42.47^{b}
1 B	6.92	1.19	46.91	6.51	1.23	45.13
2 B	7.97	1.15	49.32	7.11	1.19	47.21
3 B	6.40	1.27	45.81	5.74	1.24	44.88
4 B	7.31	1.18	47.26	6.60	1.21	46.02
Mean	7.15^{a}	1.19^{a}	47.33^{a}	6.49^{a}	1.22^{a}	45.81^{a}
1 C	5.38	1.26	44.87	4.26	1.32	44.23
2 C	6.41	1.21	46.76	5.32	1.25	46.18
3 C	5.48	1.29	44.60	4.30	1.33	43.96
4 C	5.77	1.22	45.72	4.63	1.28	45.35
Mean	5.76^{b}	1.24^{b}	45.49^{b}	4.63^{b}	1.30^{b}	44.93^{a}
L.S.D (0.05)	0.63	0.03	1.19	0.61	0.04	1.13

Soil moisture constants:

Soil field capacity, wilting point and available water are considered the three main soil moisture constants. The amount of water available to plant depends on two factors: the quantity of water that is able to infiltrate into the soil and the quantity of water that the soil is able to hold onto. Field capacity and available water holding capacity are influenced by the particle size, structure and content of OM.

Data in Table (6) pointed out that all treatments significantly increased field capacity and available water compared to control. It is clear that the added treatments improved field capacity and available water values in the first season, also these parameters were improved in the second season as affected by the residual effect of these treatments. The highest values of filed capacity and available water were found in plots treated by acid digested compost then base digested and non-treated compost. The best addition improved field capacity and available water was 2B, followed by 2C then 4B. The higher values obtained in 2B and 4B may be attributed to the organic matter (resulted from acid treated compost) which indirectly contributes to soil texture via increased soil faunal activity leading to improve the soil aggregation and porosity which ultimately increased the number of macro-pores and thus, infiltration rates. The organic matter was found contributing to the stability of soil aggregates and pores through the binding properties of organic material. These results are in agreement with those of **Malik et al. (2014)**, who found that soil treatment with compost gave higher values for field capacity due to improvement of the soil aggregates and pores spaces which allowed the free movement of water within the soil there by, increasing the moisture content at field capacity. An increase field capacity should be considered a consequence of total porosity augmentation in soils after rice and corn composts application **(Weber et al., 2007)**.

Table (6): Soil moisture constants (%) in the studied soil as affected by different treatments

	After first season			After second season		
	F.C (%)	W.P (%)	A.W (%)	F.C (%)	W.P (%)	A.W (%)
Control	36.62^{d}	16.20^{c}	20.42^{d}	36.30^{d}	16.15^{c}	20.15^{c}
1 A	41.23	16.14	25.09	39.83	16.32	23.51
2 A	38.86	15.38	23.48	37.61	15.20	22.41
Mean	40.12^{c}	15.76^{c}	24.29^{c}	38.72^{c}	15.76^{c}	22.96^{b}
1 B	44.90	18.30	26.60	42.78	18.97	23.81
2 B	50.91	21.50	29.41	49.14	20.96	28.18
3 B	44.82	19.68	25.14	41.01	17.98	23.03
4 B	46.18	19.04	27.14	45.02	20.52	24.50
Mean	46.70^{a}	19.63^{a}	27.07^{a}	44.51^{b}	19.68^{a}	24.83^{a}
1 C	43.06	19.00	23.06	41.36	18.40	22.96
2 C	46.23	19.10	27.13	44.69	19.61	25.08
3 C	42.81	17.25	25.56	41.07	18.14	22.93
4 C	43.26	17.12	26.14	42.80	18.53	24.27
Mean	43.84^{b}	18.12^{b}	25.47^{b}	42.48^{a}	18.67^{b}	23.81^{a}
L.S.D (0.05)	1.68	0.81	1.04	1.53	0.76	1.41

Sorghum and barley yields as affected by the added treatments:

It is clear from the data in Table (7), that sorghum and barley yields were significantly increased in all the treated plots as compared to control (untreated soil). It can be deduced that acid digested compost led to the highest increase in grains yield of sorghum and barley (1.17 and 2.22 ton fed^{-1}, respectively), followed by base digested compost (1.02 and 1.83 ton fed^{-1}), while non-digested compost led to the lowest increase in sorghum and barley yields (0.73 and 1.52 ton fed^{-1}, respectively). Previous studies have also shown that applications of compost increased barley grain yield (**Agegnehu et al., 2016**). Also **Abd El-Mageed et al. (2018)** found a significance increase in sorghum grains yield after compost application. This increase in sorghum and barley yields may be attributed to that the pre-acid and base treatment of corn and rice straw caused a high delivering of nutrients into the soil. Also, using of pre-digested compost had decreased soil pH and EC and improved soil physical properties which led to increase availability of nutrients and increase sorghum and barley yields. Also, application of the pre-digested compost to the soil led to a high supplying organic matter to the soil that improved the soil content nutrients after mineralization of the organic matter and increased the availability of nutrients for plants; subsequently, the uptake of nutrients will be increased and the growth and productivity of sorghum and barley will be improved **(Hartley et al., 2010)**.

Table (7): Sorghum and barley yields as affected by different treatments

Treatment	Sorghum-first season (ton fed^{-1})	Barley-second season (ton fed^{-1})
Control	0.64^{d}	1.21^{d}
1 A	0.75	1.60
2 A	0.71	1.43
Mean	0.73^{c}	1.52^{c}
1 B	0.99	1.90
2 B	1.34	2.55
3 B	1.03	1.96
4 B	1.31	2.48
Mean	1.17^{a}	2.22^{a}
1 C	0.96	1.75
2 C	1.19	2.03
3 C	0.89	1.70
4 C	1.04	1.84
Mean	1.02^{b}	1.83^{b}
L.S.D (0.05)	0.07	0.15

CONCLUSION

Application of rice and corn straws treated by acid and base improved soil physical properties to high extent. Such improvement attributed to one or more of the following reasons: (1) Incorporation of compost into the soil, aggregate stability increases most effectively. (2) The organic matter produced from the treated straw compost increased formation of macro aggregates that led to formation of macro pores and increase the total porosity.(3) Values of hydraulic conductivity were increased as a result of formation of large number of macro pores that improve water flow through soil layers. (4) Compost application decreased values of soil bulk density as a result for the admixture of low density organic matter into the mineral soil fraction. (5) Treated compost gave higher values for field capacity due to improvement of the soil aggregates and pores spaces which allowed the free movement of water within the soil there by increasing the moisture content at field capacity.

REFERENCES

Abd El-Mageed, T.A. ; I.M. El- Samnoudi ; A.M. Ibrahim and A.R. Abd El Tawwab (2018). Compost and mulching modulates morphological, physiological responses and water use efficiency in sorghum (*bicolor* L. *Moench*) under low moisture regime. Agricultural Water Management 208: 431-439.

Agegnehu, G. ; P.N. Nelson and M.I. Bird (2016). Crop yield, plant nutrient uptake and soilphysicochemical properties under organic soil amendments and nitrogen fertilizationon Nitisols. Soil Tillage Res., 160: 1–13.

Ali, H. G. ; Sh. I. Abbas and A. A. Badawy (2017). Barley Productivity and Protein Content as Effected by fertilization Treatments under Calcareous Soil Conditions. Alex. J. Agric. Sci., 62(3): 319-328.

Amlinger, F. ; S. Peyr ; J. Geszti ; P. Dreher ; W. Karlheinz and S. Nortcliff (2007). Beneficial effects of compost application on fertility and productivity of soils.Literature Study, Federal Ministry for Agriculture and Forestry, Envi. and Water Management, Austria. [Online] Available: www.umweltnet.at/filemanager/ download/ 20558/(Dec. 2013).

Brown, S. and M. Cotton (2011). Changes in Soil Properties and Carbon Content Following Compost Application: Results of On-farm Sampling. Compost Science and Utilization, 19(2): 87-96.

Carpenter-Boggs, L. ; A. C. Kennedy and J. P. Reganold (2000). Organic and biodynamic management: Effects on soil biology. Soil Sci. Soc. Am., 54: 1651-1659.

Civeira, G. (2010). Influence of municipal solid waste compost on soil properties and plant reestablishment in Peri-Urban environments. Chilean J. Agric. Res., 70(3): 447-453.

Cottenie, A. ; M. Verloo ; L. Kiekens ; G. Velgh and R. Camerlynch (1982). "Chemical analysis of plants and soils, Lab". Anal Agrochem State Univ. Ghent Belgium, 63.

Esmaeil, M. A. (2018). Effect of sulphur, gypsum and compost addition and tillage methods on soil properties and wheat productivity in saline soil. Menoufia J. Soil. Sci., 3(6): 121-139.

Eusufzai, M. K. ; T. Maeda and K. Fujii (2007). Field Evaluation of Compost, Sawdust and Rice Straw Biomass on Soil Physical and Hydraulic Properties. J. Jpn. Soc. Soil Phys., 107: 3-16.

FAO STAT (2012). FAO Statistical Yearbook: agriculture production. [cited Jan 6, 2015]. Available from: http://www.fao.org/economic/ess/ess-publications/ess-yearbook/ess-yearbook 2012/en/.

FAO, (2013). Faostat 2013 http://faostat.fao.org Food and Agriculture Organization (FAO), Rome, Italy.

Farrell, M. and D.L. Jones (2009). Critical evaluation of municipal solid waste composting andpotential compost markets. Bioresource Tech., 100: 4301-4310.

Fliessbach, A. ; P. Mader ; D. Dubois and L. Gunst (2000). Results from a 21 years old field trial. Organic farming Enhance Soil Fertility and Biodiviersity Fi Bl Dossier N1, 15, pp19.

Gao, M. ; F. Liang ; A. Yu ; B. Li and L. Yang (2010). Evaluation of stability and maturity duringforced- aeration composting of chicken manure and sawdust at different C/N ratio.Chemosphere 78: 614-619.

Gee, G. W. and J. W. Bauder (1986). Particle size analysis in Mehtods of soil Analysis. (Klute, Ed. part 1.Agron.9, 15:383-409, Am. Soc. Agron. Madison, Wisconsin, U.S.A).

Gomez, K.A. and A.A. Gomez (1984). Statistical Procedures for Agriculture Research (2 ed.) John Wiley and Sons I nc. New York.

Hartley, I.P. ; D. W. Hopkins ; M. Sommerkorn and P. A. Wookey (2010). The response of organic matter mineralization to nutrient and substrate additions in sub-arctic soils. Soil Biol. Biochem., 42: 92-100.

Haynes, R.J. and R. Naidu (1998). Influence of lime, fertilizer and manure application on soil organic matter content and soil physical conditions. Nutrient Cycling in Agro ecosystems, 51(2): 123-137.

Hemmat, A. ; N. Aghilinategh ; Y. Rezainejad and M. Sadeghi (2010). Long-term impacts of municipal solid waste compost, sewage sludge and farmyard manure application on organic carbon, bulk density and consistency limits of a calcareous soil in central Iran. Soil Till. Res., 108: 43-50.

Ibrahim, S. A. (1964). Studies of the size distribution of water stable aggregates in the soil of the Nile Delta. M. Sc. Thesis, Fac. of Agric., Ain-Shams Univ., Egypt.

Jackson, M. L. (1973). Soil Chemical Analysis. Prentice Hall of Indian Private limited. New Delhi, India.

Klute, A. (1986). Methods of Analysis. Part 1, Soil Physical Properties, ASA and SSSA, Madison, WI.

Lanza, F. and P. Spallacci (1970). Effect of long term organic manuring on soil fertility, organic matter balance and agricultural production. Soils and Fert., 39:1497.

Liu, B. ; M. L. Gumpert ; S. Hu and J. B. Ristaino (2007). Long-term effects of organic and synthetic soil fertility amendments on soil microbial communities and the development of southern blight. Soil Biology and Biochemistry, 39: 2302-2316.

Madeleine, I. ; S. Peter ; T. Tim and V. Tom (2005). Agrodok No. 8: The preparation and use of cmpost. Agromisa Foundation, Wagenningen.

Malik, S. S. ; R. C. Chauhan ; J. S. Laura ; T. Kapoor ; R. Abhilashi and N. Sharma (2014). Influence of Organic and Synthetic Fertilizers on Soil Physical Properties. Int. J. Curr. Microbiol. App. Sci., 3(8): 802-810.

Mbagwu, J.S.C. (1989). Effects of organic amendments on some physical properties of tropical Utisol. Biol. Wastes 28: 1-13.

Paulin, B. and O. M. Peter (2008). Compost Production and Use in Horticulture. Western Australian Agri. Authority, Bulletin 4746. [Online] Available: www.agric.wa.gov.au (Nov. 2013).

Rasool, R. ; S.S. Kukal and G.S. Hira (2007). Soil physical fertility and crop performance as ffected by long term application of FYM and inorganic fertilizers in rice–wheat system, Soil Till. Res., 96: 64–72.

Richard s, L. A. (1954). Diagnosis and improvement of Saline and Alkali Soils. U.S. Dept. Agric. Hand Book No. 60, U.S. Govt. Print. Office, Washington, D. C.

Shiralipour, A. ; Dennis B. McConnell and Wayne H. Smith (1992). Physical and chemical properties of soil as affected by municipal solid waste compost application. Biomass Bioenergy, 3: 195-211.

Taylor, J. ; T.J. Schober and S.R. Bean (2006). Novel food and non-food uses for sorghum and millets. J. Cereal Sci. 44 (3): 252‑271.

Weber, J. ; A. Karczewska ; J. Drozd ; M. Licznar ; S. Licznar ; E. Jamroz and A. Kocowicz (2007). Agricultural and ecological aspects of a sandy soil as affected by the application of municipal solid waste composts. Soil Biol. and Bioche., 39: 1294-1302.

Yoder, R.E. (1936). A direct method of aggregate analysis of soils and a study of the physical nature of erosion losses. J. Amer. Soc. Agron., 28: 337-351.

Zhao, X. ; G. Yuan ; H. Wang ; D. Lu ; X. Chen and J. Zhou (2019). Effects of full straw incorporation on soil fertility and crop yield in rice-wheat rotation for silty clay loamy cropland. Agronomy, 9(3): 133-144.

تأثير التحفيز الحامضى والقاعدى لبعض أنواع الكمبوست على بعض خواص الأرض الطبيعية

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تم إجراء تجربة حقلية خلال الموسم الصيفى ٢٠١٩ والموسم الشتوى ٢٠٢٠/٢٠١٩ بمحطة بحوث بهتيم بمحافظة القليوبية ، وذلك لدراسة تأثير إضافة الكمبوست المعامل مسبقاً بحامض وقاعدة على بعض الخواص الطبيعية للتربة وإنتاجية الذرة الرفيعة والشعير. تم إجراء تجربتين ، في هذه التجربة تم نقع قش الأرز والذرة فى حامض كبريتيك ٥ % لمدة ثلاثة أسابيع، بينما فى التجربة الثانية تم نقع قش الأرز والذرة فى محلول هيدروكسيد بوتاسيوم ٢ % لمدة أربعة أسابيع، ثم تم معادلتهم بواسطة كربونات الكالسيوم ومحلول الأمونيا فى معاملة الحامض بينما تم معادلتهم بحامض كبريتيك وحامض ستريك فى معاملة هيدروكسيد البوتاسيوم. أيضاً تم إضافة قش الأرز والذرة للتربة بدون معاملة بحامض أو قاعدة ، وبذلك يكون هناك أحد عشر معاملة وهى : ١- كنترول (تربة غير معاملة) ،٢- قش أرز غير معامل (1A) ، ٣- قش ذرة غير معامل (2A) ،٤- قش أرز معامل بحامض كبريتيك ومعادل بكربونات كالسيوم (1B) ، ٥- قش أرز معامل بحامض كبريتيك ومعادل بمحلول أمونيا (2B) ، ٦- قش ذرة معامل بحامض كبريتيك ومعادل بكربونات كالسيوم (3B) ، ٧- قش ذرة معامل بحامض كبريتيك ومعادل بمحلول أمونيا (4B) ،٨- قش أرز معامل بهيدروكسيد بوتاسيوم ومعادل بحامض كبريتيك (1C) ، ٩- قش أرز معامل بهيدروكسيد بوتاسيوم ومعادل بحامض ستريك (2C) ، ١٠- قش ذرة معامل بهيدروكسيد بوتاسيوم ومعادل بحامض كبريتيك (3C) ، ١١- قش ذرة معامل بهيدروكسيد بوتاسيوم ومعادل بحامض ستريك (4C).تم استخدام تصميم قطاعات كاملة العشوائية لموسمين متتاليين فى هذه التجربة لدراسة تأثير أنواع الكمبوست المختلفة على بعض الخواص الطبيعية للتربة وإنتاجية الذرة الرفيعة والشعير.

أشارت النتائج إلى وجود زيادة فى قيم التجمعات الثابتة سواء الجافة أو المبتلة وبالتالى كان هناك زيادة فى التجمعات الكلية الثابتة فى كل المعاملات مقارنة بالكنترول ، وكانت المعاملة الأفضل هى (2B). أيضاً أدت جميع المعاملات المستخدمة إلى زيادة معنوية فى قيم التوصيل الهيدروليكى والمسامية الكلية ، وكانت القيم ألأكبر للتوصيل الهيدروليكى والمسامية الكلية فى معاملة (2B) تلاها معاملة (4B). أيضاً كان هناك انخفاض ملحوظ فى قيم الكثافة الظاهرية فى المعاملات المستخدمة مقارنة بالكنترول ، وكانت القيمة الأقل للكثافة الظاهرية فى المعاملة (2B). أيضاً كان هناك زيادة معنوية فى قيم ثوابت الرطوبة فى المعاملات المستخدمة مقارنة بالكنترول، وكانت الزيادة الأكبر فى قيم السعة الحقلية والماء الميسر فى معاملة (2B) تلاها معاملة (2C) ثم (4B). أيضاً المعاملات المستخدمة أدت إلى زيادة معنوية فى إنتاجية الذرة الرفيعة والشعير مقارنة بالكنترول، وكانت المعاملة الأفضل فى تحسين إنتاجية الذرة الرفيعة والشعير هى (2B). هذه الزيادة فى إنتاجية الذرة الرفيعة والشعير نتيجة لأن إضافة الكمبوست المعامل مسبقاً بحامض أو قاعدة أدت إلى تحسن فى الخواص الطبيعية للتربة وأيضاً إلى انخفاض قيم pH و EC للتربة مما أدى إلى زيادة تركيزات العناصر المغذية المتاحة للنبات مما أدى فى النهاية إلى زيادة إنتاجية محصول الذرة الرفيعة والشعير.