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Effect of Compost and Biochar on Growth and Yield of Sunflower Under Saline Conditions

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Abstract

Sunflower (*Helianthus annuus L.*) is an oil seed crop belonging to family Asteraceae and genus Helianthus which contains 65 species. Sunflower is the most widely used oil producing crop in the world. Salinity and water stress are the major abiotic stresses that affect plant physiology and limit the growth, yield and development of sunflower plants. Salinity effects can be minimized through the application of biochar and compost. Biochar and compost application can improve soil fertility and growth of plants. There were twelve treatments, and each treatment was repeated thrice. The pots were arranged in Complete Randomized Design. Sodium chloride was used to achieve the salinity of 6 and 12dSm^{-1} along with a control treatment without any NaCl addition. Harvesting was done after 7 days and recorded the growth characteristics. The results revealed that shoots height, root/shoot fresh and dry masses significantly influenced by salinity. The data was recorded for chemical parameters (sodium and potassium contents of plant) along with agronomic parameters [number of flowers, shoot length (cm), root length (cm), weight of head (g), number of leave] and physiological parameters (relative water content, chlorophyll content and membrane stability index). At maturity stage plants were harvested. Results indicated that 0.5% combined application of compost and biochar significantly increased ($p<0.05$) total chlorophyll contents (46.97%), shoot fresh weight (41.63%), shoot length (143.16%), membrane stability index (23.55%) and decreased Na concentration in shoot (61.0%) in sunflower plants as compared to respective control under saline conditions. Purpose of this research is to study the effect of compost and biochar application on the growth and yield of sunflower under saline condition.

Keywords: Physiology; Soil amendment; Soil biological; Ammonium phosphate

Introduction

Sunflower *(Helianthus annuus L.)* is an oil seed crop belonging to family Asteraceae and genus Helianthus [1]. Sunflower lies among major oil seed crops of the world. Sunflower seeds and oil use as food its straw use as fuel in village. In some areas, it also used as ornamental plant from past centuries [2]. Biochar, which is a carbon rich soil amendment that is produced as a by-product during the pyrolysis of the agriculture wastes to produce the thermal gas, can significantly improve the gravimetric moisture content of soil, increase soil pH significantly. In addition, soil application of biochar increases the microbial population in the rhizosphere, although it has not yet been understood by the mechanism and can lead to populations of beneficial microorganisms that promote plant growth and resistance to biological stress [3]. Biochar is produced at high temperature by doing heating different types of organic waste material through the process of pyrolysis and it is intractable in nature due to its high foul smelling [4]. Biochar has mechanism similar with charcoal to minimize salinity effect on plant by decreasing Na absorption. Biochar can absorb the substantial amount of salt added in field thus immobilization of ions takes place in saline soils, or it might cause minute quantities of non-saline exchange sites for enhanced nutrient adsorption [5].

The cultivated sunflower *(Helianthus annuus L.)* ranks with soybean, rapeseed, and peanut as one of the fourth most important annual crops in the world grown for edible oil. The migration of the sunflower eastward in Europe occurred during the 17th century. Archaeological evidence reveals the use of sunflower among American Indians. Within recorded history, after the discoveries in the Americas by European explorers, frequent reference is made to the use of the sunflower plant by the native people. Most sunflower historians agree that the present cultivated sunflower in North America stems from materials reintroduced from Russia after the crop became widely grown there. Global production has been steadily increasing over the past 25 years (PSD-USDA, 2011), World production is expected to reach 60 million tonnes by 2050. The four largest producers (Russia, Ukraine, European

Union and Argentina) account for 70% of global volume. Due to extraordinary characters, sunflower oil is preferred over other vegetable oils because it is easy to improve, digests easily, has low cholesterol and saturated fat, and has certain biochemical properties [5].

Organic matter is present in various forms, compost is considered one of the major forms of organic matter. When the governed biological decomposition of organic material takes place then the resulting product is the compost. It plays a significant part in the betterment of soil physical structure, also improves the soil capacity to retain water and soil nutrient level. It also has role in the good management of soil tilts and provision of macrospores for the development of plant root and for improved germination of seed. Organic matter is considered a source of different types of nutrients present in soil. The addition of compost in the soil had another advantage that is the modification of the pH of the soil. Depending upon the soil pH and compost, by adding the compost there may increase or decrease in the pH of soil. Compost also play role in improving the CEC of soil which permit the soil to hold nutrients for longer period and keeps them away from leaching. The results show that the practice of compost causes an increase in the nutrient level in soil and at the end of process in crop plant [6].

Biochar helps in improving the soil physical properties e.g. increasing porosity of soil, water retention capacity, and nutrients also become available through solubilization and microbial utilization of biochar [7]. Biochar decreases amount of gases that are emitted from greenhouses and improves crop productivity, carbon sequestration and soil fertility. Biochar is involved in direct mechanism of growth by providing nutrients, e.g. Ca+2, K+1, S-2, P+5 and Mg+2 etc. although by improving soil biological, physical and chemical characteristics it is also involves in indirect mechanism of growth [8]. Biochar is a form of charcoal and is also used to rehabilitate environments that also causes harm to human health as well as plant growth [9].

Biochar is produced at high temperature by doing heating different types of organic waste material through the process of pyrolysis and it is intractable in nature due to its high foul smelling [4]. Biochar has mechanism similar with charcoal to minimize salinity effect on plant by decreasing Na absorption. Even so, other mechanism could also be very complicated due to which it can improve salinity stress level in plants. Biochar can absorb the substantial amount of salt added in field thus immobilization of ions takes place in saline soils, or it might cause minute quantities of non-saline exchange sites for enhanced nutrient adsorption. Limited experiments were made on the effect of biochar on plant growth under salinity stress. Mechanism of using combined treatments of pyrolyzed' fresh organic matter and biochar helps in improving the salt stress [5].

Materials and Methods

A pot experiment was conducted in wire house at Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad to evaluate the effects of biochar and compost on the growth of sunflower under saline condition. The experiment was consisted of twelve treatments and each treatment was replicated three times, following completely randomized design (CRD). According to 10kg of soil per pot, Basel dose of N, P, K at 60-80-60kg ha-1 was applied which were fulfilled through the application of chemical fertilizer such as urea, di-ammonium phosphate and sulphate of potash. NaCl salt was used to create the different salinity level. For 6 dsm^{-1} salinity level 7.11g/10kg soil and 12dsm^{-1} salinity level 18.5g/10kg soil. Six seeds were sown per pot. After germination thinning will be carried out and three plants per pot will be carried out. Irrigate the pot according to the need of plant. Before sowing and after harvesting soil analysis for physicochemical properties of soil were carried out according to standard procedures.

Soil basic analysis

Soil samples were collected from the wire house of Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad, air dried and passed from 2mm sieve for soil analysis using Hand Book No. 60. (U.S. Salinity Laboratory Staff, 1954 method.

Soil texture: For the determination of the soil texture, hydrometer method was followed. First dispersion solution prepared in a 250mL beaker by adding 10g of Sodium hexametaphosphate and 2.5g of sodium carbonate. Then taken 40g air dried soil in a 500mL glass beaker and added 60 mL dispersing solution into the air-dried soil. The soil sample was kept overnight by covering it. The sand, silt and clay % age was calculated by following formulas

Silt % + Clay % = [(CHRsc) x 100)] / Wt. of Soil

Clay %= [(CHRsc) x 100]/ Wt. of Soil Silt % = (Silt % + Clay %) - Clay % Sand % = 100- (Silt % + Clay %)

Soil textural class was determined by putting values of Sand, Silt and Clay percentage on USDA textural triangle.

Saturation percentage: Firstly, prepare Soil saturated paste with distil water and having all the characteristics of soil saturated paste. Now moved the paste to tarred china dish and oven dried the soil till constant weight, Saturation percentage (SP) was calculated by applying (U.S. Salinity Laboratory Staff, 1954; Method 27a) formula:

SP = wet soil mass - dry soil mass/ oven dry mass of soil × 100

pH of the saturated soil paste: Soil sample of 250 g weight was saturated with distilled water then kept it for overnight. Next morning prepared standard saturated paste. Now pH was recorded by pH meter (JENCO Model-671 P) with glass electrodes. For the standardization of pH meter two buffer of pH 4.1 and 9.2 were used (U.S. Salinity Laboratory Staff, 1954; Method 21 a).

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Electrical conductivity of saturation extracts (ECe): Extract of soil saturated paste was taken to calculate the ECe of soil. Extract was obtained by applying positive pressure on soil saturated paste with the help of air pump. The electrical conductivity of the extract was calculated with conductivity meter (WTW Cond 315i). To get the exact value of extract calculate the cell constant, for this conductivity meter was calibrated with 0.01 N KCI solution (U.S. Salinity Laboratory Staff, 1954; Method 21 a). Physical and chemical characteristics of the soil (Table 1), Indicated that soil was normal. The textural class of the soil was clay loam. 6 seeds of sunflower were sown in a pot for experiment and above described twelve treatments were applied to pots with three replications in completely randomized design (CRD). Harvesting was taken at maturity stage.

Table 1: Soil characteristics.

Parameters	Units	Values
pHs	-	7.6
Ece	dsm^{-1}	1.82
Textural class	-	Sandy clay loam
Saturation percentage	%	30.19
Organic matter	%	0.49
N	%	0.08
P	ppm	7.9
K	ppm	198

Measurement of Plant Growth, Physiological and Ionic Parameters

Chlorophyll content (SPAD Value) was taken by using chlorophyll meter during day light and average was taken. Fresh shoot was harvested from each treatment pots and weighed through electrical balance and average was taken. At maturity, number of leaves per plants were counted manually. At maturity, number of flowers per plants were counted manually. At maturity stage, length of shoot was determined by using scale meter. The average of 3 replications of shoot was obtained. After harvesting of the crop, the roots were clipped and removed the soil by washing and then root length of the plants was determined by using scale meter in centimeters and noted the reading from the start of the roots to the end of roots of plant. After picking the plant, head fresh weight was recorded by electrical balance.

Determination of membrane stability index after harvesting of crop. Two different samples of leaves of fresh plant were taken, each of them having weight of 0.1 g in 10mL distilled water. Placed the one set for 30 minutes in water bath at temperature of 40°C and recorded its Ec with the help of Ec meter. At boiling temperature (100°C) of water bath placed the second set for 10 minutes and record its EC.

Membrane stability index was calculated by using the formula,

MSI (%) = [1- (ECl/EC2)] x 100

Take the fresh leaf of having 0.5 g turgid weight and keep the sample into oven to get constant weight for 4 hours. After getting oven dried sample note the reading and calculated relative water contents according to

Relative water content (%) = [(Fresh weight - Dry weight)/ (Turgid weight - Dry weight)] x 10 Plant chemical analysis

Wet digestion

The wet digestion was done using soil sample mineralization procedure and after that the Na and K contents were determined by flame photometer using Sherwood 410 flame Photometer Method 10a and 11a (U.S Salinity Lab. Staff, 1954).

Statistical analysis

All the research data were subjected to statistical analysis in CRD-factorial design. The effect of salt, biochar and compost was evaluated by Analysis of Variance (ANOVA) technique. The LSD test was applied to separate significance among different treatment means by using computer-based software Statistics 8.1. Significant differences among treatments were considered at the $P<0.05$ levels.

Results

Effect of compost and biochar on total chlorophyll contents of sunflower under saline conditions: The chlorophyll contents of sunflower are presented in (Figure 1). The chlorophyll contents were significantly affected by salinity, treatments, and their interaction. Chlorophyll contents were decreased by increasing salt stress. At different salinity levels (6 dsm^{-1}, 12 dsm^{-1}) chlorophyll contents were decreased by 30.86 % and 23.03 % respectively as compared to control (T1). Under saline conditions chlorophyll contents were increased by the application of compost and biochar. At different salinity levels (6 dsm^{-1} and 12 dsm^{-1}), integrated application of compost and biochar showed better results as compared to individual application of compost and biochar.

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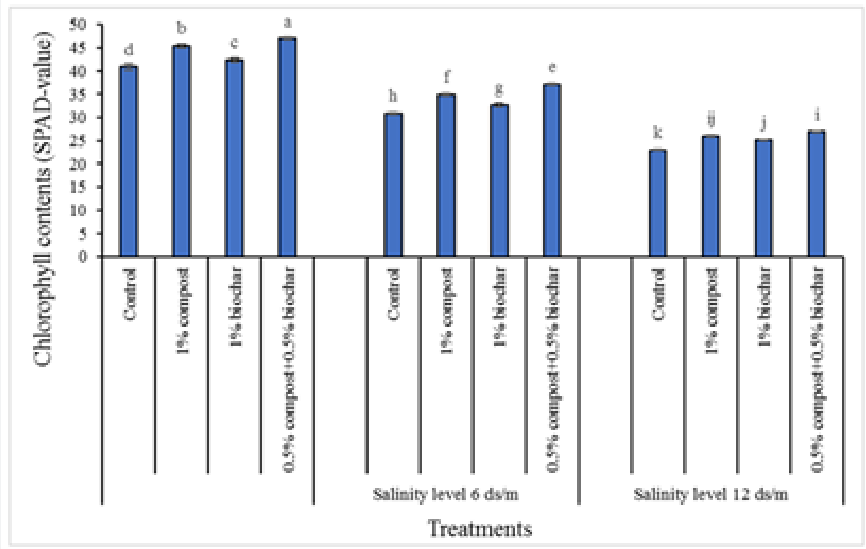

Figure 1: Analysis of variance (ANOVA) for chlorophyll contents by the application of compost and biochar.

Grand Mean 34.353, CV 1.68 LSD 0.972: Hence results showed that overall chlorophyll contents were increased more in treatments where combined applications were used. However, use of single amendment are also showed significant response Excess amount of salts present in soil effects chlorophyll contents under saline conditions. Biochar application alleviated the salt stress and increased chlorophyll contents under saline conditions. Applications of compost significantly increased plants physiological parameters such as chlorophyll contents. Combined applications of biochar and compost showed more effective results of chlorophyll contents as compared to alone applications.

Effect of compost and biochar on shoot fresh weight of sunflower under saline conditions

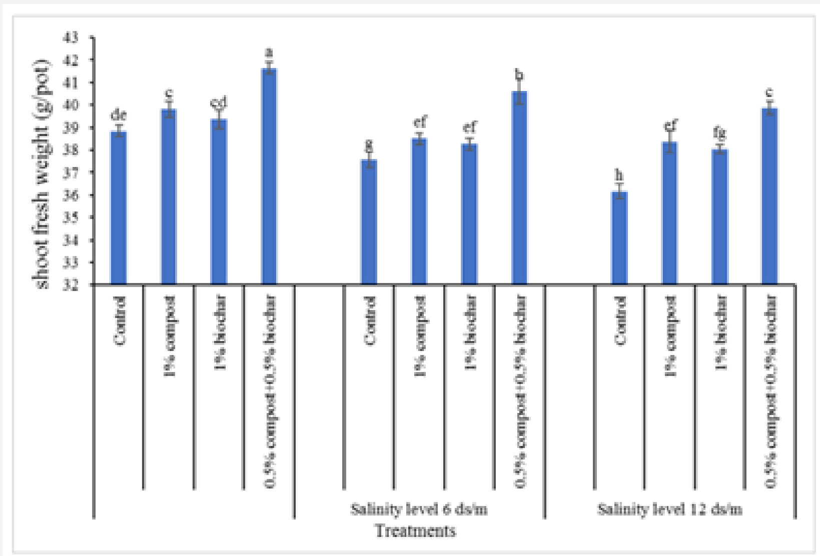

Figure 2: Effect of compost and biochar on shoot fresh weight of sunflower under saline conditions.

The shoot fresh weight of sunflower is presented in (Figure 2). The shoot fresh weight was significantly affected by salinity, treatments and their interaction. Shoot fresh weight was decreased by increasing salt stress. At different salinity levels (6 dsm^{-1}, 12 dsm^{-1}) shoot fresh weight was decreased by 37.57 % and 36.17 % respectively as compare to control (T1). Under saline conditions shoot fresh weight was increased by the application of compost and biochar. At different salinity levels (6 dsm^{-1} and

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12 dsm^{-1}), integrated application of compost and biochar showed better results as compared to individual application of compost and biochar [10].

At Ec 6 dsm^{-1}, the application of compost (T6), biochar (T7) and combined application of compost and biochar (T8) increases shoot fresh weight to 38.50%, 38.27% and 40.60% respectively as compared to T5 where Ec was 6 dsm^{-1}and no amendment was applied. At Ec 12 dsm^{-1}, application of compost (T10), biochar (T11) and integrated application of compost and biochar (T12) enhanced shoot fresh weight by 38.37 %, 38.03% and 39.87 % respectively as compared to T9 where Ec 12 dsm^{-1}and no amendment was applied.

Grand Mean 38.917, CV 0.90 LSD 0.59: Hence results showed that overall shoot fresh weight was increased more in treatments where combined applications were used. However, use of single amendment are also showed significant response. Soil salinity decreases shoot fresh weight of plants under saline conditions Biochar enhanced shoot fresh weight under saline conditions. Compost increased shoot fresh weight by increases in total carbohydrate percentage .

Effect of compost and biochar on root length of sunflower under saline conditions

The root length of sunflower is presented in (Figure 3). The root length was significantly affected by salinity and treatment. Root length was decreased by increasing salt stress. At different salinity levels (6 dsm^{-1}and 12 dsm^{-1}) root length was declined by 8.13% and 7.23% respectively as compared to control (T1). Under saline conditions root length was increased by the application of compost and biochar. At different salinity levels (6 dsm^{-1}and 12 dsm^{-1}), combined application of compost and biochar showed better results as compared to individual application of compost and biochar.

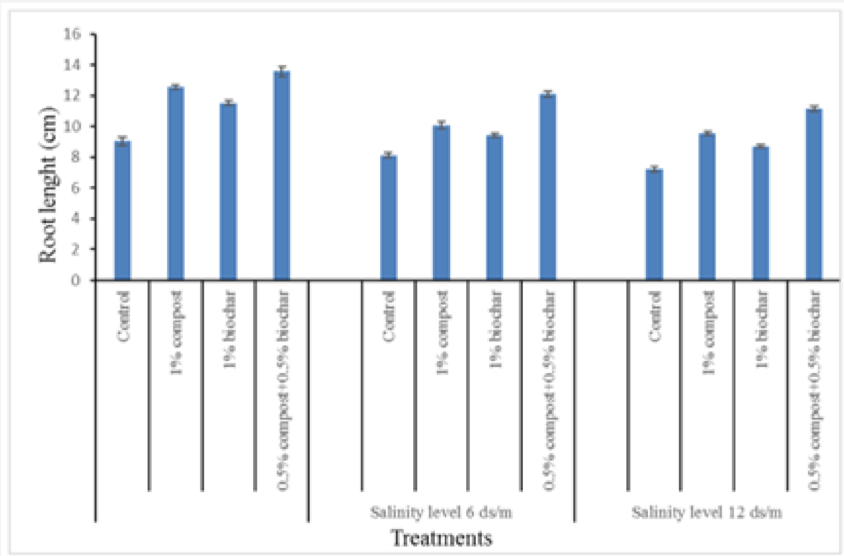

Figure 3: Effect of compost and biochar on Root Length of sunflower under saline conditions.

Grand mean 10.314, CV 16.03 LSD 2.7862: Hence results showed that overall root length was increased more in treatments where combined applications were used. However, use of single amendment are also showed significant response. Increasing of salts present in soils reduced seed germination and root length of plants due to disturbance in metabolism, cell division and elongation under saline conditions. Biochar enhanced root length under saline conditions.

Effect of compost and biochar on shoot length of sunflower under saline conditions

The shoot length of sunflower is presented in (Figure 4). The shoot length was significantly affected by salinity, treatments and their interaction. Shoot length was decreased by increasing salt stress. At different salinity levels (6 dsm^{-1} and 12 dsm^{-1}); combined application of compost and biochar showed better results as compared to individual application of compost and biochar. At Ec 6 dsm^{-1}, the applications of compost (T6), biochar (T7) and combined application of compost and biochar (T8) enhanced root length by 111.9%, 106.8% and 116.23% respectively as compared to T5 where Ec was 6 dsm^{-1} and no amendment was applied. At Ec 12 dS m^{-1}, application of compost (T10), biochar (T11) and combined application of compost and biochar (T12) enhanced shoot length by 102.5%, 99.16% and 111.26% respectively as compared to T9 where Ec was 12 dS m^{-1} and no amendment was applied.

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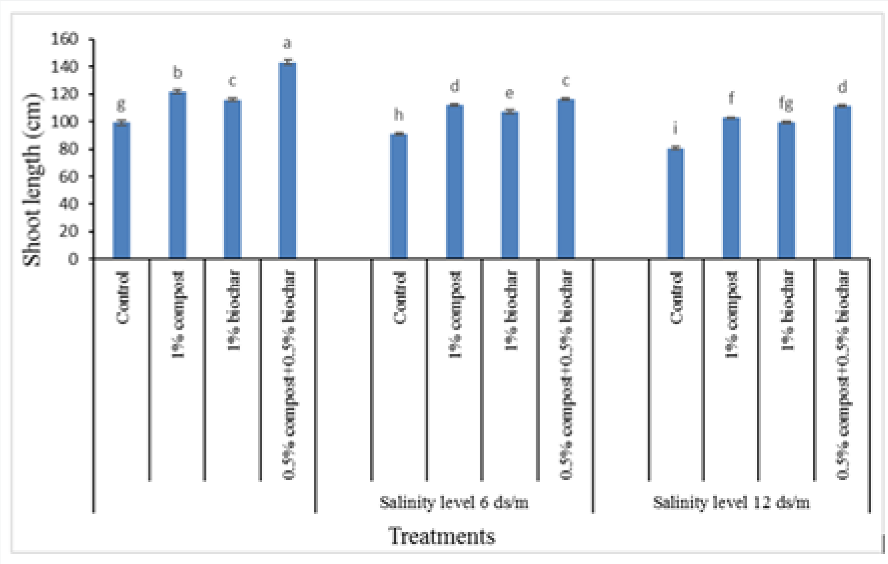

Figure 4: Analysis of variance (ANOVA) for shoot length by the application of compost and biochar.

Grand mean 108.26, CV 1.77 LSD 3.2370: Hence results showed that overall shoot length was increased more in treatments where combined applications were used. However, use of single amendment are also showed significant response. Soil salinity decreases shoot length of plants under saline conditions. Biochar significantly enhances shoot length under saline conditions. Compost increased shoot length by increases total carbohydrate Percentage. Combined application of biochar and compost significantly increases shoot length under saline conditions.

Effect of biochar and compost on membrane stability index of sunflower under saline conditions

The membrane stability index of sunflower is presented in (Figure 5). Under saline conditions membrane stability index was increased by the application of compost and biochar. At different salinity levels (6 dS m^{-1} and 12 dsm^{-1}), combined application of compost and biochar showed better results as compared to individual application of compost and biochar. At Ec 6 dsm^{-1}, the applications of compost (T6), biochar (T7) and combined application of compost and biochar (T8) enhanced membrane stability index by 21.72%, 21.32% and 22.10% respectively as compare to T5 where Ec was 6 dsm^{-1} and no amendment was applied. At Ec 12 dsm^{-1}, application of compost (T10), biochar (T11) and combined application of compost and biochar (T12) enhanced membrane stability index by 20.06%, 19.56% and 20.26% respectively as compare to T9 where Ec was 12 dsm^{-1} and no amendment was applied.

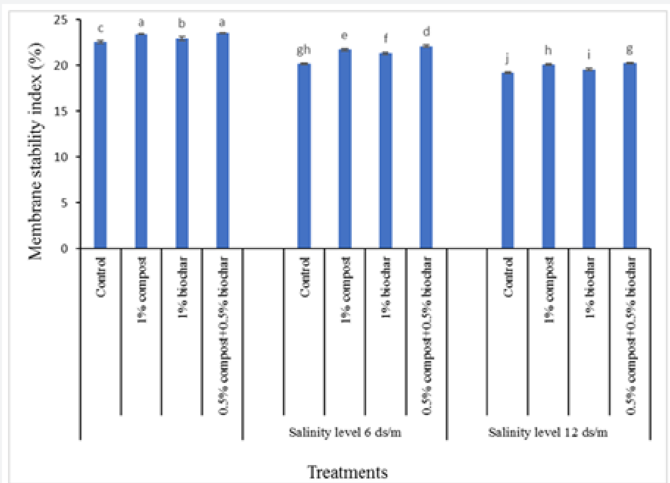

Figure 5: Effect of compost and biochar on membrane stability index of sunflower under saline conditions.

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Grand mean 21.408, CV 0.55 LSD 0.196: Hence results showed that overall membrane stability index was increased more in treatments where combined applications were used. However, use of single amendment are also showed significant response. Soil salinity decreases membrane stability index of plants. Biochar and compost applications significantly enhances membrane stability index under saline conditions.

Effect of compost and biochar on relative water content of sunflower under saline conditions

Relative water content was decreased by increasing salt stress. At different salinity levels (6 dsm^{-1}, 12 dsm^{-1}) relative water content were declined by 48.47 % and 44.50 % respectively as compare to control (T1). Under saline conditions relative water content was increased by the application of compost and biochar. At different salinity levels (6 $dsm^{-1}$and 12 dsm^{-1}), combined application of compost and biochar showed better results as compared to individual application of compost and biochar. At Ec 6 dsm^{-1}, the applications of compost (T6), biochar (T7) and combined application of compost and biochar (T8) enhanced relative water content by 50.03%, 49.73% and 51.03% respectively as compared to T5 where Ec was 6 dsm^{-1} and no amendment was applied.

Grand Mean 49.575,CV 0.56 LSD 0.4716: Hence results showed that overall relative water content was increased more in treatments where combined applications were used. However, use of single amendment was also show significant response. Soil salinity decreases relative water content of plants. Biochar and compost applications significantly enhance relative water content under saline conditions.

Effect of compost and biochar on head fresh weight of sunflower under saline conditions

Head fresh weight was decreased by increasing salt stress. At different salinity levels (6 dS m^{-1}, 12 dS m^{-1}) head fresh weight was decreased by 70.90 % and 60.64 % respectively as compare to control (T1). Under saline conditions head fresh weight was increased by the application of compost and biochar. At different salinity levels (6 $dsm^{-1}$and 12 dsm^{-1}), integrated application of compost and biochar showed better results as compared to individual application of compost and biochar. At Ec 6 dsm^{-1}, the application of compost (T6), biochar (T7) and combined application of compost and biochar (T8) increases head fresh weight to 85.49%, 80.14% and 90.93% respectively as compare to T5 where Ec was 6 dsm^{-1} and no amendment was applied. At Ec 12 dsm^{-1}, application of compost (T10), biochar (T11) and integrated application of compost and biochar (T12) enhanced head fresh weight by 76.07 %, 73.39% and 81.00 % respectively as compared to T9 where Ec 12 $dsm^{-1}$and no amendment was applied. Hence results showed that overall head fresh weight was increased more in treatments where combined applications were used.

Grand Mean 81.728, CV 1.45 LSD 1.9913: Salinity decreases the weight of head due to disturbance in various physiological parameters involved in the growth processes of plants. Biochar applications seems to be more effective for the head weight of sunflower Compost applications significantly improved weight of head due to enrichment of soil with nutrients. Combined applications of compost and biochar significantly increase the plant growth due to increased nutrient uptake.

Effect of compost and biochar on number of flowers of sunflower under saline conditions

Maximum number of flowers were observed in T4 (7.66%) when 1% combined application of compost and biochar were applied as soil application followed by T2 (6%) when 1% compost was applied under non- saline conditions. The minimum number of flowers were observed in T9 (2.33%) due to high salinity (Ec 12 dsm^{-1}). Under non- saline conditions the application of compost (T2), biochar (T3) and combined application of compost and biochar (T4) at 0.5% enhanced number of flowers by 6 %, 5.33 % and 7.66 % respectively as compared to control (T1). Number of flowers was decreased by increasing salt stress. At different salinity levels (6 $dsm^{-1}$and 12 dsm^{-1}) number of flowers were declined by 3.33 % and 2.33 % respectively as compared to control (T1).

Grand mean 4.4722, CV 15.81 LSD 1.1916: Hence results showed that overall numbers of flowers were increased more in treatments where combined applications were used. However, use of single amendment is also showed significant response. Increasing of salts present in soils reduced seed germination and number of flowers of plants due to disturbance in metabolism, cell division and elongation under saline conditions

Effect of compost and biochar on number of leave of sunflower under saline conditions

The number of leave of sunflower is presented in (Figure 6). The number of leave were significantly affected by salinity and treatment. Under saline conditions number of leave were increased by the application of compost and biochar. At different salinity levels (6 dsm^{-1} and 12 dsm^{-1}), combined application of compost and biochar showed better results as compared to individual application of compost and biochar.

Grand mean 13.333, CV 5.45 LSD 1.2242: Hence results showed that overall number of leave were increased more in treatments where combined applications were used. However, use of single amendment are also showed significant response. Increasing of salts present in soils reduced seed germination and number of leave of plants due to disturbance in metabolism, cell division and elongation under saline conditions.

Effect of compost and biochar on Potassium concentration in shoots of sunflower under saline conditions

The potassium concentration of sunflower is presented in (Figure 7). The potassium concentration was significantly

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affected by salinity, treatments and their interaction. Under saline conditions potassium concentration was increased by the application of compost and biochar. At different salinity levels (6 dsm^{-1} and 12 dsm^{-1}), combined application of compost and biochar showed better results as compared to individual application of compost and biochar.

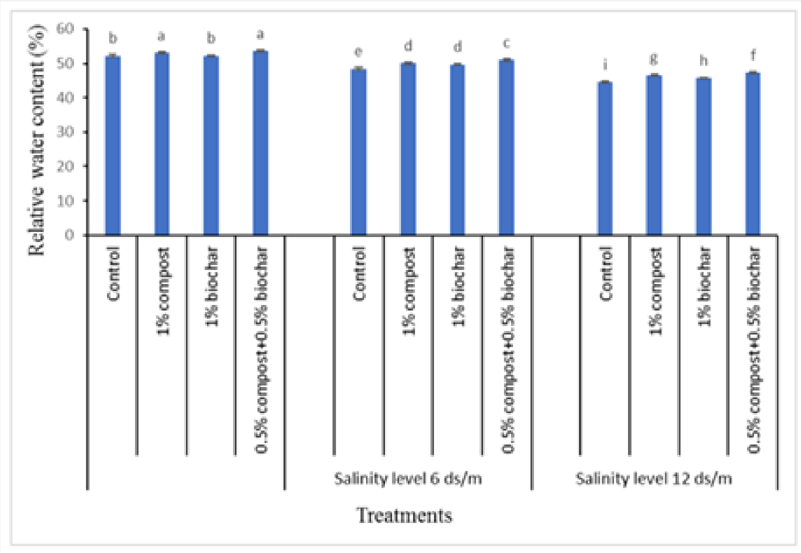

Figure 6: Effect of compost and biochar on relative water content of sunflower under saline conditions.

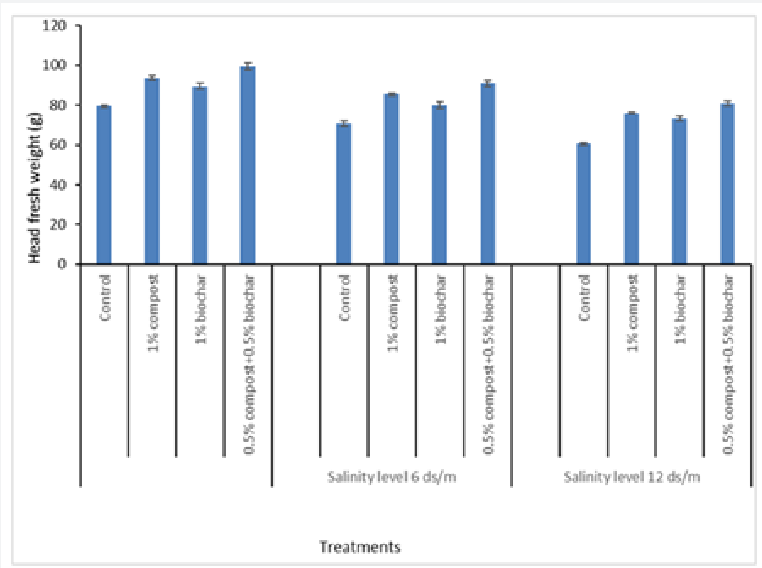

Figure 7: Effect of compost and biochar on head fresh weight of sunflower under saline conditions.

Grand mean 2.1333, CV 6.35 LSD 0.2282

Effect of compost and biochar on sodium concentration in shoots of sunflower under saline conditions

The sodium concentration of sunflower is presented in (Figure 8). The sodium concentration was significantly affected by salinity, treatments and treatment × salinity and their interaction. Minimum sodium concentration was observed in T4 (0.28%) when 1% combined (Figure 9) application of compost and biochar were applied as soil application followed by T2 (0.34%) when 1% compost was applied under non- saline conditions. Under saline conditions sodium concentration (Figure 10) was decreased

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by the application of compost and biochar. At different salinity levels (6 dsm^{-1} and 12 dsm^{-1}), combined application of compost and biochar showed better results as compared to individual application of compost and biochar Figure 11. Hence results showed that overall sodium concentration was decreased more in treatments where combined applications were used. However, use of single amendment are also showed significant response.

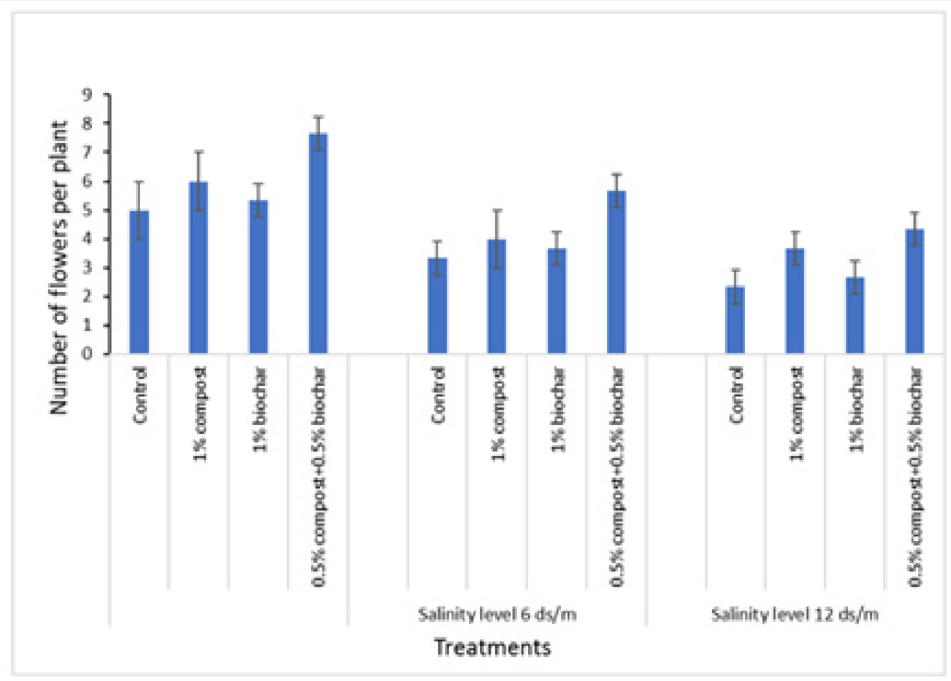

Figure 8: Effect of compost and biochar on number of flowers of sunflower under saline conditions.

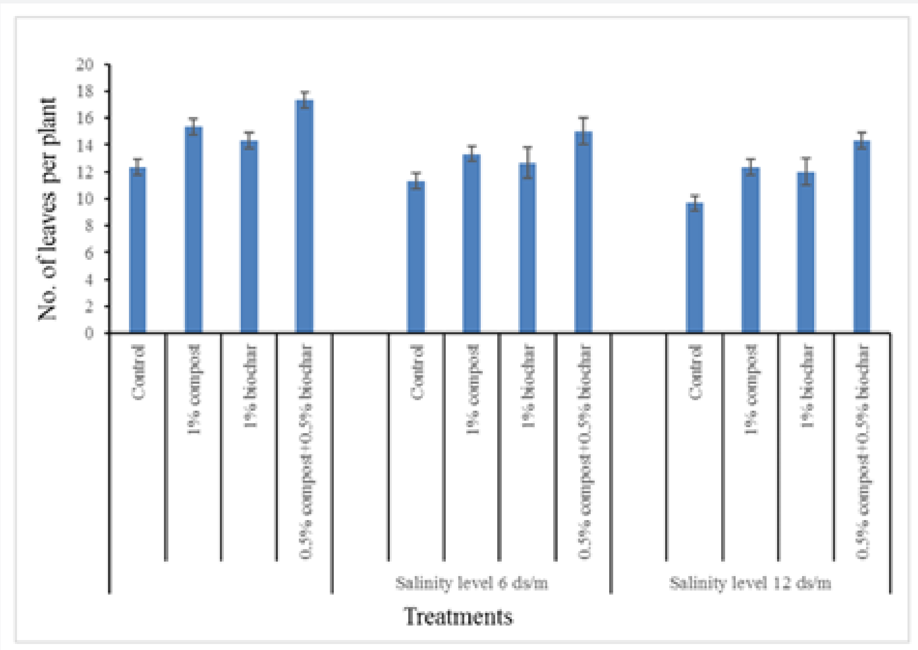

Figure 9: Effect of compost and biochar on number of leave of sunflower under saline conditions.

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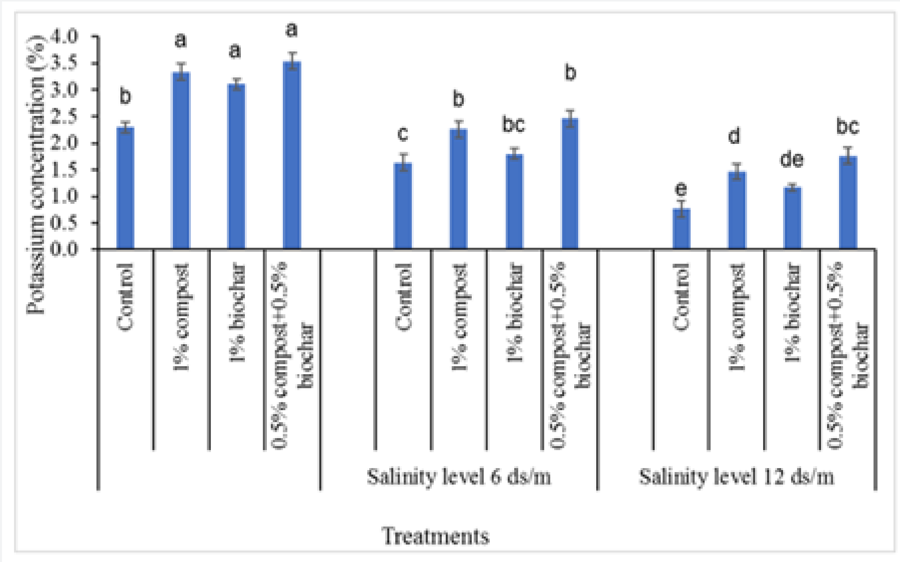

Figure 10: Effect of compost and biochar on potassium concentration of sunflower under saline conditions.

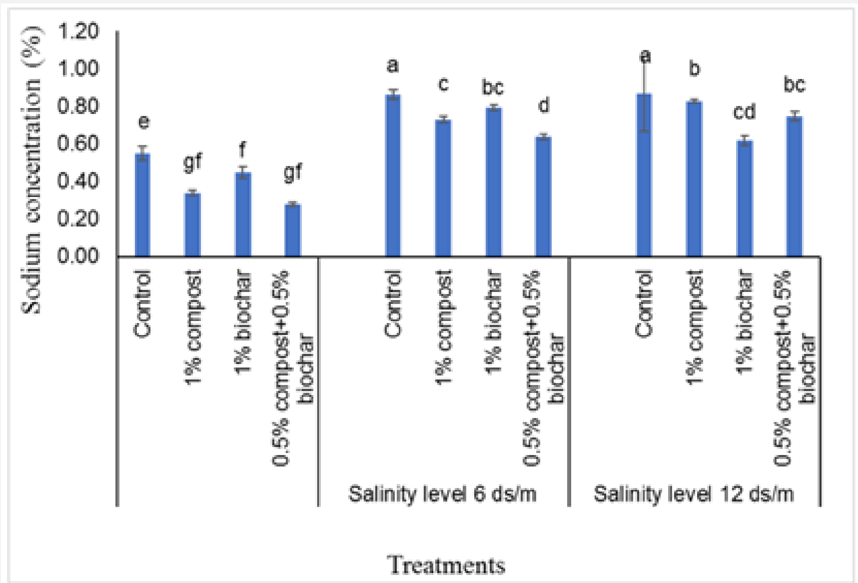

Figure 11: Effect of compost and biochar on sodium concentration of sunflower under saline conditions.

References

1. Andrew R L, Kane N C, Baute G J, Grassa C J, Rieseberg L H (2013) Recent nonhybrid origin of sunflower ecotypes in a novel habitat. Mol Ecol 22(3): 799-813.
2. Harter A V, Gardner K A, Falush D, Lentz D L, Bye R A, et al. (2004). Origin of extant domesticated sunflower in eastern North America. Nature 430(6996): 201-205.
3. Ahmad, M (2014) Causes of low yield in Pakistan.
4. Kuzyakov Y, I Bogomolova, B Glaser (2014) Biochar stability soil: decomposition during eight years and transformation as assessed by compound specific carbon analysis. Soil Biol Biochem 70: 229-236.
5. Lashari M S, Y Liu, L Li W, Pan J, Fu G, et al. (2014) Effect of amendment of biochar manure compost in conjunction with pyroligneous solution on soil quality and wheat yield of a salt stressed cropland from central china great plains. Field Crop Res 144: 113-118.
6. Marvels L F M, E Heuvelink, L R Baan Hoffman Eijer, I Den baker, L B Xue (2004) Flower and fruit abortion in sweet pepper in relation to source and sink strength. J Expt Bot 55(406): 2261-2268.
7. Sarwar A W, F Sadegh Zadeh, B J She Bardan, (2014) Characterization of biochars produced from oil palm and rice husk sand their adsorption capacities for heavy metals. Int J Environ Sci Technol 11: 967-976.

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8. Carter S, S Shackely, S Sohi, T B Suy, S Haefele (2013) The impact of biochar application on soil properties and plant growth of pot grown lettuce and cabbage. Agron 3: 404-418.

9. Cheng Y, Z C Cai, S Chang, J Wan, J B Zhang (2012) Wheat straw and its biochar have contrasting effect on inorganic N retention and N_2O production in cultivated Black chernozem. Biol Fertile Soil 48: 941-946.

10. Kahil A A, A A Isa, Y M Al Sodnay, E F Ali (2018) Effect of biochar amended saline soil on growth and some metabolic activities of two soybean cultivars in Saudi Arabia. Annual Res. Review in Bio 25: 1-14.

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