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Effect of green and farmyard manure on carbohydrates dynamics of salt-affected soil

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Abstract

In Pakistan, salinization of agricultural lands is a serious problem prevailing in arid and semi-arid regions of the country. The main objective of the present study was to investigate the carbohydrates dynamics of the salt-affected soil, amended with different organic matter combinations and incubated for varying time periods (0, 15, 30 and 60 days) and temperatures (15 and 37 ^oC). Replenishment of soil organic matter (SOM) was made with Green manure (GM) and Farmyard manure (FYM). The soil pH, EC, Na^+ and K^+ contents were evaluated through standard methods. An improvement in the soil organic carbon (OC) and nitrogen (N) contents ranging from 0.10 to 1.40% and 0.05 to 0.55% was achieved through the selected soil amendment practices. Total carbohydrates were found to be enhanced with organic treatments alone or in combination, accounting for 13.20% to 26.30% of the total soil. Non-glycosidic interactions of soil carbohydrates with minerals were investigated by applying powdered X-Ray diffraction (XRD) analysis using a Rigaku wide range goniometer (PW 1050/23). Semi-quantitative analysis of the soil organo-mineral interactions, based on their relative frequency abundance, was expressed in terms of a system of nine components. X-Ray diffraction (XRD) analysis revealed interactions of varying magnitude namely major, minor, trace and rare between the soil carbohydrates and minerals.

Keywords: Salinity, Organo-minerals, Manure, XRD.

1. Introduction

Wide spread salinity problem and rapidly growing population is creating food and fiber shortage for the people in several countries across the world. The major consequences of the soil salinity include deterioration of the soil structure, loss in soil bio-chemical activities and poor nutrients supply for plant growth, and substantial decrease in crop growth and productivity (Pathak and Rao, 1998).

Pakistan is among one of those agricultural countries where more than six million hectares of the productive agriculture land which have salinity problem and a lot more is at its risk (Khan, 1998). According to the nature and extent of salinization the salt-affected lands are classified into saline and saline sodic soils. In central part of Pakistan, Bio-saline Research Station of Nuclear Institute for Agriculture and Biology (NIAB) represents the largest area of slat-affected land, with contribution more than 1 million hectares. This zone is severely damaged by salinity due to accumulating of salts which include alkali and alkaline earth metals such as Na^+, K^+ and Ca^{++} etc.

Saline soils are enriched with soluble salts of sulphate (SO_4^{-2}) and chloride (Cl^{-1}), however, some time nitrates (NO_3^{-1}) and carbonates (CO_3^{-2}) also predominate (Rietz and Haynes, 2003)**.** Chief cations of these soils are Na^+, K^+, and Ca^{++} but Na^+ seldom makes up more than half of the salts. The Na^+ exchange capacity of these soils is less than 15 moh (Brady and Weil, 1999). Saline soils also contain high concentrations of soluble salts with their exchangeable Na^+ percentage (ESP) often higher than 15% and the pH value > 8.5. Among various environmental and eco-physiological factors, soil organic matter (SOM) is one of the main factors contributing towards loss in fertility and fabric of the salt-affected lands. Percent organic carbon and nitrogen content of the soil provide an indirect measure of soil microbial activities and nutrient fertility. The content of SOM in the soil is one of the key factors that govern soil organic stocks and dynamics (Oades, 1988). Soil organic matter is composed of various organic compounds with decomposition rates varying continuously due to the complex biological, chemical and physical processes operating in the soil. Long-term management of the soil with organic matter amendments significantly increases the SOM and microbial biomass of an amended soil than that of unamended soil (Gerzabek *et al.,* 1997). Similarly the addition of composted material in soil is responsible for enhancing soil microbial activities (Aviva Hands *et al.,* 1996). The presence of carbohydrates contributes a major portion of dry weight of plant residues and soil organic matter. Hence the addition of organic substances to soil may result in substantial increase in carbohydrates content. A qualitative approach may offer more sensitive tools to assess early management-induced changes in soil organic carbon quality (Gregorich *et al.,* 1994).

The variations in the quality of soil carbohydrates are not clearly evidenced, however some studies in different regions of the world (Arshad *et al.,* 1990; Roberson *et al.,* 1991; Kaiser and Zech, 1999**)** suggest that both quality and quantity of soil carbohydrates is influenced by factors such as intensity of cultivation, soil type and texture, soil carbon status, distribution of aggregates in soils, and the climatic conditions. The measurement of carbohydrates provides a very useful tool to investigate early changes in soil organic matter caused by management practices (Angers and Mehuys, 1990; Zhang *et al.,* 1999; Turrion *et al.,* 2002). Organic matter is an essential driving force in environmental global diversity as it provides a rich source of atmospheric carbon (Schlesinger, 1997). Soil carbohydrates and humic material are considered as stable and labile part of the soil organic carbon (OC) (Spaccini *et al.,* 2000a; Spaccini *et al.,* 2000b).

Considerable efforts are being devoted for exploring the biological and chemical composition of salt-effected soils. It is well accepted that SOM determines the biological and physio-chemical aspects of the fertility of the soils. The contents of SOM not only ensure an adequate nutrient supply for the crops but also sustain and maintain the physio-chemical properties of the soils. A wealth of data is available for organic matter dynamics, and its effect on fertility of normal soil, however, there are rarely data documented for salt-affected soils. The objective of the present study was to appraise the carbohydrates dynamics of salt-affected soils, amended with different organic manures, and their combinations.

2. Materials and methods

The soil used in the present study was collected from an agricultural field of the Bio-saline Research Station (BSRS) of the Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad. This Research Station is located at Pakka Anna about 45 km away in south west of city Faisalabad in Punjab province of Pakistan. Soil was taken from 0-30 cm depth of the field. Green manure and farmyard manure were collected from the village side 20 km away from the city of Faisalabad. All the reagents used were of analytical grade and purchased from Merck (Darmstadt, Germany). Standard of glucose was procured from Sigma–Aldrich Chemical Co., (St. Louis, Mo, USA) whereas standards (Na^+ and K^+) for Flame Photometric analysis were from CIBA- CORNING (Halstead, England). Throughout the experimental work deionized water was used.

2.1 Experimental Setup

One hundred (100) grams of soil were taken into a 100 mL capacity bottles, and treated as follow: in control saline soil, 100 g soil was taken, in Green manure (GM) sample, 2.0 g Green manure into 100 g soil, in Farmyard manure (FYM), 5.0 g Farmyard manure into 100 g soil and in F+G, 1.0 g Green manure and 2.5 g Farmyard manure into 100 g soil, were added for preliminary preparations of samples. Triplicates preparations were made and after adjusting the water holding capacity at 60%, the bottles containing the samples were incubated at 15 °C and 37 °C for 0, 15, 30, 45 and 60 days. At each sampling date, the treated and untreated soils were taken out into polyethylene bags and mixed thoroughly. An appropriate portion was analyzed for organic carbon (OC), nitrogen (N), carbohydrates and organo-minerals.

2.2 Physio-chemical Analysis of Soil

The air-dried ground soil material that passed through a 2.0 mm sieve (Table 1) was analyzed for physiochemical parameters following standard soil analytical methods (Page *et al.,* 1982). Saturated paste of the soil was prepared for measuring pH using pH meter (HANNA 8521) and extracted for determination of electrical conductivity (EC).The conductometric measurement was made using a conductivity meter (HANNA HI 8733) equipped with a standard conductivity cell, having cell constant as unity. Soluble Na^+ and K^+ contents were measured using Flame photometer. Total nitrogen content of the soil samples, control and amended with different organic amendments were measured using Kjeldahl method. Organic carbon content was determined by a reported method (Riehm and Ulrich 1954).

Table 1. Physio-chemical analysis of saline soil.

Parameter	Value
pH	9.1 ± 0.5
EC (mS cm^{-1})	16.6 ± 0.5
Na^+ (ppm)	4000 ± 815
K^+ (ppm)	91 ± 7
Organic Carbon (%)	0.09 ± 0.01
Total Nitrogen (%)	0.060 ± 0.005
Total Carbohydrates (mg g^{-1} of soil)	0.13 ± 0.05

Values are mean ± SD of triplicate determinations.

2.3 Organic Manure

For green manure 90 days old plants of Berseem (*Trifolium aculeata*) were harvested from the field. Oven-dried plant material was ground in a mill to fine powder. A representative sample of the powdered material showed organic carbon, 42.69% and total N (2.75%) and C/N ratio 15.52. Similarly after air-drying the farmyard manure (FYM) was ground to fine powdered form for further analysis. Analysis of a representative sample indicated organic carbon 16.39%, total nitrogen 1.46% and C/N ratio 11.65**.**

2.4 Determination of Na^+ and K^+ contents of the Soil

Three hundred (300 g) grams of saline soil was taken. About 100 mL distilled water was poured into it and stirred well until a uniform past of the soil was formed. From the uniform past extracted the maximum amount of free water for the analysis of Na^+ and K^+ ions. For sodium (Na^+), the sample was diluted 2000 times, and then emission intensity for Na^+ recorded using a Perkin-Elmer flame photometer (model No. 52-A). Similarly, emission intensity for potassium (K^+) was also recorded. The amounts of Na^+ and K^+ ions were calculated using standard calibration curve of the respective ions.

2.5 Total Organic Carbon and Total Nitrogen Content of the Soil

The method based on the oxidation of organic matter with hot mixture of $K_2Cr_2O_7$ and H_2SO_4 (Riehm and Ulrich 1954) was adopted for the determination of organic carbon (OC) content of the control and treated soil samples following the equation given below:

$$\% \text{ O.C} = \frac{\text{OD (Sample)} \times \text{mg C (Standard)} \times 100}{\text{OD (Standard)} \times \text{weight of soil}}$$

Total nitrogen content of the soil samples treated and control was determined by micro Kjeldahl method modified to include NO_3^{-1} present in the samples (Bremner and Mulvaney, 1982).

$$\% N = 1.4 \times \frac{\text{Acid used}}{\text{Sample wt}} \times \text{Normality of Acid}$$

2.6 Total Carbohydrates

Method described by Angers *et al.* (1988) was used for the carbohydrate extraction from the control and organically treated soil samples. For this purpose, 1.0 g of moisture- free soil sample was taken in a 25 mL screw caped Pyrex glass test tube. After addition of 10 mL of 6M H_2SO_4 to each of the test tube, the sample was hydrolyzed at 80 °C for 24 h. The samples were cooled, filtered and centrifuged at 10,000 rpm and supernatant hydrolysates were decanted and normalized to pH 7.0 with $BaCO_3$. An aliquate of clean solution was treated to determine the total carbohydrates content of the soil samples by using standard curve of glucose (Dubious *et al,* 1956).

2.7 Soil Mineralogy

A thin layer of soil sample was prepared by spreading a glass slide and was subjected to X-Ray diffraction analysis, using Rigaku wide range goniometer (PW1050/23) equipped with a generator (PW- 1011) producing radiation at 50Kv and 40mA. A scanning rate of 1° 2ɵ/ minutes from 2 – 18° and 4×10^3 cps was used for all soil samples. Semi-quantitative analysis of the soil organo-mineral interactions based on their relative frequency abundance was expressed in terms of a system of nine components. Fine grades of semi-quantitative data, based on relative intensities of various components, were recognized as major, minor, trace and rare.

2.8 Statistical Analysis

Each experiment was conducted in triplicate. The experimental values were computed as mean ± SD. Statistical analysis for regression co-efficient and correlation were conducted by using binomial regression ($y = 0.2213x-0.0238$ and $R^2 = 0.8213$) with the help of COSTAT computer software.

3. Results

The results indicated that the type of organic amendment, temperature and organic matter of the soil, affected both the organic carbon and total nitrogen contents of the salt-affected soil. The organic carbon (OC) and nitrogen (N) contents as determined in the present analysis of Green manure (GM) and Farmyard manure (FYM) were found to be 42.69% and 2.75% and 16.39% and 1.46%, respectively (Table 2). Organic manure amendments of the soil increased the organic matter contents of the salt-affected soil to many folds as well as enhanced the soil dynamics in terms of % OC, %N, total carbohydrates and organo-minerals contents after incubation for 60 days of at two temperatures of 15 °C and 37 °C.

Table 2. Organic carbon and nitrogen contents of organic material.

Material	%Organic Carbon (OC)	%Total Nitrogen
Green Manure (GM)	42.69 ± 1.52	2.75 ± 0.60
Farmyard manure (FYM)	16.39 ± 1.12	1.46 ± 0.30

Values are mean ± SD of triplicate determinations.

3.1 Organic carbon

In control saline soil (CSS), OC content was 0.10 g 100 g^{-1} of soil which increased due to organic treatments from 1.12 to 1.40 g 100 g^{-1} soil (Figure 1, 2). Organic carbon content in the control saline soil decreased 10-50% as a result of incubation period of 15 to 45 days however it increased slightly in 60 days at both the temperatures of 15 °C and 37 °C. Organic carbon decomposition rate in the soil amended with Green manure (GM) was found to be 75% during first 15 days storage period and reached up to 92% in 45 days and then again microbialy restored 10 to 20% in 60 days. Similarly, the results showed the decrease in organic carbon in other amended soil with Farmyard manure (FYM) 70-90 % and Farmyard manure plus Green manure (F+G) 80-92%.

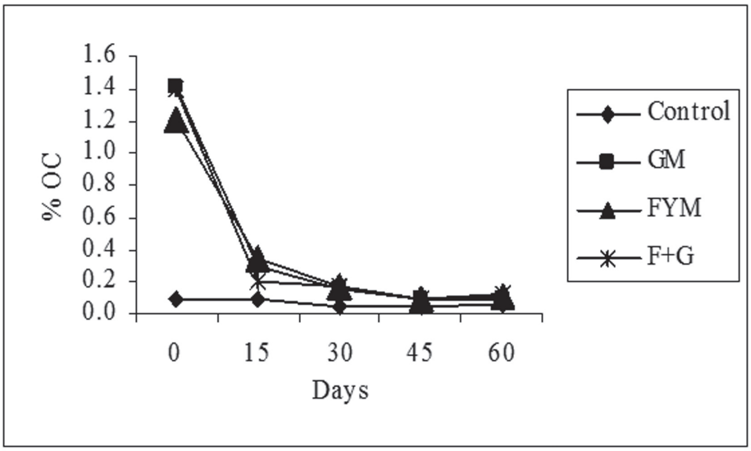


Figure 1. Effect of organic amendments on % (OC) of control and treated soils at 15 °C.

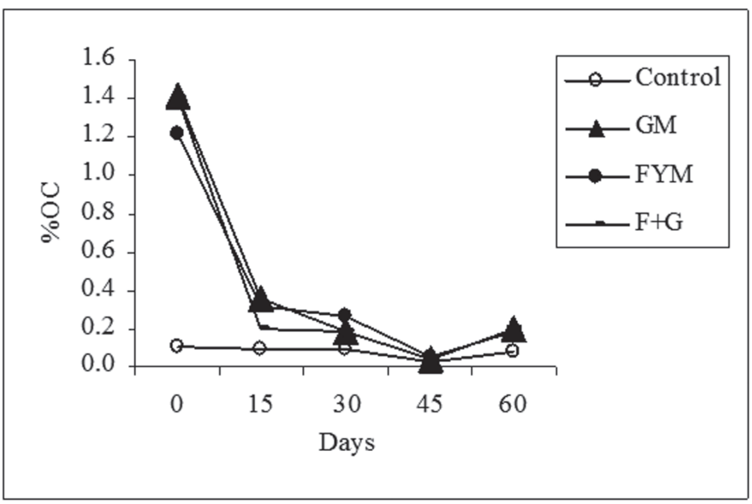


Figure 2. Effect of organic amendments on % (OC) of control and treated soils at 37 °C.

3.2 Nitrogen

The total nitrogen content was found to be 0.05 g 100 g^{-1} of soil in control saline soil which increased with addition of organic materials to a level of 0.38 to 0.55 g 100 g^{-1} of soil (Figure 3, 4), an increase of 60 to 90 %. In CSS, nitrogen decomposition rate was found to be 16 and 20% at 15 °C and 37 °C, respectively. Similarly the decomposition rate in GM, were found to be 86 and 70 % and in FYM 91 and 80% at 15 °C and 37 °C, respectively. Similar trends were observed in Farmyard + Green manure (F+G) at both the temperatures (Figure 3, 4).

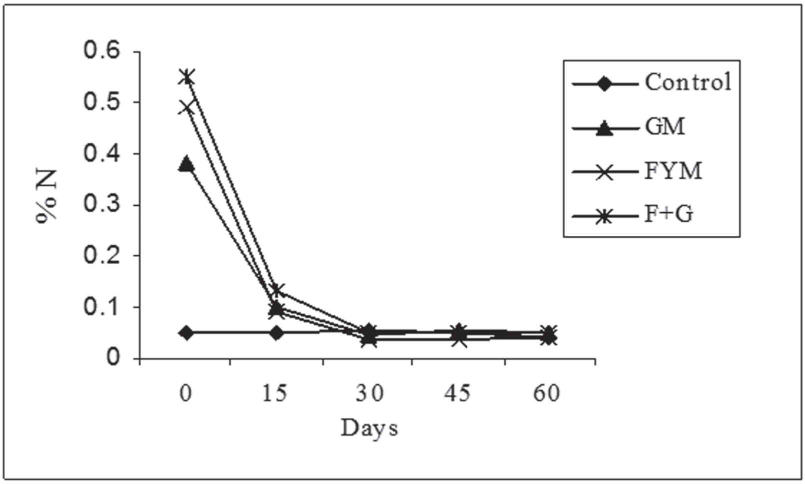


Figure 3. Effect of organic amendments on % N on control and treated soils at 15°C.

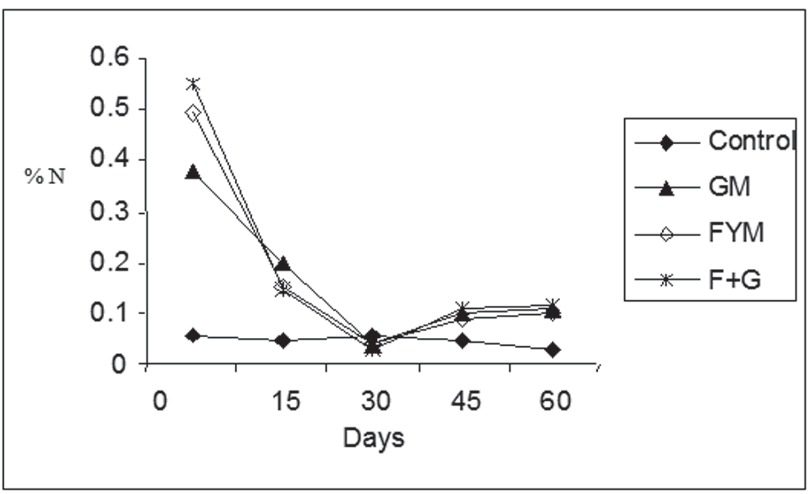
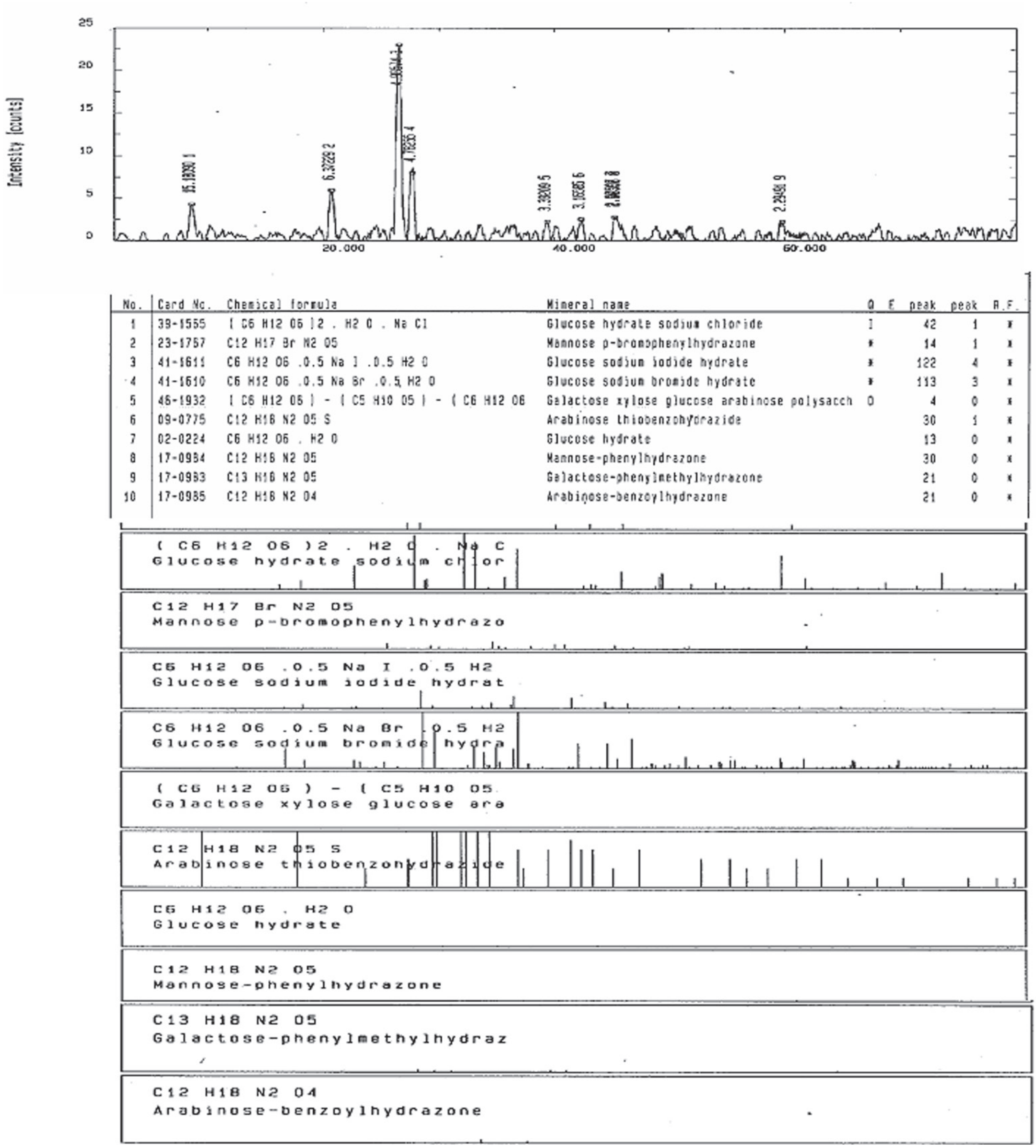


Figure 4. Effect of organic amendments on % N of control and treated at 37°C.



No.	Card No.	Chemical formula	Mineral name	Q	E	peak	peak	R.F.
1	39-1555	[C6 H12 O6]2 . H2 O . Na Cl	Glucose hydrate sodium chloride	I		42	1	*
2	23-1757	C12 H17 Br N2 O5	Mannose p-bromophenylhydrazone	*		14	1	*
3	41-1611	C6 H12 O6 .0.5 Na I .0.5 H2 O	Glucose sodium iodide hydrate	*		122	4	*
4	41-1610	C6 H12 O6 .0.5 Na Br .0.5 H2 O	Glucose sodium bromide hydrate	*		113	3	*
5	46-1932	[C6 H12 O6] - (C5 H10 O5) - (C6 H12 O6	Galactose xylose glucose arabinose polysacch	O		4	0	*
6	09-0775	C12 H18 N2 O5 S	Arabinose thiobenzohydrazide			30	1	*
7	02-0224	C6 H12 O6 . H2 O	Glucose hydrate			13	0	*
8	17-0984	C12 H18 N2 O5	Mannose-phenylhydrazone			30	0	*
9	17-0983	C13 H18 N2 O5	Galactose-phenylmethylhydrazone			21	0	*
10	17-0985	C12 H18 N2 O4	Arabinose-benzoylhydrazone			21	0	*

Figure 5. X-Ray diffraction analysis of Farmyard + Green manure treated soil sample.

3.3 Total Carbohydrates of the Soil

The total concentration of carbohydrates in control and organically amended soil samples at 0 day followed the trend GM>F+G>FYM>CSS (Table 4, 5). Considering the organically amended soils, the carbohydrate values were found highest in the GM treatments (26.90 mg 100 g^{-1} of soil). As the treatments were improved, the carbohydrate content raised above the control levels (Table 4).

The major improvement was achieved with Green manure (GM) 26.90 mg 100 g^{-1} of soil and Green manure + Farmyard manure (F+G) 23.60 mg 100 g^{-1} of soil followed by Farmyard manure (FYM) 20.40 mg 100 g^{-1} soil. A positive correlation between organic carbon and carbohydrates contents was significant for percentages of carbon 0 days versus carbohydrates 30 days, supporting variation in estimated values (Table 5).

The concentration of carbohydrate in control and treated soil samples decreased with increasing incubation time at temperature 15 °C and 37 °C, however the decomposition rate at 37 °C was relatively more pronounced than the rates at observed at 15 °C. Almost similar trends in the decomposition of carbohydrates were observed in all such types of organically amended and control soils. In comparison to the control saline soil, there was a rapid rate of decline in the content of acid-hydrolysable carbohydrates in treated soils for all types of organic amendments (Table 3, 4)

Table 3. Carbohydrates contents of different organic treatments at 15 °C.

Days	**0 DAYS**		**15 DAYS**		**30 DAYS**		**45 DAYS**		**60 DAYS**	
	mg g^{-1} of soil	**% of OC**	**mg g^{-1} of soil**	**% of OC**	**mg g^{-1} of soil**	**% of OC**	**mg g^{-1} of soil**	**% of OC**	**mg g^{-1} of soil**	**% of OC**
CSS	0.132 ± 0.005	14.19 ± 0.52	0.061 ± 0.001	8.24 ± 0.30	0.082 ± 0.001	16.73 ± 0.63	0.087 ± 0.00	16.73 ± 0.82	0.091 ± 0.001	14.97 ± 0.76
GM	0.269 ± 0.003	19.35 ± 0.62	0.128 ± 0.002	5.73 ± 0.15	0.127 ± 0.002	8.41 ± 0.35	0.172 ± 0.002	8.41± 0.48	0.185 ± 0.002	17.27 ± 0.95
FYM	0.204 ± 0.002	16.85 ± 0.39	0.100 ± 0.001	4.40 ± 0.10	0.093 ± 0.001	6.99 ± 0.27	0.221 ± 0.003	6.99 ± 0.52	0.158 ± 0.002	12.98 ± 0.65
F+G	0.236 ± 0.006	16.31 ± 0.42	0.10 5± 0.001	3.73 ± 0.10	0.095 ± 0.001	5.40 ± 0.22	0.156 ± 0.002	5.4 ± 0.33	0.153 ± 0.001	14.85 ± 0.68

Values are mean ± SD of triplicate determinations
CSS- Control Saline Soil
GM- Green Manure treated soil
FYM- Farmyard Manure treat treated soil
F+G - Farmyard Manure + Green Manure

Table 4. Carbohydrates contents of different organic treatments at 37 °C.

Days	0 DAYS		15 DAYS		30 DAYS		45 DAYS		60 DAYS	
	mg g^{-1} of soil	% of OC	mg g^{-1} of soil	% of OC	mg g^{-1} of soil	% of OC	mg g^{-1} of soil	% of OC	mg g^{-1} of soil	% of OC
CSS	0.132 ± 0.001	14.19 ± 0.52	0.059 ± 0.001	8.81 ± 0.30	0.090 ± 0.001	10.22 ± 0.45	0.104 ± 0.003	43.33 ± 1.50	0.094 ± 0.005	11.46 ± 0.51
GM	0.269 ± 0.003	19.35 ± 0.62	0.108 ± 0.001	6.45 ± 0.20	0.096 ± 0.001	6.19 ± 0.39	0.175 ± 0.002	54.68 ± 2.12	0.129 ± 0.006	11.41 ± 0.49
FYM	0.204 ± 0.002	16.85 ± 0.39	0.107 ± 0.001	6.45 ± 0.20	0.133 ± 0.003	5.85 ± 0.29	0.186 ± 0.002	31.33 ± 1.15	0.107 ± 0.003	11.5 ± 0.27
F+G	0.236 ± 0.003	16.31 ± 0.42	0.104 ± 0.001	3.71 ± 0.10	0.120 ± 0.002	8.82 ± 0.55	0.146 ± 0.002	25.29 ± 1.10	0.110 ± 0.003	11.82 ± 0.34

Values are mean ± SD of triplicate determinations
CSS- Control Saline Soil
GM- Green Manure
FYM- Farmyard Manure
F+G - Farmyard Manure + Green Manure

Table 5. Correlation of Carbohydrates with carbon% of control and treated soil sample.

Correlation	r.	Estimate	Df (n^{-2})
	r_{all}	0.332*	16
% C_0 vs. $Carboh_0$	r_{15^oC}	0.328ns	16
	r_{37^oC}	0.336ns	34
	r_{all}	0.668***	16
% C_{15} vs. $Carboh_{15}$	r_{15^oC}	0.566*	16
	r_{37^oC}	0.855***	34
	r_{all}	0.145ns	16
% C_{30} vs. $Carboh_{30}$	r_{15^oC}	0.021ns	16
	r_{37^oC}	0.604**	34
	r_{all}	0.202ns	16
% C_{45} vs. $Carboh_{45}$	r_{15^oC}	0.025ns	16
	r_{37^oC}	0.316ns	34
	r_{all}	0.695***	16
% C_{60} vs. $Carboh_{60}$	r_{15^oC}	0.807***	16
	r_{37^oC}	0.335ns	34
	r_{all}	1.462**	16
% C_0 vs. $Carboh_{15}$	r_{15^oC}	0.339ns	16
	r_{37^oC}	0.949***	34
	r_{all}	0.682***	16
% C_0 vs. $Carboh_{30}$	r_{15^oC}	0.646***	16
	r_{37^oC}	0.766***	34

Continued...

Correlation	r.	Estimate	Df (n^{-2})
	r_{all}	0.668***	16
% C_0 vs. $Carboh_{45}$	r_{15^oC}	0.756***	16
	r_{37^oC}	0.587*	34
	r_{all}	0.333*	16
% C_0 vs. $Carboh_{60}$	r_{15^oC}	0.331ns	16
	r_{37^oC}	0.617**	34

*** = More significant ** = significant *= Least significant ns=Non significant

3.4 Soil Mineralogy

The results obtained by XRD for soil organo-minerals revealed the presence of nine various components. Major contribution was made by glucose sodium iodide hydrate and glucose sodium bromide hydrate. Relative frequency occurrence of both the mineral carbohydrate components was found to be higher i.e. 10, 14, 16 in green manure (GM) treated soil as compared to control saline soil (CSS) at all incubation periods, respectively. Similarly, values of frequency occurrence of glucose sodium bromide hydrate were also higher i.e. 13 and 11 in soil samples treated with green manure (GM) at 30 and 60 days of incubation periods. All such other seven components: glucose hydrate sodium chloride, glucose hydrate, arabinose thiobenzohydrazide, mannose *p*-bromo phenyl hydrazone, mannose phenyl hydrazone, galactose phenyl methyl hydrazone and arabinose benzoyl hydrazone (Table 6) were present in the range of 1 to 3 indicating trace levels to minor level of occurrence.

Table 6. Relative abundance of organic minerals at 37^{o}C.

Treatments	CSS			GM			FYM			F+G		
Days	0	30	60	0	30	60	0	30	60	0	30	60
A	8	15	5	10	14	16	4	9	3	9	9	4
B	11	9	3	7	13	11	5	12	6	4	11	3
C	2	5	1	5	4	2	1	2	1	1	0	1
D	0	3	0	2	2	0	1	1	1	0	0	0
E	1	5	2	2	5	2	2	3	3	4	2	1
F	1	4	1	2	1	1	0	0	0	0	2	1
G	0	1	2	3	5	2	3	3	2	3	2	0
H	1	3	0	1	1	2	0	2	0	2	0	0
I	2	4	1	3	5	3	1	1	0	1	1	0

A. Glucose Sodium iodide hydrate Trace = 1 Rare = 2
B. Glucose Sodium bromide hydrate Minor = 3 Major = ≥ 4
C. Glucose sodium chloride hydrate
D. Glucose hydrate
E. Arabinose Thiobenzohydrazide
F. Mannose p-bromo phenyl hydrazone
G. Mannose phenyl hydrazone
H. Galactose phenyl methyl hydrazone
I. Arabinose benzoyl hydrazone

4. Discussion

Organic manure amendments of the saline soil showed a significant ($p< 0.05$) increase in the carbon and nitrogenous parameters but the effect became less pronounced as the incubation period progressed indicating a rapid transformation and loss of added organic materials. Organic manures have positive response in decreasing the adverse effect of salinity (Ahmad and Jabeen 2009). However, this influence is partly attributed to the chemical composition of organic sources (Yazdanpanah and Mahmoodabadi, 2012). According to the study of Sekiguchi *et al*. (2002), Green manure produced better results as compared to farmyard manure for applications in soil microbial activity. Various research studies revealed a considerable decrease in organic matter content of the soil after amendment with organic manure (Chantigny *et al*., 1999) or with an organic carbon source (Bensard *et al*., 1996). In the present work, a decrease in decomposition and loss of soil organic carbon with increasing incubation period might be attributed to the presence of recalcitrant organic residues like lignin and other complex organic compounds which are often inaccessible to soil microbes for decomposition (Chantigny *et al*., 1999). Soil temperature is considered as one of the prominent factors responsible for variability in decomposition of soil organic matter (Fierro *et al*., 1999). The uses of farmyard manure (FYM) and green manure for soil nutrients supplementation have significant effect on the increase of the staple food grain crops (Sarwar *et al.,* 2008).

The carbohydrate content of the soil organic matter is the most dynamic component and accounts for almost 6-14% of the total carbon (Shnitzer, 1978). Similarly, at the time of organic matter incorporation, the carbohydrate content of the organic matter treated soils ranged from 14.1 to 19% but with the passage of incubation period, either the quantity reduced due to decomposition or it increased with the assimilatory activity of the soil organisms.

The polysaccharide fraction of plant residue decreased rapidly during initial phase of decomposition but at later stages the rate of decay reduced as more stable fractions remain in the soil, inferring that residual polysaccharides of plant material are composed of resistant polymers synthesized by soil microbes. Individual polysaccharides such as starch, mannose, pectic substances, xylan and others may decompose in few weeks (Mehta *et al.,* 1961).

Carbohydrates have an appreciable contribution in the formation of soil organic matter (5-20% of total soil organic carbon). It mainly comprised mono and polysaccharides, synthesized photosynthetically in plants and through soil microbial activity (Decau, 1968). Characterization of plant polysaccharides revealed that a major fraction of pentoses (Xylose and Arabinose), whereas hexoses (Galactose and Mannose) are an enriched source of microbial polysaccharides (Cheshire, 1977). It is possible to infer through this study that physiochemical characteristics of soils are function of soil organic matter (SOM) as well as acid hydrolysable carbohydrates contents of soils, which reduce when soils are cultivated (Spaccini *et al*., 2004). Jolivet *et al*., (2006) concluded that soil organic matter quality can be better demonstrated through sensitive land use indicators of carbohydrates. There occurs a significant correlation between organic matter and humic acid, which play major role in clay-organic complex formation (Whalen *et al*., 2003).

5. Conclusions

It could be concluded from the present study that in saline soil the decomposition and assimilation of organic matters proceeds in a different way to those in normal soils and therefore the combined application of green manure (GM) with composted organic matter is more beneficial in terms of carbohydrates metabolism of the soil saccharides. Formation of organo-minerals determines that carbohydrates dynamics in saline soil may be a valuable source of long term fertility due to slower rate of decomposition as compared to free carbohydrates. It can also be concluded that organo-mineral formation enhance the process of mineralization for plant growth system. However, further studies are needed to clearly establish the effect of these types of organic amendments on physiochemical characteristics and the organic constituents of the marginal soils and their effects on plant growth system.

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