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Full Length Article

Comparable Effect of Commercial Composts on Chemical Properties of Sandy Clay Loam Soil and Accumulation of Trace Elements in Soil-Plant System

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Abstract

Plant growth in coarse texture soils is normally limited by plant-available nutrients. Organic amendments such as composts can improve soil properties for adequate plant growth. A pot experiment was conducted to evaluate the impact of commercial composts on soil properties and trace elements accumulation in soil-pant system. The treatments included; Green Force Compost (GFC), Super Bloom Compost (SBC), Lahore Compost (LCC) and University of Agriculture Faisalabad Compost (UAC) applied at rate of 5 g kg^{-1} (0.5% *w/w*) and 10 g kg^{-1} (1.0% *w/w*) of soil. Compost application altered the soil chemical properties like pH_s of soils was decreased with all treatments, while electrical conductivity (EC) and soil organic matter (SOM) content were significantly increased. Highest increment in total nitrogen (TN), total potassium (TK) and SOM was 97, 38 and 33% with SBC (1.0%) than control, while the highest increase in total phosphorus (TP) was observed 69% with LCC at 1.0% than control. The concentration of cadmium (Cd) in grains of rice amended with GFC, LCC and UAC was found above safe limit. Concentration of Cd, copper (Cu), lead (Pb) and zinc (Zn) did not exceed safe limits only with SBC at 0.5%. The highest straw (36.69 mg kg^{-1}) and grain (23.84 mg kg^{-1}) yields were recorded with SBC (1.0%) which was 39 and 59% higher than control treatment where only chemical fertilizer (CF) applied. Despite significant increase in crop yield with SBC at 1.0%, this level cannot be recommended because of increase in the concentration of Cd above the critical limit. Therefore, SBC at 0.5% is recommended for sandy clay loam soil to improve soil fertility status and produce rice free of Cd and other metals.

Keywords: Soil fertility; Compost; Rice; Trace elements; Soil properties

Introduction

The deterioration of soil can result from extensive use of chemical fertilizers without using organic amendments. Recently, high prices of chemical fertilizers have forced the farmers to seek alternate sources like manure, composts and biosolids. Rapid urbanization and industrialization in Pakistan produces large amount of industrial and municipal wastes on daily basis (Zuberi and Ali, 2015). According to Akhtar *et al.* (2017) no proper waste collection and disposal systems are in place in Pakistan. The farmers are using various types of waste materials like industrial wastes, municipal wastes and sewage sludge without knowing their potential harmful effect on soil properties and food quality.

In recent times, many companies have initiated to collect municipal solid wastes for preparation of compost product. Compost as a product of organic residues produced by aerobic biological decomposition is usually a good soil amendment with an extensive history (Luo *et al*., 2017). Compost is considered more economical for soil as well as for plants compared to chemical fertilizers in terms of plant nutrition. Physical and chemical properties of soil can be improved by using compost, which may ultimately increase crop yields that warrants large scale use of such amendments (Akhter *et al*., 2015). Further it has emerged as more preferred way to deal with raw waste materials recycling (Askarany and Franklin-Smith, 2014). Previous studies shown various positive changes in soil properties like soil reaction (pH), EC, SAR, SOM, total organic carbon (TOC), soil microbial biomass carbon (MBC) etc. (Lillenberg *et al*.,

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2010; Bass *et al*., 2016; Luo *et al*., 2017; Teutscherova *et al*., 2017).

Although, a great deal of information on composts as a rich source of nutrients is available in literature. Besides many benefits compost may contain variable levels of certain toxic trace elements, which upon release from the soil-applied composts could get their way into food chain to adversely affect soil, plant and human health (Smith, 2009; Hadi *et al*., 2015; Hanjra *et al*., 2015). However, inadequate data is available about the effects of commercially produced composts on changes in properties and trace element content in sandy clay loam soil. Rice (*Oryza sativa* L.) is one of the most important cereal and cash crops grown in Pakistan. It is the major source of foreign exchange earning in Pakistan. It accounts for 4.9% of value added in agriculture and 1% in GDP (Murtaza *et al.,* 2014). Therefore, a pot experiment was conducted with rice as a test crop exposed to a sandy clay loam soil amended with four locally commercially produced composts to evaluate their effect on soil-plant health and quality.

Materials and Methods

Experimental Site

The pot experiment was conducted in the glasshouse of Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, Pakistan. The ambient temperature in the glasshouse ranged 30⁄25±3℃ (day⁄night) with relative humidity of 55–65% and bright sunlight prevailed during the experimental duration.

Collection of Soil and Composts

The soil was collected from a farm area at Village No. 132/GB (73° 06' 53 and 31° 19' 03), Dijkot, Pakistan. It can be classified as a sandy clay loam (63.65% sand, 12.88% silt and 23.43% clay), slightly alkaline (pH=8.01), with low organic matter content (0.47%). The collected soil was illite dominated clays under irrigation of canal water, calcareous in nature and developed in alluvium beneath arid climate which was resulting from Himalayas during Pleistocene periods. Regarding the trace elements concentrations the soil in question has low levels of total elements below the limit values of the legislation (Table 1). Four composts were collected from different companies, i.e. Green Force Compost, Lahore (GFC), Super Bloom Compost, Multan (SBC), Lahore Compost, Lahore (LCC) and University of Agriculture Faisalabad Compost (UAC). The dry samples of compost were ground to get a homogenous mass. The selected properties of soil and composts samples are shown in Table 1.

Experimental Design and Raising of Plants

The test crop used for this study was rice (*Orzya sativa* L. cv. Super Basmati). Its length is almost four times greater than its width. Its long size pointed edges and exclusive aroma make it king of all basmati varieties. The seed was obtained from Rice Research Station, Kala Shah Kaku, Sheikhupura. The rice seeds were in sown on 4th June 2015 and the nursery was transplanted in pots on 11th July 2015. Two levels (0.5 and 1.0% *w/w*) of each compost were selected. To compare the results of treatments with chemical fertilizers treatments with no compost application (CF, control), only the recommended dose of fertilizer for rice (N-P-K=100-67-60 kg ha^{-1}) were subjected by using urea, diammonium phosphate and sulphate of potash as sources of N, P and K respectively. Ten kg soil was filled in each glazed pot (45×30 cm) and required quantities of treatment combinations were properly mixed to respective pots before the transplanting of rice nursery. The NPK level in compost treated soil was maintained equal to recommended rate by subtracting NPK already present in respective compost. Three plants were maintained in each pot till maturity and harvested on 10th November 2015. A known volume of canal water was used to maintain continuous submerged condition.

Gas Exchange Attributes and Leaf Chlorophyll

After sixty days of rice transplanting, gas exchange characteristics like stomatal conductance (*gs*), photosynthesis rate (*A*), transpiration rate (*E*) and chlorophyll contents (SPAD value) were measured during 10:00 am to 1:00 pm from the penultimate leaf by using Infra-Red Gas Analyser (Li-Cor 6400 XT) and SPAD chlorophyll meter (SPAD-502). During data recording, leaf chamber molar gas flow rate was 248 µmol s^{-1}, ambient CO_2 concentration (Cref) was 352 µmol mol^{-1}, temperature of leaf chamber (Tch) varied from 36.1 to 40.4ºC, ambient pressure (P) 98.01 kPa, molar flow of air/leaf area 221.06 mol m^{-2} s^{-1} and leaf chamber volume gas flow rate (v) was 380 mL min^{-1}.

Plant and Soil Analysis

Harvested plant samples were washed in detergent solution, 0.1 *N* HCl solution and de-ionized water in sequence and dried at 70°C till the constant weight. Straw and grain yield per pot was recorded by weighing. Straw and grains were digested in a di-acid mixture ($HClO_4$:HNO_3: 1:3 *v/v*) and analyzed for Cd, Cu, Pb and Zn using atomic absorption spectrophotometer (Solar S-100, Thermo Electron, USA) (AOAC, 1990). The soil samples were collected after the harvest of crop. The post-harvest soil samples were analyzed for pH_s, EC, N, P K, (U.S. Salinity Laboratory Staff, 1954; Page *et al*., 1982), organic matter (Jackson, 1962) and trace elements (Salim and Amacher, 1996: USEPA, 2005). The plant and soil samples were acid digested in triplicate along with blanks to minimize the error. The atomic absorption spectrophotometer was standardized after feeding of every ten (10) samples with a series of standard solutions supplied by the manufacturer (Thermo Electron S series; Thermo Scientific, Waltham, Mass).

Statistical Analysis

The pot experiment was conducted in a completely randomized design with three replicates of each level of treatment. The least significant difference (LSD) test ($p<0.05$) was applied for comparison among treatment means (Steel *et al.,* 1996). Statistical analyses were performed using Statistix 8.1® for Windows (Analytical Software, Tallahassee, USA). The obtained data were also computed for standard deviation (SD) in MS Excel (Microsoft Corporation, Pullman, Washington, USA).

Results

Yield

The rice straw and grain yields are shown in Table 2. The application of composts resulted in significance ($p\leq0.05$) differences in straw and grain yields. The highest straw yield was recorded with the addition of SBC at 1.0% (38% higher than control). The lowest straw yield (15% lower than control) was recorded with the addition of LCC at 1.0% application rate. Similar to straw yield the highest grain yield (23.8 mg kg^{-1}) was recorded with SBC at 1.0% level which was 59% more as compared to control treatment where chemical fertilizers were applied without any addition of compost. On the other hand, the yield declined to 17% and 30% with 0.5 and 1.0% levels of LCC, respectively compared to control treatment.

Trace Element Concentration in Straw and Grain

The concentrations of trace elements (Cd, Cu, Pb and Zn) in straw are shown in Fig. 1a–d. The concentration of all trace elements in plant parts was significantly ($p\leq0.05$) higher from treated pots compared to un-amended pots (control). There was a remarkable increment in trace elements with increasing levels of all composts. The concentration of Cd, Cu, Pb and Zn in rice straw ranged from 0.43 to 2.14, 1.80 to 6.00, 0.09 to 7.65 and 68 to 157 mg kg^{-1}, respectively. Maximum increment of Cd, Cu and Pb was observed in LCC with respect to control by 170, 229 and 1494%, respectively. The concentrations of trace elements (Cd, Cu, Pb and Zn) in grains are shown in Fig. 2a–d. The concentration of Cd, Cu, Pb and Zn in rice grain ranged from 0.01 to 1.72, 1.04 to 3.37, 0.01 to 2.58 and 20.06 to 39.16 mg kg^{-1}, respectively. The concentration of trace elements in grains was significantly lower than those found in straw. The concentrations of trace element showed a decreasing trend of Zn>Cu>Cd>Pb in rice straw. The highest concentration of Cd in grains was detected with LCC at 1.0% level of application as compared to control treatment while the lowest concentration was found with UAC at 0.5% level as compared to control treatment. The maximum concentration of Cu (3.37 mg kg^{-1}) and Pb (2.58 mg kg^{-1}) in grains was found with the addition of LCC at 1.0% level as compared to control treatment. The highest Zn contents (39.16 mg kg^{-1}) in grain were recorded with SBC at 1.0% level of application than control treatment.

Physiological Attributes and Chlorophyll Contents

Fig. 3 (a–d) presents the physiological growth of rice plant under different treatment combinations. Results showed that the photosynthetic rate significantly ($p\leq0.05$) affected with the addition of composts at both the levels. The maximum increase in photosynthetic rate was observed with the SBC at 1.0% level of application (Fig. 3a). The photosynthetic rate was also declined with LCC addition about 5 and 26% at 0.5 and 1.0% level, respectively as compared to control treatment (CF). The maximum increased in transpiration rate was observed with SBC at 1.0% level as compared to CF (control). The lowest transpiration rate (44% lower than control) was found with GFC applications at 0.5% level (Fig. 3b). The highest chlorophyll contents (SPAD value) were detected with SBC at 1.0% level as compared to control treatment where no compost was applied (Fig. 3c). The chlorophyll contents were also declined about 12 and 16% at 0.5 and 1.0% level of application. The stomatal conductance (*gs*) increased 12, 20, 12% and 10, 37 and 18% with GFC, SBC, UAC at 0.5 and 1.0% respectively as compared to control treatment where only chemical fertilizer applied. The *gs* was also declined by about 12 and 16% at 0.5 and 1.0% level of application of LCC, respectively.

Changes in Soil Chemical Properties

The chemical properties of post-harvest soil are listed in Tables 3 and 4. With respect to control treatment, the application of all composts significantly decreased the pH and increased EC. The highest EC (5.04 dS m^{-1}) was recorded with GFC at 1.0% level of application while the lowest EC (4.09 dS m^{-1}) was recorded with control treatment. In case of soil pH the maximum decline was observed with the addition of SBC at 1.0% level as compared to control (Table 3). There was a significant increase in N, P and K contents with increasing application rates of composts. The highest total soil nitrogen (T-N), total soil phosphorus (T-P) and total soil potassium (T-K) was found with SBC, UAC and SBC at 1.0% level which accounts 91, 75 and 63% increment as compared to control treatment. The soil organic matter (SOM) contents of post-harvest soil ranged from 0.49 to 0.89%, which gradually increased with increasing levels (Table 4). The maximum SOM was found within SBC at high level (1.0%) as compared to control treatment.

Trace Element Concentration in Post-harvest Soils

The concentration of trace elements in post-harvest soil is shown in Table 4. There was remarkable increment in trace element concentration with the application of all composts as compared to control. A highest concentration (2.18 mg kg^{-1})

Table 1: Some selected properties of soil and composts used in study

Parameter	Soil	GFC	SBC	LCC	UAC	[a]MAL
$EC_{(1:10)}$ (dS m^{-1})	4.02±0.09	4.46±0.86	3.05±0.26	3.77±0.33	3.73±0.74	
$pH_{w(1:10)}$	8.01±0.12	7.51±0.19	6.23±0.27	7.20±0.05	6.53±0.14	
TOC (%)	0.87±0.03	23.0±1.2	26.65±1.42	18.8±0.9	25.54±1.3	
N (mg kg^{-1})	345±26	978±101	2120±213	1380±162	1823±121	
P (mg kg^{-1})	398±29	1012±121	1328±136	1547±187	1236±143	
K (mg kg^{-1})	265±27	1421±132	1665±134	456±34	1345±105	
Cd (mg kg^{-1})	0.08±0.002	0.71±0.02	0.4±0.011	7.8±0.63	0.7±0.01	20-40
Cu (mg kg^{-1})	13.21±1.89	13.9±1.12	26.5±1.7	28.7±2.3	34.2±2.71	1000-1750
Mn (mg kg^{-1})	87.0±8.69	203±19	268±21.2	345±28	160±12.7	200-400
Pb (mg kg^{-1})	4.30±0.15	8.01±0.66	6.03±0.46	369±32	3.03±0.42	750-1200
Zn (mg kg^{-1})	61.6±2.3	105±9	271±19.7	457±34	46±31.8	2500-4000

Values are means±standard deviation, n = 3; TOC: Total organic carbon. GFC: Green Force compost, SBC: Super Bloom compost, LCC: Lahore compost, UAC: UAF compost, CF: Chemical fertilizer

[a]Maximum Allowable limits for agriculture practices, (McGrath *et al*., 1994)

Table 2: Effect of treatments on straw and grain yield (mg kg^{-1})

Treatment	Level	Straw Yield	Grain Yield
GFC	0.5%	23.29 ± 1.23^{ef}	17.54 ± 0.46^{cd}
	1.0%	29.84 ± 1.43^{b}	21.27 ± 0.59^{b}
SBC	0.5%	28.36 ± 1.63^{bcd}	22.42 ± 0.76^{ab}
	1.0%	36.69 ± 2.11^{a}	23.84 ± 0.56^{a}
LCC	0.5%	25.95 ± 1.32^{de}	12.43 ± 0.87^{f}
	1.0%	22.47 ± 1.11^{f}	10.44 ± 0.32^{g}
UAC	0.5%	29.29 ± 1.43^{bc}	16.39 ± 0.66^{de}
	1.0%	34.11 ± 1.32^{a}	19.62 ± 0.98^{b}
CF		26.48 ± 1.21^{cd}	14.98 ± 0.78^{e}
LSD value		3.17	1.83

Values are means±standard error, n=3; Different letters for each parameter show significant difference at $p<0.05$. GFC: Green Force compost, SBC: Super Bloom compost, LCC: Lahore compost, UAC: UAF compost, CF: Chemical fertilizer

of total soil Cd (T-Cd) in post-harvest soil was detected with LCC at 1.0% level as compared to control. The maximum concentration (7.26 mg kg^{-1}) of total soil Cu (T-Cu) in post-harvest soil was noticed with SBC at 1.0% level as compared to control. The highest concentration (5.75 mg kg^{-1}) of total soil Pb (T-Pb) in post-harvest soil was recorded with LCC at 1.0% level as related to control treatment. The uppermost concentration (183 mg kg^{-1}) of total soil Zn (T-Zn) in post-harvest soil was detected with SBC at 1.0% level as compared to control. The concentrations of trace element showed a decreasing trend, i.e. Zn>Cu>Cd>Pb in post-harvest soil. Thus, Cd, Cu, Pb and Zn concentrations in post-harvest soils were significantly proportional to compost levels (Table 4). This was showed higher SOM results in higher trace elements accumulation. It means the SOM contents increased with the application of composts but organic-matter bound elements was also build up in the post-harvest soils.

Discussion

The composts application decreased the soil pH (Table 3) that could be attributed to mainly to the high buffering capacity of calcareous soil. The increase in EC with all types of composts especially with GFC at 1.0% level may be ascribed to the elevated levels of soluble salts in composts. These results are in agreement with the previous work (Garcia-Gil *et al*., 2000; Franco-Otero *et al*., 2012; Yadav *et al*., 2017). Other studies also suggested that composts amendments have incredible amount of salts and regular application to crop land results in the accumulation of salts in soil (Eghbal *et al.*, 2004).

In this study, the TN was increased at both applied levels with the application of all composts (Table 3). Liu *et al*. (2012) observed an increase in TN with the application of compost. Overall, the increment in soil TP and TK was observed with all compost treatment combinations. This increment was mainly, because of presence of large variety of nutrients in municipal waste composts and evident in soil after the harvest of rice crop. These results are according to the findings of previous studies (Sarwar *et al*., 2007; Weber *et al*., 2007; Liu *et al*., 2012; Alvarenga *et al*., 2015). The increase in SOM after composts application could be explained by the large amount of organic matter in them. Rivero *et al*. (2004) also observed increment in SOM with the application of compost.

The addition of composts increased the concentration of trace elements in soil. In the present study, increase in T-Cd was maximum with LCC at both applied levels because it was prepared from municipal solid waste (MSW) while other three composts (GFC, SBC and UAC) were prepared from agricultural wastes. Studies showed that the soil application of MSW composts increased the concentration of various trace elements (Warman *et al*., 2004; Baldantoni *et al*., 2010; Carbonell *et al*., 2011; Zhang *et al*., 2011). The increase in SOM after composts application could be explained by the huge volume of organic matter in them. Although organic amendments application significantly increased the total concentrations of trace elements (Cd, Cu, Pb and Zn) in soil (Table 4). The concentration of trace elements in post-harvest soils did not exceeded to the critical limits with all composts and both levels proposed by Denneman and Robberse (1990) and Ministry of Housing, Netherland (1994). The compost addition also significantly enhanced the concentration of trace elements like Cd, Cu, Pb and Zn in different plant parts

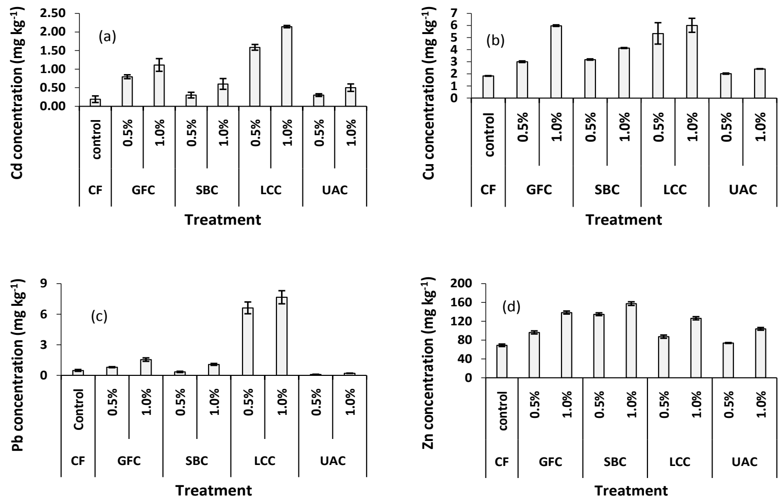

Fig. 1: Accumulation of (a) Cd, (b) Cu, (c) Pb and (d) Zn in rice straw

Values are means±standard error, *n*=3; GFC: Green Force compost, SBC: Super Bloom compost, LCC: Lahore compost, UAC: UAF compost, CF: Chemical fertilizer

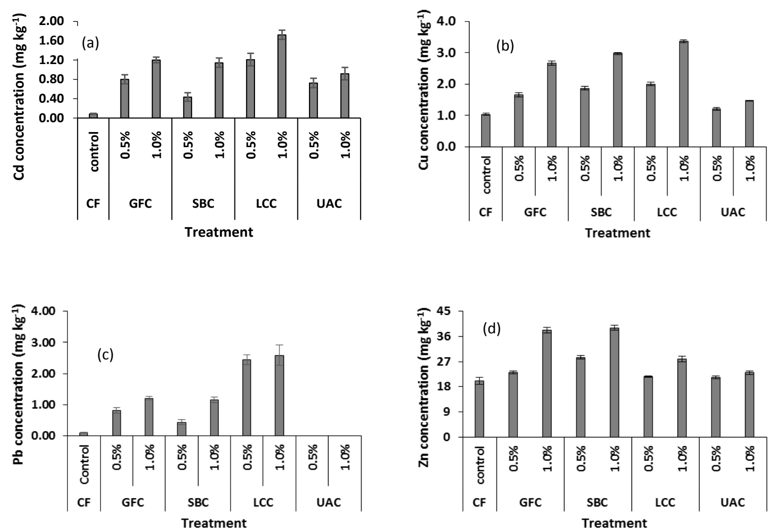

Fig. 2: Accumulation of (a) Cd, (b) Cu, (c) Pb and (d) Zn in rice grains

Values are means±standard error, *n*=3; GFC: Green Force compost, SBC: Super Bloom compost, LCC: Lahore compost, UAC: UAF compost, CF: Chemical fertilizer

(Figs. 1 and 2). The permissible limit of Cd in plants, recommended by Ernst (1996) is 0.02 mg kg^{-1}, in recent study, it crossed with all the treatment combinations except CF and SBC at 0.5% rate of application. The permissible limit of Pb in plants recommended by WHO is 2 mg kg^{-1}, in this study, the concentration of Pb exceeded to the safe level with LCC application at both levels. As regard to Cu and Zn accumulation in straw and grain, it was present in almost all the plant samples but did not cross the permissible limits.

The higher accumulation of trace elements in different plant parts also affected the photosynthetic condition of plant (Ouzounidou *et al.,* 2006; Khaliq *et al.,* 2016). The significant increment in all photosynthetic attributes was noted with SBC at 1.0% level. This was may be because of less accumulation of trace elements in plant parts and maximum uptake of nutrients.

A higher percentage of organic matter in composts could be the possible reason to slow release of elements (nutrients and toxic) which directly affect the *gs* and transpiration rate of plant leaves. The release of toxic elements like Cd, Pb and Ni etc. above to the safe limit caused various dysfunction in plant physiological performance. It has been reported that the trace element toxicity decreased gas exchange features like transpiration rate in various plant species (Burzynski and Kłobus, 2004; Aziz *et al*., 2015; Ramzani *et al*., 2016). The concentration of trace elements also declined the straw yield as well as grain yield. In our study, the maximum decline was observed with

Table 3: Changes in soil chemical properties and major nutrients content in post-harvest soils

Treatment	Level	EC (dS m^{-1})	pH	TN (mg kg^{-1})	TP (mg kg^{-1})	TK (mg kg^{-1})
GFC	0.5%	5.04 ± 0.21	7.78 ± 0.46	353 ± 31	3632 ± 232	1121 ± 101
	1.0%	6.11 ± 0.32	7.56 ± 0.59	512 ± 43	4343 ± 377	1732 ± 123
SBC	0.5%	4.12 ± 0.09	7.23 ± 0.76	374 ± 31	3521 ± 398	1278 ± 108
	1.0%	4.33 ± 0.12	7.12 ± 0.56	637 ± 56	4178 ± 411	1789 ± 153
LCC	0.5%	4.45 ± 0.09	7.67 ± 0.87	342 ± 46	3733 ± 319	1122 ± 98
	1.0%	4.65 ± 0.07	7.45 ± 0.32	505 ± 62	4588 ± 421	1432 ± 99
UAC	0.5%	4.34 ± 0.08	7.43 ± 0.66	382 ± 48	3222 ± 324	1211 ± 103
	1.0%	4.56 ± 0.08	7.18 ± 0.98	449 ± 38	4778 ± 432	1532 ± 167
CF		4.09 ± 0.09	8.07 ± 0.78	332 ± 22	2721 ± 198	1093 ± 95
LSD value		1.08	1.83	54	173	121

Table 4: Effect of treatments on soil organic matter (SOM) and trace element concentration in post-harvest soils

Treatment	Level	SOM (%)	T-Cd (mg kg^{-1})	T-Cu (mg kg^{-1})	T-Pb (mg kg^{-1})	T-Zn (mg kg^{-1})
GFC	0.5%	0.54 ± 0.02	0.36 ± 0.01	3.34 ± 0.12	1.17 ± 0.03	143 ± 12
	1.0%	0.65 ± 0.03	0.42 ± 0.02	5.13 ± 0.32	1.57 ± 0.05	153 ± 13
SBC	0.5%	0.75 ± 0.03	0.14 ± 0.01	5.10 ± 0.43	1.05 ± 0.03	170 ± 15
	1.0%	0.89 ± 0.04	0.19 ± 0.01	7.26 ± 0.65	1.95 ± 0.02	183 ± 16
LCC	0.5%	0.55 ± 0.04	1.44 ± 0.04	3.28 ± 0.11	4.78 ± 0.22	90 ± 16
	1.0%	0.69 ± 0.05	2.18 ± 0.06	4.11 ± 0.21	5.75 ± 0.32	182 ± 15
UAC	0.5%	0.71 ± 0.05	0.19 ± 0.01s	2.64 ± 0.09	1.20 ± 0.05	124 ± 11
	1.0%	0.85 ± 0.06	0.40 ± 0.01	2.97 ± 0.09	1.50 ± 0.06	150 ± 12
CF		0.49 ± 0.03	0.13 ± 0.01	1.33 ± 0.06	0.33 ± 0.02	82 ± 9
LSD value		0.11	0.08	1.23	1.09	10

Values are means±standard error, *n*=3; Different letters for each parameter show significant difference at p<0.05. GFC: Green Force compost, SBC: Super Bloom compost, LCC: Lahore compost, UAC: UAF compost, CF: Chemical fertilizer

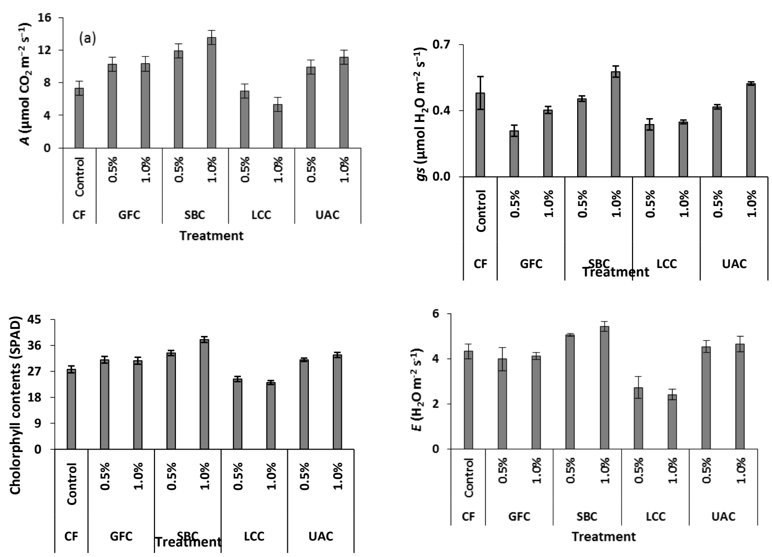

Fig. 3: Photosynthetic parameters of rice plants grown with various treatments

Values are means±standard error, *n*=3; GFC: Green Force compost, SBC: Super Bloom compost, LCC: Lahore compost, UAC: UAF compost, CF: Chemical fertilizer

LCC at both levels. This may directly have related to trace elements toxicity in soil-plant system which antagonized the many essential nutrients to enter in plant. The toxicity of Cd, Pb and Cu in other crops like wheat and maize also reported, which directly reduced the straw and grain yield (Nazar *et al.*, 2012; Ramzani *et al.*, 2016). On the other hand, increment in yield parameters was also observed with SBC, GFC and UAC as compared to chemical fertilizer (Table 2). Sarwar *et al.* (2007) stated significant increment in grain and straw yields of rice and wheat crops with the application of compost at 12 and 24 t ha^{-1}. Previous studies have shown that organic materials (manures, compost and biosolids) improve nutrient status of soils by slow releasing of nutrients and reducing their losses due to organic matter contents (Ibrahim *et al.*, 2008; Latare *et al.*, 2014; Sarwar *et al.*, 2017).

Conclusion

The application of composts improved the soil chemical properties. This change was correlated to selected compost levels. The pH of soil decreased, while EC and soil organic matter content was increased with the application of composts. LCC application caused a significant increase in the concentration of trace elements. The concentration of Cd and Pb exceeded to the safe limit with LCC at both levels while SBC at 0.5% showed higher yield and less accumulation of of these trace elements in plant parts. The straw and grain yield was also declined with LCC at both levels as compared to all treatments. While SBC, GFC and UAC composts showed a noticeable influence on crop yield with the accumulation of trace elements except SBC as compared to control. Our findings suggest that the commercially available composts no doubt increase the SOM and soil fertility status but also introduced trace elements in soil-plant system and therefore companies should also mention the concentration of trace elements present in their products for the surety of contamination free food production.

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