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Use of Rice Straw Mixed Ammonium, Biochar and Compost for Improving Productivity of a Sandy Soil and the Response of Wheat

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ABSTRACT

This laboratory and field experiment were to assess the use of rice straw (RS); biochar rice straw-compost (BRS); rice straw- ammonium (RSN) and compost (ST) at 0, 12.5 and 25 Mg ha^{-1} on the development of wheat plants and improve a sandy soil's productivity. In winter seasons of 2017/2018 – 2018/2019 at the Ismailia Agricultural Research Station. In laboratory experiment soil treatments incubation and studied OC%, SP, FC, PWP and AW. In field experiment i.e. yield, yield components, N, K and P, pH, ECe and bulk density at ripeness's stage, times application before sowing (Ap_1) and with sowing (Ap_2) on wheat and study design a split block. Results the end of incubation period, losses of OC% about 21.2, 7, 20.6 and 32.1% due to 25 Mgha^{-1} for RS, BRS, RSN and ST respectively, we found a positive effect of rice straw and compost on SP, FC, PWP and AW. In field experiment the highest relative increase over control due to 25 Mgha^{-1} BRS, RSN and ST at Ap_1 for plant height were 36.58, 68.95 and 74.73 % where dry weight/plant were 35.00 48.44 and 69.06 %, grain yield were 45.13, 58.70 and 69.32%. 100 seed weight and N K P content significant affected by BRS, RSN and ST respectively. Soil available N, K and P due to all organic treatments. Soil EC was improved by RSN and ST, addition of ST impact on pH and bulk density was slightly reduced, but BRS was due to a slight increase.

*Keywords :*Rice straw-ammonium • Biochar • nutrients • Plant growth

INTRODUCTION

Recycling the rice straw as a soil modification becomes a vital task (El-Mahrouky, *et al*., 2015).Recycling of rice straw waste blended with ammonium sulphate for compost production improve the output of soil's physical, chemical and microbial characteristics (Bunna, *et al*., 2011). All growth parameters, yield, soil nutrient concentrations such as N, K, P, Ca and Mg, and micronutrients were considerably improved by rice straw application at rates1250, 2500 and 3750 Kg ha^{-1} (Abd El-Aziz, *et al*., 2016). Using rice straw in sandy soil improved EC in 35 days up to 1.7 times, anaerobic digestion (Aidee, *et al*., 2015). In sandy soil, rice straw induced important soil physical characteristics (decreasing bulk density and water content), soil chemical characteristics (pH, organic carbon, EC and availability of nutrients), and increased wheat development (dry weights of straw, grains and N, K and P concentrations) (Maha, *et al*., 2018). Application of rice straw waste to sandy soil improving chemical properties such as increased supply of nutrients, organic carbon content, nitrogen percentage and decreased pH in soil (El-Saied, *et al*., 2014). Rice straw application in sandy calcareous soil has a positive effect on chemical properties as the pH decreases slightly, CEC increases, organic carbon increases, N, K and P increases, and biological activity increases (Houssni, *et al*., 2016). Biochar improves soil physical characteristics (WHC soil) by distribution of biochar pore size after oxidation (Brewer, *et al*., 2014; Sorrenti, *et al*., 2016) and soil texture, soil porosity that varies from sandy to clay through the blockage of biochar pores (Masiello, *et al*., 2015; Sorrenti, *et al*., 2016). Rice straw biochar generated at elevated temperatures (400 to 700oC) having the impact of ion exchange owing to dehydration and decarboxylation and condensed quantities of C was polyaromatic, while lower temperatures (250 to 400^{o}C), including aliphatic, cellulose type structures, excellent organic character and greater yield recoveries. These can be substrates for mineralization by microorganisms that boost and aggregate the turnover of nutrients (Baldock, *et al*., 2002; Glaser, *et al*., 2003 and Jeffrey, *et al*., 2009). Rice straw biochar added 0, 20, 50 and 100 t ha^{-1} to soil and mixed with NPK fertilization significantly enhanced seed yield, K, N, crud protein, P, decreasing pH, plant height and yield in a sesame crop where improved soil bulk density, exchangeable K, exchangeable N, and CEC increased. (Cosmas, *et al*., 2019). Improved crop production is essential and affected most by biochar amendment in soils (Jeffery, *et al*., 2015). Biochar can improve the availability of soil nutrients and decrease the loss of soil, CEC and moisture content (Reverchon, *et al*., 2014). Application of biochar significantly enhanced soil exchange capacity, available potassium, organic carbon, crop growth improvements and reduced soil bulk density (Abrishamkesh, *et al*., 2015). Addition of compost and rice straw in clay loam soil considerably improved soil physical characteristics and soil water content (Moniruzzaman, *et al*., 2007). Compost and rice straw application had a beneficial impact on the fundamental physical and hydraulic clay loam soil characteristics and

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water retention ability (Linlin, *et al*., 2018). Application of rice straw composts ammonium sulfate in sandy soils considerably enhanced its chemical properties, physical characteristics and improved field capacity and welting point (Magdi, *et al*., 2003). Application of compost in sandy soil at 0, 9, 18 and 27 Mg ha^{-1} for every 3rd year increased organic matter content, decreased bulk density and rapid soil degradation (József, *et al*.,. 2016). After 75 days sowing in a In sandy soil compost corn stalks or rice straw increase in plant height, grain, straw yields, and N, K, and P content in leaves (Hassanein and Abul-Soud 2010). Composts improve of soil physical properties, soil chemical properties, organic matter, crop production, crop quality, soil water retention, the availability of plant nutrients and thus crop yields

(Getinet, 2018). Application of all compost kinds in loamy sand and sandy soils improves chemical and physical soil properties reflecting reduced bulk density, pH, improved, total carbon content, total nitrogen, EC, fresh, dry fruit weights, plant height, parameters of plant growth and yield (Emmanuel, *et al*., 2012). The compost addition to sandy soil increased storage pores volume and water retention as available water (Tomasz, 2014) To the best of our understanding, the impact on sandy soil productivity and wheat output of rice straw mixed with $NH4^+$, rice straw biochar and time application has not yet been researched. So, the objective of this research was to assess the use of rice straw waste on the development of wheat plants and to improve a sandy soil's productivity.

MATERIALS AND METHODS

These laboratory and field experiments were carried out under sandy soil conditions (Typic Torripsamment; Entisol [Arenosol AR]) of the Ismailia Agricultural Research Station, (30° 35' 30" N 32° 14' 50" E elevation 3 m) Agricultural Research Center (ARC) – Egypt, and during the winter seasons of 2017/2018 – 2018/2019.

Laboratory experiment

In 2.5 litter capacity closed bottom plastic pots two kg portion of soil sample were mixed with 0, 5.25 and 10.5 g from RS, BRS, RSN and ST, the applied amounts of organic wastes are roughly equivalent to rates of 0, 12.5 and 25 t ha^{-1}. Soil moisture for all treatments was adjusted to nearly filled capacity (table 6) throughout the experimental course (130 days). All pots were aerobically incubated under laboratory conditions (nearly $20\,^0$C). Two pots from each treatments were carried at 1, 5, 20, 40, 70, 90 and 130 days and subjected to soil organic carbon, correlation analysis for all treatments was used to evaluate relationships between total organic carbon losses and incubation time. Soil water retention, moisture contents at saturation (SP), field capacity (FC), wilting point (PWP) and available water capacity (AW) at one day were measured of the samples at different matric potentials for all treatments via pressure chamber at 0.01, 0.1, 0.3, 3.0, 10 and 15 bar. The points 0.1, 0.3, 3, 10, and 15 bar in Richard chamber, (Van-Genuchten, 1980) and 0.01 bar in Haines' apparatus (Studio, 2018).

Planting

Wheat crop (*Triticum aestivum L*. Masr one) was recommended due to multi-locations stability and responses sandy soil stress. Variety was obtained from Field Crops Institute, Agriculture Research Centre/Egypt. Sowings were performed in November 2017, 2018 where one grain/hill were mechanical sown with 5 cm apart between hills. A split randomized block design with 4 organic sources x3 rates x2 times add x5 replicates (120) plots and 10.5 m^2 plot area. Additionally fertilized during growth for all treatments as follows: ammonium sulfate (20% N) at rates of 238 Kg N ha^{-1}, triple superphosphate (45% P_2O_5) at a rate 36.89 Kg P_2O_5 ha^{-1} and potassium sulfate (48% K_2O) at a rate 114.24 Kg K_2O ha^{-1}.

Factor and their treatments were as follows: [1] Control (Cont) with recommended dose of chemicals fertilizers but without any organic sources application , [2] rice Straw (RS) rice straw application to soil , the rice straw was air dried and cut to pieces (1-2 cm), [3] (BRS) mixed between biochar rice straw (BR) and compost (ST) was used in this experiment at rate 1 : 0.25 (w/w) respectively, and keep its down plastic sheet 21 days and added water 10 % (w/w) with stir the pile at four days continuously for biochar degradation, adsorption of organic minerals, storage of water and there decreased C/N ratio from 134.86 (47.20/0.35) to 52.59 (42.60/0.81). (BR) through low pyrolysis process at temperature of 400 °C for 30 minutes as a retention time (Lu, *et al*., 2014). The biochar have been crushed and sieved to size (< 2 mm), by the Jordan Maser company for import, export. [4] (RSN) mixed between rice straw and ammonium sulfate solutions at a rate 4.07 Kg N T^{-1} (animal feed contain 13.8 N T^{-1}, equivalent 30 Kg urea T^{-1} corn Stover) were prepared clear solution by ammonium sulfate : distilled water (20.33 Kg : 142.3 L respectively) and mixed with air dried rice straw (1-2 cm size) and keep its down plastic sheet 21 days with stir the pile at 48 h continuously at water 20 % (w/w) and there decreased C/N ratio from 73.0 (44.53/0.61) to 48.53 (43.68/0.90). Ammonium concentrations in stock solutions were measured using (Bremner, 1982) by a Bioblock Scientific distiller. and [5] compost (ST).Two times used for add organic sources (treatments) for 0 - 30 cm deeps from surface soil, (Ap_1) application before three weeks from sowing with tow times irrigation in week and (Ap_2) direct application with sowing and three rates used add from organic sources control its (C_0) 0.00 organic source, (C_1) 12.5 Mg ha^{-1} and (C_2) 25 Mg ha^{-1}. Some of the chemical and physical properties of the soil and organic sources used in the present study are shown in Table 1 and 2.

Table 1. Some properties of soil used in the experiment before cultivation

Soil	Properties
Particle size distribution (%)	
Coarse Sand	63.11
Fine Sand	30.15
Silt	4.27
Clay	2.47
Texture	Sand
$CaCO_3$ (g kg^{-1})	6.13
Organic Matter (g kg^{-1})	1.40
pH (1:2.5 soil : water suspension)	8.01
Saturation Percent (SP, %)	21.00
EC (dS m^{-1}) (in soil saturation extract)	1.16
Bulk denisity Mg m^{-3}	1.82
CEC (cmolic kg^{-1} soil)	1.00
Available nutrients (mg/kg)	
N	13.35
K	46.22
P	3.61

Table 2. Some chemical characteristics of rice straw (RS), biochar rice straw mixed compost (BRS), biochar rice straw (BR) and compost (ST) used in the experiment before cultivation

Properties	RS	BRS	B R	ST
EC (dS m-1)	1.26*	1.93*	2.12*	0.86**
pH	7.09*	7.80*	7.97*	7.75**
Total carbon (g kg^{-1})	445	426	472	293
CEC (cmol^{+} kg^{-1})	nd	40.3	34.5	47.2
Total N (%)	0.61	0.81	0.35	1.46
Total P (%)	0.42	0.39	0.30	0.86
K (%)	0.86	1.31	0.92	2.06
Ca (%)	0.57	0.70	0.53	2.98
Mg (%)	0.25	0.29	0.22	0.50
Bulk density (Mg m^{-3})	0.27	0.57	0.51	0.68

***Suspension of 1:5 organic wastes : water ratio (w/v),**
**** Suspension of 1:20 compost : water ratio (w/v).**

At 120 days from sowing, some of the growth parameters such as crop height (cm), dry weight / plant (g), tiller number and spikes number were registered. At harvest time, April 2018 and April 2019 (130 days from sowing), picked up by hand to avoid seed loss and air-dried. Yield and yield components such as the weight of 100 seeds (g), the number of spike seeds, the yield of seeds and straw (kg/plot).

Analysis of Soil Samples and Plant

Samples of soil after harvested have been dried, passed through a sieve of 2 mm and retained for analysis. For chemical analysis sub samples from grain and straw were taken over dried at 70 ^{0}C for 50 h and digested using concentrated sulfuric and perchloric acid - combination, (1:1 $H_2SO_4/HClO_4$) Chapman and Pratt (1961). Available nitrogen was determined in KCl extract (1: 10) for soil or in water, phosphorus was extracted by 0.5 N $NaHCO_3$ Page, *et al*., (1982) and available potassium was 1 N NH_4OAc (pH 7.0) Jakson, (1973) . Total percentage and the available of N were estimated by distillation using Kjeldahl apparatus Black, (1965), P colorimetrically by UV-Vis.

Spectrophotometer using the Sn Cl2 (Jackson, 1973) and K indicator by the flame photometer, Black, (1965). Protein percentage in grains was calculated as an N% × 6.25.

Statistical Analysis

The effects between soil, compost proportion and Times application were analyzed using three factors of variance (ANOVA). The analysis of variance (ANOVA) was carried out the Co-State software (Ver. 6.311) for determining the statistical significance (LSD) of the treatments effect at a significance level *P = .05* Gomez and Gomez (1984). Also, regression statistical analysis (r and r^2) were carried out in order to establish the organic carbon losses, relationship of the water retention parameters and organic wastes rates.

RESULTS AND DISCUSSION

Laboratory experiment

Soil organic carbon

Table (3), show that the soil used in experiment was found to be very poor in organic carbon (0.81 g C kg^{-1}soil), and application of organic wastes significantly raised the organic carbon contents of soil. However, the longer the incubation period, the lower was the organic carbon content in the soil. The end of the incubation period, losses of organic carbon varied depending on the type rice straw , compost and rate of addition. In general about 19.9, 1.1, 34.2 and 29.4 % of these total losses occurred during 130 days of incubation due to 12.5 Mgh^{-1} and 21.2, 7, 20.6 and 32.1% due to 25 Mgh^{-1} for RS, BRS, RSN and ST. Could be attributed to considerable amounts of easily decomposable. The above observation was actually confirmed by the results of soil microbiological. Gilmour and Gilmour (1980) who found that no more than 30% of the added C decomposed after 120 days of incubation. Similar results were found by (Saothongnoi, *et al*., 2014; Maha, *et al*., 2018; El-Saied, *et al*., 2014 and Houssni, *et al*., 2016). Application of all compost kinds in sandy soils improves chemical and physical soil properties as bulk density, pH, improved total carbon content, available nitrogen and EC (Emmanuel, *et al*., 2012). Correlation analysis was used to evaluate relationships between total organic carbon losses and incubation time for all treatments (Table 4). Highly significant correlation were found between the two parameters for RS, RSN and ST treatments, however BRS and control were not significant .

Table 3. Periodical changes in soil organic carbon (g kg^{-1}) as affected by RS, BRS, RSN and ST application

Time (days)	Control	RS		BRS		RSN		ST	
		12.5 (Mgh^{-1})	25.0 (Mgh^{-1})	12.5 (Mgh^{-1})	25.0 (Mgh^{-1})	12.5 (Mgh^{-1})	25.0 (Mgh^{-1})	12.5 (Mgh^{-1})	25.0 (Mgh^{-1})
		Organic carbon g kg^{-1}							
1	0.81	3.12	6.60	3.43	6.85	3.04	6.51	2.96	5.89
5	0.80	3.10	6.58	3.45	6.50	3.01	6.45	2.90	5.83
20	0.82	3.05	6.50	3.40	6.44	2.56	5.74	2.74	5.41
40	0.78	2.88	5.97	3.42	6.51	2.10	4.98	2.39	4.66
70	0.80	2.46	5.15	3.40	6.38	1.85	4.96	2.19	4.32
90	0.77	2.42	4.89	3.35	6.30	1.83	5.01	2.10	4.13
130	0.78	2.51	5.20	3.39	6.37	2.00	5.17	2.09	4.00
LSD 0.05	ns	0.18	0.38	ns	ns	0.40	0.68	0.15	0.36

Table 4. Regression of total organic carbon losses, Y (g carbon kg^{-1} soil) for incubation time, X (days)

Treatments		Regression equation	r	r^2	n
Control		Y =0.81+(-0.00026) x	0.700814	0.49114	7
RS	12.5 (Mgh^{-1})	Y =3.093+(-0.0060) x	0.760956	0.579053	7
	25.0 (Mgh^{-1})	Y =6.55+(-0.014) x	0.833656	0.694982	7
BRS	12.5 (Mgh^{-1})	Y =3.46+(-0.00078) x	0.635778	0.404214	7
	25.0 (Mgh^{-1})	Y =6.61+(-0.0026) x	0.70169	0.492369	7
RSN	12.5 (Mgh^{-1})	Y =2.80+(-0.0091) x	0.901128	0.812032	7
	25.0 (Mgh^{-1})	Y =6.1+(-0.01093) x	0.902711	0.814888	7
ST	12.5 (Mgh^{-1})	Y =2.85+(-0.0073) x	0.930597	0.866011	7
	25.0 (Mgh^{-1})	Y =5.69+(-0.0157) x	0.93801	0.879863	7

Increasing incubation period the total organic carbon losses linearly depending on the type and added rate of organic wastes. In these soil the rates of organic carbon losses (Y) for an incubation day (X) are calculated from regression equation for all treatments. Rice straw biochar has important effects directly or indirectly significant increasing of microbial populations by influence of microbial nutrition (Xu, *et al*., 2014). Weber, *et al*., (2007) reported that biochar degradation of 25% within 100 years, translated into a biochar turnover of around 300 years. Rice straw application in sandy calcareous soil has a positive effect on chemical properties as CEC increases, organic carbon increases, organic matter increases, total N increases, C/N decreases and biological activity increases (Houssni, *et al*., 2016).

Addition of biochar decreased organic matter decomposition after its recalcitrant nature thermally which seriated microbial decomposition and physicochemical protection of native Soc which had to increase Soc stability.

Soil water retention

Table (5) showed that the effect of RS, BRS, SRN and ST on soil water retention in sandy soil, organic sources have higher water available content than the soil without organic and the higher organic wastes dose increased the water available in the soil. From table (5), we found a positive effect of rice straw and compost on water contents SP (0.01 bar), FC (0.3 bar), PWP (15 bar) and AW (water retention at FC - PWP). In gnarly for RS, BRS, SRN and ST about 22.0, 25.5, 22.9 and 26.6 % due to 12.5 Mg ha^{-1} while 23.1, 25.7, 24.0 and 28.1 % due to 25 Mg ha^{-1}for SP ; 10.1, 10.2, 10.9 and 11.9 % due to 12.5 Mg ha^{-1} while 10.8, 112, 11.4 and 12.5 % due to 25 Mg ha^{-1} for FC and 7.9, 8.0, 8.6 and 9.5 % due to 12.5 Mg ha^{-1} while 8.5, 8.8, 8.0 and 9.8 % due to 25 Mg ha^{-1} for AW respectively, at one day from incubation. The direct positive effect of the investigated, soil organic wastes on water retention with the compost and rice straw because may be its degradation requires a short time but molecules the biochar degradation requires a long time. These data in line with those obtained by (Tomasz, 2014 ; Brewer, *et al*., 2014 and Sorrenti, *et al*., 2016)). Linlin, *et al*., (2018) reported that application of compost and rice straw to soil had a beneficial impact on the fundamental hydraulic characteristics and enhanced water retention ability.

Table 5. Effect of RS, BRS, RSN and ST application on soil water retention at one day from incubation

Soil Treatments		Pressure chamber (bar) 0.01	0.10	0.30	3.00	10.0	15.0
		Moisture (cm^3 cm^{-3}) Soil					
Control		0.211	0.148	0.097	0.074	0.033	0.020
RS	12.5 (Mgh^{-1})	0.220	0.113	0.101	0.079	0.036	0.022
	25.0 (Mgh^{-1})	0.231	0.122	0.108	0.084	0.038	0.023
BRS	12.5 (Mgh^{-1})	0.255	0.170	0.102	0.075	0.034	0.022
	25.0 (Mgh^{-1})	0.257	0.185	0.112	0.079	0.038	0.024
RSN	12.5 (Mgh^{-1})	0.229	0.129	0.109	0.081	0.039	0.023
	25.0 (Mgh^{-1})	0.240	0.162	0.114	0.090	0.044	0.024
ST	12.5 (Mgh^{-1})	0.266	0.181	0.119	0.102	0.035	0.024
	25.0 (Mgh^{-1})	0.281	0.190	0.125	0.105	0.047	0.027
r^2		0.940523	0.983681	0.874220	0.802542	0.576395	0.467518

In sandy soil, rice straw induced important soil physical characteristics (decreasing bulk density and increasing porosity, water holding ability and water content), important soil chemical characteristics. (Maha, *et al*., 2018). Addition of compost and rice straw in clay loam soil considerably improved hydraulic conductivity, reduced solid phase, enhanced total porosity, and soil water content to retain soil water (Moniruzzaman, *et al*., 2007).

Application of rice straw composts with a source of nitrogen ammonium sulfate in sandy soils improved physical characteristics, field capacity and welting point (Magdi, *et al*., 2003).

Field experiment

Plant growth

Data shown in Table (6) demonstrate the impact of organic sources (RS ; BRS ; RSN and ST) and the application times on the growth characters of wheat plants.The obtained results show that effect of BRS, RSN and ST significantly increased plant height and dry weight/plant of wheat plant. The relative increase of plant height were 36.58, 68.95 and 74.73 % where dry weight/plant were 35.00, 48.44 and 69.06 %, respectively due to the addition of 25 Mg ha^{-1} at before three weeks from sowing where plant height were 31.58, 33.68 and 73.95 %; where dry weight/plant were 34.69, 35.31 and 65.62% due to the addition of 25 Mg ha^{-1} BRS, RSN and ST at with sowing respectively while RS only was not significant. BRS, RSN and ST application at a rate 12.5 Mg ha^{-1}, for plant height and dry weight/plant were significant and the relative increase for plant height 26.68, 50.26 and 53.42%, Where the dry weight/plant was 22.19, 35.00 and 38.44 % respectively at before three weeks from sowing, the relative rise of 26.58, 26.32 and 50.53 % for plant height where dry weight / plant was 22.50, 24.38 and 35.94 % respectively at with sowing. Only the addition of 12.5 Mg ha^{-1} RSN and ST significant effect on number of tillers , the high relative rise was 36.84 and 18.42 % respectively for implementation before three weeks from sowing and 15.79 and 18.42 % respectively for application with sowing, however, owing to the addition of 25 Mg ha^{-1} RSN and ST, the increase were 15.79 and 31.57 % respectively before three weeks from sowing, where 23.68 and 26.32 % respectively at with sowing. While spikes number there were 47.06 and 32.35 % owing to the addition of 12.5 Mg ha^{-1} RSN and ST at the application before three weeks from sowing where 32.35 and 32.35 % were at application with sowing, but the high relative increase due to the addition of 25 Mg ha^{-1} RSN and ST was 32.35 and 47.06 % at application before three weeks from sowing and were 38.30 and 32.35 % at application with sowing respectively. Effect of BRS, RSN and ST on development of wheat plants (Table 6) shows that there was a substantial impact on plant height and dry weight, but RSN and ST had a major impact on number of tiller and number of spikes. The interaction effect between combined times of application and organic sources on plant height and dry weight plant were significant. The plant height, dry weight/plant, number of tillers and number of spikes were obtained due to RSN and ST at 25 Mg ha^{-1} at application before three weeks of sowing. These data in line with those obtained by (Cosmas, *et al*., 2019, Maha, *et al*., 2018, Hassanein and Abul-Soud 2010). Ahmed and Naeem (2012) reported that composting increasing plant growth parameters. Biochar rice straw improves the stability of organic carbon and organic fraction (Lehmann and Joseph 2015). Biochar increased plant growth of different plants (Zhang, *et al*., 2016).

Table 6. Effect of RS, BRS, RSN, ST and times application (Ap) on some growth at ripeness stage of wheat plant

Organic Levels	Organic rates (Mg ha^{-1})				Organic rates (Mg ha^{-1})			
	C_1	C_2	C_1	C_2	C_1	C_2	C_1	C_2
	Dry wt. straw (g) plant^{-1}		Plant height (cm)		No of tillers plant (10)		No of spikes plant (10)	
Control	3.20		38.00		38		34	
				Ap_1				
RS	3.45	3.49	41.00	41.90	34	36	33	34
BRS	3.91	4.32	48.20	51.90	35	32	35	33
RSN	4.32	4.75	57.10	64.20	52	44	50	45
ST	4.43	5.41	58.30	66.40	45	50	45	50
				Ap_2				
RS	3.35	3.39	37.90	39.60	32	34	32	34
BRS	3.92	4.31	48.10	50.00	30	30	30	30
RSN	3.98	4.33	48.00	50.80	44	47	45	47
ST	4.35	5.30	57.20	66.10	45	48	45	45
L.S.D.0.05	0.68	1.07	4.62	4.94	7.6	8.5	6.4	6.8

Yield components

Table (7) shows the grain yield, straw yield and 100 seed weight reacted to BRS, SRN and ST but SR not affected. The highest relative increase for grain yield, straw yield and 100 seed weight over control for BRS were 45.13, 36.82 and 17.24% ; RSN 58.70, 44.77 and 18.97 % and ST 69.32, 61.59 and 19.31% respectively due to the addition of 25 Mg ha^{-1} and application before sowing. While BRS were 32.74, 29.54 and 16.19% ; RSN 56.34, 35.23 and 17.93 % and ST 67.55, 43.64 and 18.28 % respectively due to the addition of 25 Mg ha^{-1} at application with sowing. Where No. of grain spike^{-1} significant affected with RSN and ST was considerably 25.00 % and 38.00 % above before sowing application but 20.0 % and 30.0 % above with sowing application compared to control owing to 25 Mg ha^{-1} respectively. The comparative height rise for protein over control for to addition BRS before sowing was 66.66% ; RSN 70.37% and ST 77.77% While BRS was 58.52 % ; RSN 51.85 % and ST 74.81% owing to the addition of 25 Mg ha^{-1} for at sowing application. These data are in line with those obtained by(Cosmas, *et al*., 2019, Abd El-Aziz, *et al*., 2016, Xu, *et al*., 2014, Hassanein and Abul-Soud 2010).

Table 7. Effect of RS,B RS, RSN, ST and times application (Ap) on grain, straw yield, weight of 100 seed (g), No of grain spike^{-1} and Grain protein % at ripeness stage of wheat plant

Organic Levels	Organic rates (Mg ha^{-1})				Organic rates (Mg ha^{-1})					
	C_1	C_2	C_1	C_2	C_1	C_2	C_1	C_2	C_1	C_2
	Grain yield (kg plot^{-1})		Straw yield (Kg plot^{-1})		Weight of Seed (g) 100		No of grain spike^{-1}		Grain protein (%)	
Control	3.39		4.40		2.90		40		8.44	
					Ap_1					
RS	3.12	3.42	4.39	4.52	3.03	3.10	42	41	8.44	8.75
BRS	4.82	4.92	5.78	6.02	3.35	3.40	41	42	12.0	14.06
RSN	5.16	5.38	6.19	6.37	3.41	3.45	49	50	12.5	14.38
ST	5.36	5.74	6.81	7.11	3.44	3.46	50	55	13.13	15.00
					Ap_2					
RS	3.10	3.36	3.56	4.27	3.08	3.10	41	40	8.19	8.63
BRS	4.35	4.50	5.70	6.10	3.30	3.39	40	44	11.56	13.37
RSN	5.10	5.30	5.95	6.50	3.38	3.42	45	48	12.50	12.81
ST	5.18	5.68	6.32	7.10	3.43	3.43	50	52	13.25	14.75
L.S.D.0.05	0.93	1.02	1.15	1.27	0.28	0.31	4.20	5.10	0.36	0.50

Table (7) indicates the impact of organic sources and the time of application in the yield and yield components. The significant affected of BRS, RSN and ST on wheat yield and yield components may be due to their effect on physiochemical and nutrients characteristic of soil. Karer, *et al*., (2013) that increasing yield and yield components of various crops under organic sources. Similarl (Cosmas, *et al*. 2019 ,Mahaet, al., 2018; Aidee, *et al*., 2015 and Moniruzzaman, *et al*., 2017). Vaccari, *et al*., 2011) reported that under field conditions biochar increased wheat grain yield. Biochar application increased soil productivity (Jeffery, *et al*., 2015).

Nutrient contents

Data presented in Table(8,9) revealed that organic sources BRS ,RSN and ST and tow times of treatments application were significant effect on N ,K and P contents in seeds and straw compared to control, whereas organic source RS were not significant affected. The relative increased of N content over control due to 25 Mg ha^{-1} to BRS, RSN and ST were 66.66, 70.37and 77.77 % for grain,; 33.33, 43.33 and 58.33 % for straw, at time before sowing and were 58.52, 51.85 and 74.81 % for grain,; 33.33, 35.00 and 41.66 % for straw, at time with sowing respectively. The relative increase of K content over control under 25 Mg ha^{-1} BRS ,RSN and ST were 36.84 , 46.20 and 52.63 % for grain ;59.91 ,63.36 and 66.66 % for straw at time before sowing and were 33.92 ,42.11 and 49.71 % for grain 43.39 ,56.68 and 62.88 % for straw, at time with sowing respectively .

Table 8. Effect of RS, BRS, RSN, ST and times application (Ap) on the concentration (%) of N, K and P by wheat grain after harvested at ripeness stage of plant growth

Organic Levels	Organic rates (Mg ha^{-1})					
	C_1	C_2	C_1	C_2	C_1	C_2
	Conc. of N(%)		Conc. of K(%)		Conc. of P(%)	
Control	1.35		1.71		0.24	
			Ap_1			
RS	1.35	1.40	1.80	1.90	0.29	0.30
BRS	1.92	2.25	2.08	2.34	0.36	0.40
RSN	2.00	2.30	2.10	2.50	0.39	0.45
ST	2.10	2.40	2.35	2.61	0.41	0.48
			Ap_2			
RS	1.31	1.38	1.80	1.88	0.25	0.26
BRS	1.85	2.14	2.00	2.29	0.32	0.38
RSN	2.00	2.05	2.05	2.43	0.38	0.43
ST	2.12	2.36	2.34	2.56	0.37	0.45
L.S.D.0.05	0.55	0.68	0.35	0.45	0.08	0.12

Table 9. Effect of RS,BRS, RSN, ST and times application (Ap) on the concentration (%) of N, K and P by wheat straw after harvested at ripeness stage of plant growth

Organic Levels	Organic rates (Mg ha^{-1})					
	C_1	C_2	C_1	C_2	C_1	C_2
	Conc. of N(%)		Conc. of K(%)		Conc. of P(%)	
Control	0.60		1.32		0.16	
			Ap_1			
RS	0.70	0.74	1.40	1.42	0.17	0.18
BRS	0.78	0.80	2.00	2.10	0.30	0.33
RSN	0.83	0.86	2.05	2.16	0.34	0.35
ST	0.90	0.95	2.10	2.20	0.36	0.38
			Ap_2			
RS	0.65	0.75	1.40	1.41	0.16	0.18
BRS	0.77	0.80	1.80	1.90	0.26	0.31
RSN	0.79	0.81	1.89	2.07	0.30	0.31
ST	0.83	0.85	2.00	2.15	0.35	0.37
L.S.D.0.05	0.12	0.18	0.40	0.53	0.10	0.14

The relative increase of P content over control due to 25 Mg ha^{-1} to BRS, RSN and ST were 66.66 ,87.75 and 100 % for grain ;106.3 ,11.8 and 137.5 % for straw at time before sowing and were 58.33 ,79.16 and 87.75 % for grain ;93.75 ,93.75 and 131.3 % for straw, at time with sowing respectively. The highest increase in N, K and P contents was obtained for 25 Mg h^{-1} at time before sowing application. RS not significant on N, K and P concentration (%)of wheat plant at ripeness stage with 12.5 and 25 Mg ha $^{-1}$ application and two times application. The highest increase in N, K and P contents was obtained for 25 Mg h^{-1} at time before sowing application, RS was not significant on N, K and P concentration (%) of wheat plant at ripeness stage with 12.5 and 25 Mg ha $^{-1}$ application and two times application. These findings are consistent with the outcomes acquired by(Cosmas, *et al*., 2019; Maha, *et al*., 2018 ; Abd El-Aziz, *et al*., 2016 and Hassanein, and Abul-Soud 2010). Glaser, *et al*., (2015) who shown that the biochar and compost application were impact on N, K and P concentration percentage of wheat plant at ripeness stage. (Vaccari, *et al*., 2011) due to application of organic sources BRS and compost biomass of wheat 30% and barley 10 % over control, grain yield improvements and improved nutrient availability (Karer, *et al*., 2013).

Soil Available N, K and P

Available concentrations of soil N, K and P at the ripeness point of each treatment are shown in Table (10).

Application of all organic sources (RS; BRS; RSN and ST) and two-fold application substantially impacted on N; K and P (mg kg^{-1}) in wheat plant at ripeness stage. The height relative increase at ripeness stage of available soil N (mg kg^{-1}) over control du to 25 Mg ha^{-1} RS; BRS; RSN and ST were 58.44, 88.00, 92.88 and 127.78% at time before sowing respectively, whereas it were 58.00, 93.11, 93.33 and. 113.89% at time with sowing respectively, whereas available soil K (mg kg^{-1}) were 26.00, 42.39, 49.41 and 52.00% at time before sowing respectively, whereas it were 28.37, 44.04, 49.88 and 53.90 at time with sowing respectively.

Table 10. Effect of RS, BRS, RSN, ST and times application (Ap) on soil available N, K and P (mg Kg^{-1}) after wheat sampled at ripeness stage of plant growth

Organic Levels	Organic rates (Mg ha^{-1})				Organic rates (Mg ha^{-1})			
	C_1	C_2	C_1	C_2	C_1	C_2	C_1	C_2
	N (mg Kg^{-1})		K (mg Kg^{-1})		P_{NaHCO3} (mg Kg^{-1})		P_{Water} (mg Kg^{-1})	
Control	9.00		42.30		3.79		0.79	
			Ap_1					
RS	12.20	14.26	50.60	53.30	5.18	5.50	1.00	1.00
BRS	15.13	16.92	57.51	60.23	5.52	6.07	1.19	1.27
RSN	15.16	17.36	61.20	63.20	5.63	6.10	1.20	1.30
ST	18.15	20.50	63.10	64.30	6.20	6.60	1.38	1.50
			Ap_2					
RS	13.20	14.22	51.30	54.30	4.95	5.09	0.90	1.00
BRS	15.10	17.38	57.10	60.93	4.98	5.16	1.14	1.28
RSN	15.87	17.40	60.10	63.40	5.10	5.20	1.20	1.35
ST	19.10	19.25	60.80	65.10	5.70	5.81	1.31	1.46
L.S.D.0.05	2.92	4.07	6.90	8.65	1.12	1.18	0.10	0.16

P_{NaHCO3} : Available P extracted by NaHCO3
P_{Water} : Available P extracted by water

Soil available P_{NaHCO3} (mg kg^{-1}) were 45.12, 60.16, 60.95 and 74.14% at time before sowing respectively, whereas it were 8.44, 36.15, 37.2 and 53.30% at time with sowing respectively, but Soil available P_{water} (mg kg^{-1}) were 26.58, 60.76, 64.56 and 89.87 at time before sowing respectively, whereas it were 26.58, 62.20, 70.89 and 84.48% at time with sowing respectively.RS and RSN affected significantly on available N, K and P at ripeness stages of wheat growth, two rates and two times application. These data confirm information acquired from (El-Saied, *et al*., 2014; Abd El-Aziz, *et al*., 2016; Houssni, *et al*., 2016; Getinet, *et al*., 2018 and Cosmas, *et al*., 2019) and (Ahmed and Naeem 2012; Saothongnoi, *et al*., 2014 and Usman, *et al*., 2016). Ding, *et al*., (2016) addition of organic sources as a soil enhancement contributes to its physical, chemical properties as well as N, P and K as available. Glaser, *et al*., (2015) who printed that compost and biochar use in combination with inorganic fertilizers enhanced nutrient availability.

Soil salinity and bulk density

Table (11) presents soil salinity (soil saturation extract), soil pH and bulk density as influenced by all treatments. The implementation of BRS, RSN and ST organic sources has an important impact on EC soil at ripeness and two times application. The increased soil EC du to 25 Mg ha^{-1} and the relative increase were 22.88, 27.12 and 32.20 at the time before sowing, respectively, and at the time of sowing were 20.34, 24.58 and 33.90. This rise was not substantially influenced by RS on soil EC. Similar result (Maha, *et al*., 2018; Aidee, *et al*., 2015; Luo, *et al*., 2013 and Emmanule, *et al*., 2010). Basso, *et al*., (2013) reported that positive effects of rice biochar amendment on physiochemical properties.

Table 11. Effect of RS; BRS; RSN and ST and times application (AP) on soil EC dSm^{-1} , pH and bulk density (Mg m^{-3}) after wheat sampled at ripeness stage of plant growth

Organic Levels	Organic rates (Mg ha^{-1})		Organic rates (Mg ha^{-1})			
	C_1	C_2	C_1	C_2	C_1	C_2
	EC (dSm^{-1})		soil pH (1 : 2.5)		bulk density (Mg m^{3})	
Control	1.18		8.06		1.78	
			Ap_1			
RS	1.25	1.30	8.00	7.95	1.68	1.68
BRS	1.39	1.45	8.01	8.05	1.66	1.64
RSN	1.40	1.50	7.80	7.78	1.66	1.64
ST	1.52	1.56	7.76	7.72	1.61	1.61
			Ap_2			
RS	1.20	1.26	8.00	7.96	1.70	1.69
BRS	1.35	1.42	7.90	8.08	1.68	1.65
RSN	1.36	1.47	7.86	7.80	1.69	1.64
ST	1.50	1.58	7.80	7.74	1.65	1.60
L.S.D.0.05	ns	0.22			ns	0.16

-- pH : (1:2.5) water : soil)soil saturation extract : (EC

Data in Table (11) showed the effect of different treatments on soil bulk density. All treatments (RS, BSR and RSN) did not substantially affect soil bulk density at two rates and two times application.Compost slightly decreases soil bulk density before three weeks of sowing of development.The bulk density at ripeness stage decreased from 1.78 to 1.61 and from 1.78 to 1.61 for application 12.5 and 25 Mg ha^{-1} respectively at time before sowing. These data obtained by, (József, *et al*., 2016; Lu, *et al*., 2014; Moniruzzaman, *et al*., 2007) . Basso, *et al*., (2013) reported that positive effects of rice biochar amendment on bulk density. Brown and Cotton (2011), observed that soil bulk density decreased due to increases in the organic fraction.

Data in Table (11) showed the effect of different treatments (RS, BRS, RSN and ST) on soil pH. Compost at rate of 12.5 and 25 Mg ha^{-1} decreased of soil pH. Soil pH at ripeness stage at rate of 12.5 Mg ha^{-1} decreased from 8.06 to 7.76 in time before sowing application and from 8.06 to 7.80 with sowing application ,while at rate of 25 Mg ha^{-1} decreased from 8.06 to 7.72 in time before sowing application and with sowing application decreased from 8.06 to 7.74. BRS at rate of 25 Mg ha^{-1} in two times applications showed a slight increase in soil pH at growth phase but interest decrease in soil pH at ripenesis phase at rate 12.5 Mg ha^{-1} and tow times. These data confirm information acquired from (Maha, *et al*., 2018; Linlin, *et al*., 2018 Abd El-Aziz, *et al*., 2016). Castaldi *et al*., (2011), found a pH in a field soil increased from 5.2 to 6.7 following biochar amendments at rates 6 and 3 kg m^{-2} for two growing seasons of wheat.

CONCLUSION

In sandy soil, certain chemical and physical characteristics and wheat plants (Triticum aestivum L. Masr one) yield and yield components in the ripeness stage were positively impacted by organic sources RS < BRS < RSN < ST respectively, rate 25 > 12.5 Mg ha^{-1} and Ap_1 > Ap_2. The current data were recorded and statistically analyzed as an average of two seasons. The highest relative of organic carbon and water contents impacted by organic sources BRS < RS < RSN < ST respectively, rate 25 > 12.5 Mg ha^{-1} and Ap_1 > Ap_2. Yield and yield components, N, K and P contents of seeds and straw were considerably impacted as BRS<RSN < ST respectively.soil available N, K and P was considerably impacted as RS< BRS<RSN < ST respectively, rate 25 > 12.5 Mg ha^{-1} and Ap_1 > Ap_2. Compost slight decrease soil bulk density and pH at two stages of growth and tow times application. Organic sources RS and RSN due to a slight decrease soil pH at ripeness stage and two times application, but BRS in two times application showed slightly increased of soil pH at rate 25 Mg ha^{-1} but at rate 12.5 Mg ha^{-1} showed not increased of soil pH.

Add compost effect on the estimated growth parameters, nutrients and yield components was slightly more pronounced than rice straw mixed with ammonium sulfate which the latter (RSN) can be used for improving productivity of sandy soil.

REFERENCES

Abdul Aziz, A.; Bolaji, U. O. and Emmanuel O. E. (2016). Rice straw a valuable organic manure for soil amendment in the cultivation of groundnut (*Arachis hypogaea*) Environmental and Experimental Biology 14: 205–211.

Abrishamkesh, S. ; Gorji, M. ; Asadi, H. ; Bagheri-Marandi, G.H. and Pourbabaee, A.A. (2015). Effects of rice husk biochar application on the properties of alkaline soil and lentil growth . 61: (11), 475–482.

Ahmed, A. A. and Naeem, E.S. (2012). Effect of integration between compost and urea fertilizer on the productivity of sakha 105 rice cultivar J. Plant Production, Mansoura Univ., 3: (3), 535 – 543.

Aidee, K. K.; Mohamad, R. S.; Umi Aisah, A.; Onn Hassan, N. U. and Utami, F. R. (2015). Enhancement of Sandy Soil Quality Using Plant Waste Int'l Journal of Advances in Agricultural & Environmental Engg. (IJAAEE) Vol. 2, Issue 1 ISSN 2349-1523 EISSN 2349-1531.

Baldock, J.A. and Smernik, R. J. (2002). Chemical composition and bioavailability of thermally altered *Pinus renosa* (red pine) wood. Org. Geochem. 33: 1093-1109.

Basso, A.H.; El-Saied, H. ; Hady, E. and El-Dewiny, C.Y. (2013). Evaluation of rice straw-based hydrogels for purification of wastewater. Polym. Plast. Technol. Eng. 52: 1074–1080.

Black, C.A. (1965). Methods of soil analysis. Part I, American Society of Agronomy. Madison, Wisconsin, USA.

Bremner, J.M. and Mulvaney, C.S. (1982). Nitrogen total. In: Page A.L.,

Miller R.H. and Keeny D.R. (eds.). Methods of Soil Analysis. Part 2. Chemical and Microbiological Properties. 2nd Ed. Madison,Soil Science Society of America.

Brewer, C.E.; Chuang, V.J. and Masiello, C.A. (2014). New approaches to measuring biochar density and porosity. Biomass and Bioenergy 66:176–185.

Brown, S. and Cotton, M. (2011). Changes in Soil Properties and Carbon Content Following Compost Application: Results of On-farm Sampling. Compost Science and Utilization, 19, (1) : 88-97.

Bunna, S.; Sinath, P.; Makara, O. ; Mitchell, J. and Fukai, S. (2011). Effects of straw mulch on mungbean yield in rice fields with strongly compacted soils. F." F. Crop. Res. 124: 295-301.

Castaldi, S. ; Riondino, M. and Baronti, S. (2011) . Impact of biochar application to a Mediterranean wheat crop on soil microbial activity and greenhouse gas fluxes. Chemosphere 85:1464–1471.

Chapman, H.D. and Pratt, P.F. (1961). Methods of analysis for soils, plants and waters. Division of Agricultural Sciences, University of California, Riverside.

Cosmas, W. ; Naoki, O. ; Daniel, B. ; Takuo, H. ; Daisuke, S. ; Robert, A. ; Tadashi, I. ; Masako, K. ; Tsugiyuki, M. ; Sadahiro,Y. ; and Eiji, N.(2019). Growth, Seed Yield, Mineral Nutrients and Soil Properties of Sesame (*Sesamum indicum* L.) as Influenced by Biochar Addition on Upland Field Converted from Paddy. J. Agronomy, 9: 55- 75.

Ding, Y.; Liu, Y. and Liu, S. (2016). Biochar to improve soil fertility. A review. Agron Sustain Dev 36:36. doi: 10.1007/s13593-016-0372-z

El-Mahrouky, M.; El-Naggar, A.H.; Usman, A.R. and Al-Wabel, M. (2015). Dynamics of CO2 emission and biochemical properties of a sandy calcareous soil amended with Conocarpus waste and biochar. Pedosphere, 25 : 46–56.

El-Saied, H.; Basta, A.H.; Waley, A.I.; El-Hady, P.A.; Abo-Sedera, S.A.; Abdel-Kader, A.A.; El-Dewiny, C.Y. and Shaban, S. M. (2012). Enhancing the utilization of rice straw as potential low cost superabsorbent materials. In: 10th Int. Conf. Egypt Soil Science Society (ESSS), 5–8 November, America, Alex., Egypt.

El-Saied, H.; El-Hady, O. A. ; Basta, A. H. ; El-Dewiny, C. Y. and Abo-Sedera, S. A. (2014). Bio-chemical properties of sandy calcareous soil treated with rice straw-based hydrogels, J. Saudi Soc. Agric. Sci., 1–7.

Emmanule, I.; Moyin, J. and Fraceci, O. A. (2010). Comparetive evaluation of different organic fertilizer on soil fertility improvement leaf mineral composition and growth performance of African cherry nut.Cchrysophy llum Albidium, seed lings. J. of Amer. Sci., 6: (8), 217- 223.

Emmanuel, A. ; Wim, C. and Fatemeh, R. (2012).Compost amendment to sandy soil affects soil properties and greenhouse tomato productivity. 20: 215-221.

FAO. (2014). World Reference Base for Soil Resources. A framework for international classification, correlation and communication. Soil Taxonomy, Food and Agriculture Organization of the United Nations, Rome, Italy.

Getinet, Adugna, (2018). A review on impact of compost on soil properties, water use and crop productivity. Agricultural Science Research Journal 4:(3), 93-104.

Glaser, B.; Lehmann, J. and Zech, W. (2002). Ameliorating physical and chemical properties of highly weathered soils in the tropics with charcoal—A review. Biol. Fertil. Soils, 35: 219-230.

Glaser, B.; Guggenberger, G.; Zech, W. and Ruivo, M.D.L. (2003). Soil organic matter stability in amazonian dark earths", in Lehmann, J. *et al*.,. (eds), Amazonian Dark Earths: Origin, Properties, Management, 141-158, Kluwer, Netherlands.

Glaser, B.; Wiedner, K. and Seelig, S. (2015). Biochar organic fertilizers from natural resources as substitute for mineral fertilizers. Agron. Sustain. Dev. 35: 667–678.

Gomez, K.A. and Gomez, A.A. (1984).Statistical procedures for agriculture research. A Wiley – Inter Science Publication, John Wiley and Sons, Inc. New York, USA.

Jackson, M.L. (1973).Soil chemical analysis.Prentice-Hall, Inc., Englewood Cliffs. NJ, USA.

Jeffrey, M. ; Novak, J.M .; Isabel, L.; Baoshan, X.; Julia, W. G.; Christoph, S.; Das , K.C. ; Mohamed, A.; Djaafar, R.; Donald, W. W.; Warren, J. B. and Harry, S. (2009). characterization of designer biochar produced at different temperatures and their effects on a loamy sand J.M .Novak *et al*.,., Annals of Environmental Science, 3: 195-206.

Jeffery, S.; Meinders, M.B.J. and Stoof, C.R. (2015). Biochar application does not improve the soil hydrological function of a sandy soil. Geoderma 251:47–54.

József, T. A.; Attila, T.; Marianna, M.; József, M. and Lajos, B. (2016). Changes in physical properties of sandy soil after long-term compost treatment. Institute of Agrophysics, Polish Academy of Sciences 30: 269-274.

Hassanein, M.K. and Abul-Soud, M. (2010). effect of different compost types and application methods on rowth and yield of three maize hybrids. Journal of Applied Sciences Research, 6: (9), 1387-1399.

Houssni, El-Saied,; Omar, A. El-Hady,; Altaf, H. Basta,; Camilia, Y. El-Dewiny, and Salah, A. Abo-Sedera, (2016). Bio-chemical properties of sandy calcareous soil treated with rice straw-based hydrogels J. of the Saudi society of agricultural science, 15: 188-194.

Kamara, A.; Kamara, H.S. and Kamara, M.S. (2015). Effect of Rice Straw Biochar on Soil Quality and the Early Growth and Biomass Yield of Two Rice Varieties. Agricultural Sciences, 6: 798-806.

Karer, J. ; Wimmer, B. and Zehetner, F. (2013). Biochar application to temperate soils: Effects on nutrient uptake and crop yield under field conditions. Agric. Food Sci., 22:390–403.

Lehmann, J. and Joseph, S. (2015). Biochar for environmental management: An introduction. In Biochar for environmental management: Science, technology and implementation. 2nd Ed. Lehmann, J. and Joseph, S. pp. 1-14. Routledge, New York

Linlin, S.; Yinan, X.; Qingxu, M. and Lianghuan, W.(2018). The Short-Term Effects of Rice Straw Biochar, Nitrogen and Phosphorus Fertilizer on Rice Yield and Soil Properties in a Cold Waterlogged Paddy Field J. Sustainability 10: 537-554.

Lu, S.G.; Sun, F.F. and Zong, Y.T. (2014). Effect of rice husk biochar and coal fly ash on some physical properties of expansive clayey soil (Vertisol). Catena, J. 114: 37–44.

Luo, Y. Durenkamp, M. De Nobili, M. (2013). Microbial biomass growth, following incorporation of biochars produced at 350 °C or 700 °C, in a silty-clay loam soil of high and low pH. Soil Biol. Biochem. 57:513–523.

Magdi, T. A.; Horiuchi, T. and Oba, S. (2003). Bioresource Technology, 93: 183-189.

Maha, M. E. Ali, (2018). ffect of Plant Residues Derived Biochar on Fertility of a new Reclaimed Sandy Soil and Growth of Wheat (*Triticum aestivum* L.) Egypt. J. Soil Sci. 58: (1), 93 – 103.

Masiello, C.A.; Dugan, B. and Brewer, C.E. (2015). Biochar effects on soil hydrology. In Literature cited 122 Biochar for environmental management: Science, technology and implementation. 2nd Ed. Lehmann, J. and Joseph, S. pp. 541-560. Routledge, New York

Moniruzzaman, K. E.; Takeki, M. and Katsumi, F. (2007). Field evaluation of compost sawdust and rice straw biomass on soil physical and hydraulic properties., J. Jpn . Soc. Soil Phys. 107: 3-16.

Page, A.L.; miller, R. H. and Keeney, D. R. (eds.) (1982). Methods of Soil Analysis. Part 2: Chemical and Microbiological Properties. Am. Soc. Agron. Madison, Wisconsin, USA .

Reverchon, F.; Flicker, R.C.; Yong, H.; Yan, G.J.; Xu, Z.H. and Chen, C.R. (2014). Changes in N^{15} in a soil–plant system under different biochar feedstocks and application rates. Biology and Fertility of Soils,50: (2), 275–283.

Saothongnoi, V.; Amkha, S. ; Inubushi, K. and Smakgahn, K. (2014). Effect of rice straw incorporation on soil properties and rice yield. Agricultural Sciences Journal , 1: (47), 7-12.

Sorrenti, G.; Masiello, C.A.; Dugan, B. and Toselli, M. (2016). Biochar physicochemical properties as affected by environmental exposure. Sci. Total Environ. 563-564:237–246.

Studio Team, R. and Studio, R. (2018). Integrated Development for R; Studio, R. Inc.: Boston, MA, USA, 2015; Available online: http://www. rstudio.com.

Tomasz Glab (2014).Water Retention and Repellency of a Sandy Soil Amended with Municipal Compost Compost Science & Utilization, 22:47–5

Usman, A.R.A.; Al-Wabe, l.M.I.; Ok, Y.S.; Al-Harbi A.; Wahb-Allah, M.; El-Naggar, A.H.; Ahmed, M.; Al-Faraj, A. and Al-Omran, A. (2016). Conocarpus biochar induces changes in soil nutrient availability and tomato growth under saline irrigation. Pedosphere, 1: (26), 27–38.

Vaccari, F.P.; Baronti, S. and Lugato, E. (2011). Biochar as a strategy to sequester carbon and increase yield in durum wheat. Eur. J. Agron. 34:231–238.

Van-Genuchten, M.T. (1980). A Closed-form equation for predicting the hydraulic conductivity of unsaturated Soils.Soil. Sci. Soc. Am. 44 : 892–898.

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

Xu, H.; Wang, X. and Yao, H. (2014). Biochar impacts soil microbial community composition and nitrogen cycling in an acidified soil. Environ. Sci. Technol. 17:9391–9399.

Zhang, D.; Yan, M. and Niu, Y. (2016b). Is current biochar research addressing global soil constraints for sustainable agriculture. Agric. Ecosyst. Environ. 226:25–32.

استخدام قش الارز المعامل بالامونيوم و البيوتشار و الكومبوست لزيادة انتاجية الأراضي الرملية ومدى استجابة القمح لها

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اجريت هذة التجربة نحت طروف الارض الرملية معمليا و حقليا و كان الهدف منها هو تقفيم قش الارز كمخلف عضوى فى صور مختلفة على انتاج القمح صنف مصر واحد و كذلك زيادة انتاجية الاراضى الرملية. اقيمت التجربة فى شتاء ٢٠١٧/ ٢٠١٨ و ٢٠١٨/ ٢٠١٩ فى محطة البحوث الزراعية بالاسماعيلية و قد استخدم قش الارز على الصور الاتية: قش الارز --خليط متخمر من بيوتشار قش الارز مع الكومبوست بنسبة ١ : ٠,٢٥ --قش الارز المتخمر المعامل بالامونيوم و يقارن ذلك بالكومبوست وكانت المعدلات المستخدمة هى صفر و ١٢,٥ و ٢٥ طن / هكتار. التجربة المعملية : حيث اقيمت تجربة تحضين للترب المضاف لها المخافات العضوية و تحت الظروف الهوائية فى عبوات ٢,٥ لتر واخزت منها عينات فى فترات ١، ٥ ، ٢٠ ، ٤٠ ، ٧٠ ، ٩٠ ، ١٣٠ يوم وتم تقدير المحتوى الرطوبى للتربة عند يوم من التحضين ومحتوى فقد التربة من الكربون العضوى خلال فترات التحضين. التجربة الحقلية : وتمت اضافة المخلفات العضوية فى فترتين الاولى قبل ثلاثة اسابيع من الزراعة و الاخرى مع الزراعة مباشرة و تم دراسة اضافة هذة المخلفات على المحصول و مكونات المحصول و محتوى النبات و التربة من النيتروجين و البوتاسيوم و الفوسفور و الكثافة الظاهرية والرقم الهيدروجينى و التوصيل الكهربى للتربة فى مرحلة النضج (١٣٠ يوم من الزراعة) ووزعت التجربة فى قطع منشقة (شرائح) مرة واحدة و كان الاطار العام للنتائج كالتالى:التجربة المعملية : فى نهاية فترة التحضين و جد زيادة معنوية للكربون العضوى المفقود من التربة بزيادة معدل الاضافة و فترة التحضين. وجدت زيادة فى النسبة المئوية للتشبع و السعة الحقلية و ارتفاع رقم الذبول الدائم و الماء الميسر و الكثافة الظاهرية بزيادة معدلات الاضافة على الترتيب من الاقل الى الاكبر قش الارز< قش الارز المعامل بالامونيوم < الكوومبوست بنما لم يحدث تاثير واضح للبيوتشار المتخمر عند المعدل ١٢,٥ طن/ هكتار بنما كان له تاثير عند المعدل ٢٥ طن / هكتارحيث كان التاثير على الترتيب البيوتشار المتخمر< قش الارز< قش الارز المعامل بالامونيوم < الكومبوست.التجربة الحقلية : حيث وجد ان اضافة بيوتشار قش الارز المتخمر و قش الارز المعامل بالامونيوم والكومبوست عند معدلى الاضافة ووقتى الاضافة اعطى فروق معنوية و كانت اعلى زيادة عن الكنترول فى المعدل ٢٥ طن / هكتار حيث كانت الزيادة عن الاضافات السابقة و عند اضافة المعاملات قبل الزراعة بثلاث اسابيع على الترتيب مع ارتفاع النبات ٣٦,٥٨ –٦٨,٩٥ –٧٤,٧٣ % و مع وزن المادة الجافة/ نبات ٣٥,٠ –٤٨,٤٤ –٦٩,٦ % أما مع وزن الحبوب/ بلوط كانت الزيادة فى وزن الحبوب ٤٥,١٣ – ٥٨,٧٠ – ٦٩,٣٢ % و فى وزن ١٠٠ حبة ١٧,٢٤ -١٨,٩٧ – ١٩,٣١ % وتاثر معنويا محتوى النيتروجين و البوتاسيوم و الفوسفور بالحبوب بالاضافات على الترتيب البيوتشار المتخمر و قش الارز المعامل بالامونيوم و الكومبوست ولوحظ وجود زيادة معنوية فى النيتروجين والبوتاسيوم و الفوسفور المتيسر بالتربة با لاضافات على الترتيب قش الارز و البيوتشار المتخمر و قش الارز المعامل بالامونيوم و الكومبوست و كانت اعلى زيادة عند المعدل ٢٥ طن/ هكتار. درجة ملوحة التربة و الكثافة الظاهرية للتربة أعطت فروق معنوية عند اضافة قش الارز المعامل بالامونيوم و الكومبوست عند معدلى و وقتى الاضافة بينما درجة حموضة التربة حدث فيه انخفاض محدود فى الرقم الهيدروجينى مع الكومبوست فقط ولكن مع بيوتشار قش الارز حدث ارتفاع بسيط لها عند المعدل ٢٥ طن / هكتار فقط. اضافة الكمبوست أعطت زيادة طفيفة مقارنة بقش الارز المعامل بالامونيوم مع انتاج القمح و خصائص التربة الكيميائية و الطبيعية التى تناولتها الدراسة و بالتالى يمكن التوصية باستخدام قش الارز المعامل بالامونيوم والمتخمر بهذا المعدل و هذا المحتوى من النيتروجين فى تحسين انتاجية الاراضى الرملية.