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RESEARCH PAPER

Influence of some Bio chars and organic fertilizers on some biological parameters of sweet corn (Zea mays L.) at Sulaimani Governorate, IKR.

Bakhtyar abdulkadir Rashid1, Akram Othman Esmail1

[1] Department of Soil and Water,College of Agricultural Engineering Sciences, Salahaddin University-Erbil, Kurdistan Region, Iraq.

A B S T R A C T:

This study was conducted in July 2021 until October 2022 at kanipanka research farm, Sulaimani governorate, IKR with GPS readings of 35^0 22' 25.3" N, 45^0 43' 24.5" E to test, the influence of five levels (0, 14, 28, 42 and 56 ton ha^{-1}) of some treatments such as control (a1), rise husk bio char (a2), oak charcoal (a3) and poultry manure (a5) which equivalent to 0, 0.4, 0.8, 1.2 and 1.6% w/w% of soil, also five levels (0, 12.5, 25, 37.5 and 50 kg ha^{-1}) of Humic acid (a4) to examine the quantity and quality of sweet corn. Additionally 240kg ha^{-1} of triple super phosphate was added to each experimental unit. The result showed that the poultry manure has a great effect on sweet corn compared to biochars due to high content of phosphorus and nitrogen in poultry manure, also biochars such as rice husk and charcoal were effect on TSS%, P concentration in seed and plants. The highest yield (20.61ton ha^{-1}) was recorded from the interaction treatments of (42 ton ha^{-1}) of poultry manure, also the highest protein %, oil % and chlorophyll content (14.90%, 5.93% and 44.80 SPAD value) were recorded from the interaction treatments of 56 ton ha^{-1} of poultry manure.

KEY WORDS: *Biochars, Humic Acid, sweet corn, Oak charcoal and poultry manure*
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1. INTRODUCTION:

Biochars are defined as a charcoal that is used for agricultural purposes or environmental domains(Majeed et al., 2018). One of the cereal families is Maize, and its benefits for human and animals (Jasim et al., 2014), and one type of maize is sweet corn(Abbas Mohammed et al., 2018). Humic Acid is a plant growth catalyst to dynamics growth roots such as root size or root density as a result increasing surface for absorption(Canellas and Olivares, 2014). Poultry manure is organic fertilizer and it can be used like an alternative to chemical fertilizer(Farhad et al., 2009).

Biochar is a charcoal added to soil for agricultural purposes, and it is made from different organic materials by pyrolysis processes. (Majeed et al., 2018).

It is a factor to decrease nutrients leaching in soil as a result increase nutrient availability and nutrient uptake for plant means: recycling of nutrients, soil condition and sequestration of carbon(Nair and Lawson, 2013).

Sweet corn is kernels production of important vegetables and is used frozen, fresh or in salads. Initially when harvesting; the kernel sugar change to starch rapidly, addition of this the moisture of kernels is 72-76% "ripe sweet corn". When sweet corn goes to milk stage, it indicate that the time is suitable for harvesting (Mohammed et al., 2017) . Sweet corn is famous by content of phenolic flavonoid antioxidant and ferulic acid. New studies focused on effect of ferulic acid to preventing cancer, human inflammation and aging. Flavour, tenderness and sweetness are marketing characteristic of sweet corn(Diver et al., 2008)

Humintech(2012) wrote that Humic Acid is benefit for growth of plant, plant nutrition,

* **Corresponding Author:**
Bakhtyar abdulkadir Rashid
E-mail: Bakhtyar.Rashid@student.su.edu.krd
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germination of seeds, seedling growth, initiation and growth of root, development of shoot and macro and micro elements uptake for plant, addition of those researchers wrote that one kg of Humic Acid can be used as a substitute for one ton of manure(Daur and Bakhashwain, 2013).

Poultry manure is a type of organic fertilizer and it is to increase soil fertility by increasing essential nutrient elements to soil. Retention of nutrients and moisture content are two characteristics of poultry manure(Farhad et al., 2009).

Organic fertilizers are a better choice than chemical fertilizers for sweet corn quality, because can be beneficial to soil health in many ways such as: it helps soil respiration, bacteria and fungi activity(Pangaribuan and Hendarto, 2018).

The aim of this research is to measure the effect of bio chars and organic fertilizers on the quality and quantity of sweet corn, to determine which level of them needs to be added to soil for optimum yield.

2. Materials and Methods.

2.1. Location or site of field experiment:

The field experiment was conducted in Sulaimani governorate, IKR at Kanipanka research field in summer season from 27-7-2021 to 7-10-2021. GPS readings of the latitude, longitude and altitude were: 35^0 22' 25.3" N, 45^0 43' 24.5" E and 544m.a.s.l respectively. The area of each experimental unit was $2m^2$ (2m*1m).

2.2. Field experiment:

The field experiment consists of the combined effect of some biochars and organic fertilizers each of them with five levels on sweet corn (*Zea mays L.*) growth, yield and quality using factorial Complete Randomized Block Design (RCBD) with three replicates. The factors were:

First factor: The levels of first factor were types of fertilizers which consist of two types of biochars, two types of organic fertilizers and control which were explained as follow.

a1=Control, a2= Rice husk biochar, a3= Oak charcoal, a4= Humic acid and a5 =Poultry manure

Second factor: Five levels of the applied fertilizers.

b1= 0 ton ha^{-1}, b2=14 ton ha^{-1}, b3=28 ton ha^{-1}, b4=42ton ha^{-1} and b5= 56 ton ha^{-1} of some treatments such as control (a1), rise husk biochar (a2), oak charcoal (a3) and poultry manure (a5) which equivalent to 0, 0.4, 0.8, 1.2 and 1.6% w/w% of soil, also the levels of humic acid(a4) are b1=0 kg ha^{-1}, b2=12.5 kg ha^{-1}, b3=25 kg ha^{-1}, b4=37.5 kg ha^{-1} and b5=50 kg ha^{-1} .On the other hand, 240 kg ha^{-1} triple super phosphate was added to each of experimental units. On, 2021 sweet corn seeds were sown then irrigated, using dripping system whenever needed. The agricultural practices were done whenever needed.

2.3. Land preparation:

Prior delineating the layout of field experiment, a rough grading was done on ions and vegetative cover removal. Subsequently, the field was flooded with water then allowed to soak in. After some days when the soil becomes suitable for plowing, the field was chisel plowed to 30 cm depth and harrow disked 2 days before seeding. After that, the field was subdivided into three blocks and each block was subdivided into 17 plots or experimental units. The plot dimensions were 2*1 m with 3 rows per plot. The distance between plants was 20 cm; while between rows was 67 cm and 15 plants $plot^{-1}$. The space between blocks was 1.5 m, while between experimental units 1m.

2.4. Harvesting:

Sweet corn's ears are harvested by hands; milk stage is indicated to time of harvesting. It harvested in 7-10-2021.

2.5. Soil and plant analysis:

After harvesting, the data are collected during the experiment and harvesting day, after these sampling processes of plants, leaves, ears and soils to analyze. Soil sample was analyzed such as soil pH by pH-meter (HANNA instruments, HI 9023, microcomputer pH meter), total N by Kjeldahl and available phosphorus using Olsen method and spectrophotometer as mentioned in Rowell (2014). Soil texture was determined according to international pipette method(Day, 1965) (table1). Plant height and leaf area were measured, and chlorophyll content by SPAD value. Soil samples and plant samples were analyzed in laboratory. Protein and Oil content were determined by Grain Analyzer Hectoliter. The Total Soluble Solids (TSS %) was determine by Hand Refractometer : digital model" through placed drop of the fruit extract on the prism of digital Refractometer and can be read the total soluble solid values(Mohammed et al., 2017). The diameter of ears (cm) was measured by digital Vernier, when the kernel moisture was about 72% (milk stage), the time was suitable for fresh consumption(Olsen et al., 1990). Fresh yield components including ear length, ear diameter, number of kernel/ears and weight of ears were determined(Gokmen et al., 2004). The data was analyzed in Microsoft Excel 2010, using SPSS 26 program and using Duncan multiple range test to examine the significance differences between the mean of treatments and interaction treatments as mentioned by (Duncan, 1955)

3. Results

The significant effect of biochars, organic fertilizers and their levels on growth characters were demonstrated in table (2). The highest values of plant height and leaf area (199.1 cm and 75.42 cm^2) respectively were recorded from Oak charcoal (a3). The highest values for both number of days for 50 % silking and number of days for 50% tasseling (59.0 and 49.33 days) respectively were recorded from control (a1) treatment, while their lowest values (54.73 and 43.8 days) respectively were obtained from poultry manure (a5).

The highest values of plant height and leaf area (202.6 cm and 70.32 cm^2) were recorded from levels b4 and b5 respectively and the highest values for remain characters (59.0cm and 49.33cm^2) were observed from control.

Table -3- explains the significant influence of interaction treatments on most of the studied growth characters except plant height which was not affected significantly. Their highest values (90.08cm^2, 59.0days and 49.33days) were obtained from interaction treatments of (a3b5, a1b1 and a1b1) respectively, while the lowest values of them (51.51cm^2, 51.33days and 40.0days) were noted from interaction treatments of (a1b1, a5b5 and a5b5) respectively.

Table (4) explains the significant effect of biochars and organic fertilizers and their levels on yield, yield components (ear length and ear diameter) and biomass, The highest values of them (18.9ton ha^{-1}, 20.36cm, 4.41cm and 84.35ton ha^{-1}) were recorded from poultry manure (a5), while their lowest values (16.45 ton ha^{-1}, 18.94cm, 4.33cm and 64.43 ton ha^{-1}) were obtained from control treatment (a1). While the case of levels of application the highest values of them (18.47 ton ha^{-1}, 19.98, 4.50cm and 79.09cm ton ha^{-1}) were observed from level (b4) and level (b2), also the lowest values (16.45 ton ha^{-1}, 18.94cm, 4.33cm and 64.43 ton ha^{-1}) were recorded from (b1).

Table (5) explains the significant effect of interaction treatments on the yield and yield biomass, ear length, ear diameter and number of kernels per ear. The highest values of them (20.61 ton ha^{-1}, 96.96 ton ha^{-1}, 21.86cm, 4.65cm and 660.89kernels) were recorded from interaction treatments of (a5b4, a5b5, a5b5, a2b4 and a5b4) respectively, while their lowest values (14.58 ton ha^{-1}, 63.67 ton ha^{-1}, 18.11 cm, 4.25 cm and 540.89 kernels) were recorded from interaction treatments of (a2b2, a4b3, a2b2, a3b3 and a3b3) respectively.

Table (6) indicates to the effect of type of fertilizers and their levels on chlorophyll content of flag leaves and leaves under ear. The highest SPAD values (40.86 and 48.16) were recorded from poultry manure (a5) and Humic acid (a4), while the lowest SPAD values (34.10 and 39.63) were obtained from control treatments of (a1), While in case of levels of application the highest SPAD values of them (39.09 and 44.71) were observed from level (b4), also the lowest SPAD values (34.10 and 39.63) were recorded from (b1).

Table (7) shows the significant effect of the interaction treatments on chlorophyll content of flag leaves and leaves under ear (SPAD values), the highest values (44.80 and 51.73) were recorded from combination treatments of (a5b5), also the lowest values (31.96 and 39.63) were recorded from combination treatments of (a2b2 and a1b1) respectively.

Table (8) refers to a significant role of type of fertilizers and their levels on some chemical properties (Protein%, Oil%, TSS%, P concentration in seed and plant) of seeds, the highest values of them (13.48%, 5.71%, 21.17%, 1632.22 ppm and 1296.210 ppm) were observed from fertilizers (a5 ,a5 , a3 a2 and a3) respectively, while their lowest values (11.96%, 5.60%, 16.30%, 1002.95 ppm and 745.69 ppm) were recorded from control treatment of (a1) respectively. On the other hand the highest values of them (13.14%, 5.74%, 20.08%, 1612.59 ppm and 1384.32 ppm) were recorded from the level (b4, b5, b5, b3 and b5) respectively, while their lowest values (11.96, 5.60, 16.30, 1002.95 and 745.69) were observed from control or b1.

Table (9) shows the significant effect of the interaction treatments on some chemical properties (i.e. the percentage of Protein, Oil and TSS, P concentration in seed and plant) of seeds, The highest values of them (14.90%, 5.93%, 22.96%, 1996.07 ppm and 1883.96 ppm) were recorded from interaction treatments of (a5b5, a5b5, a3b5, a4b3 and a3b5) respectively, while their lowest values (11.96%, 5.50%, 16.30%, 1002.95 ppm and 745.96 ppm) were recorded from interaction treatments of (a1b1, a4b4, a1b1, a1b1 and a1b1) respectively.

4. **Discussion**

The results of soil analysis in (table 1), indicated to deficiency of phosphorus and nitrogen in the study soil, it means the application of triple super phosphate (TSP) with and without biochars and organic fertilizers is necessary, physical analysis (soil texture) was benefit to limit the time of irrigation water and time interval, between two successive irrigation.

The highest significant values for plant height and leaf area were recorded from Oak charcoal (a3) (table,2), this may due to the role of bio chars in increasing nutrient availability, or the high absorbed water content in the plant tissues following an improved soil water retention capacity induced by bio char additions(Şeker and Manirakiza, 2020).

Table (3) the reason of significant differences between the earliest days to 50% silking and tasseling from interaction treatment of (poultry manure added with a level of 56 ton ha^{-1} a5b5). This could be due to increase in nutrient availability in rhizosphere, which can easily be accessed by plant roots then enhance plant growth(Alarefee et al., 2021).

Table (4) the highest ear length was recorded by poultry manure (a5) compared to control (a1), this may be due to high nutrient content of poultry manure that contains of 1.52 and 7.28% of P and N respectively (table 10) which causes an increase in sweet corn growth as well as increase productivity(Abbas Mohammed et al., 2018). The level (b4) was superior to control (b1) in yield and biomass. It means the application of bio chars and fertilizers to a certain level had positive effect after that caused non-significant decrease, it means b4 is an adequate amount or level for sweet corn, may be due to the most important point is, the highest yield value was attributed with yield component values and leaf area (table 4 and 2) or may be due to high chlorophyll content (table 6). The significant correlation between ear diameter and yield explains the role of ear diameter in increasing corn yield (figure1).

Table (5) the highest yield value (20.61 ton ha^{-1}) was recorded from interaction treatment of poultry manure with the level of 48 ton ha^{-1} (a5b4) this may be due to the highest chlorophyll contentment in the mentioned interaction treatment with the value of (44.06 SPAD) as shown in table (7). The significant correlation between yield for interaction treatments and their chlorophyll content for leaves and flag leaves with the correlation coefficient values of $r= 0.69^{*}$ and 0.68^{*} respectively explains the role of chlorophyll content in increasing yield of sweet corn (figure 2 and 3), also another factor was the significant correlation between yield for interaction treatments and ear length (figure 4).

Poultry manure (a5) was a treatment which recorded the highest significant value for leaf chlorophyll in comparison with other treatments, and poultry manure level of 42 ton ha^{-1} was superior to control (a1) as shown in table (6). It means application of fertilizers to a certain level caused increase in SPAD values then caused decrease in it at highest level (b5), the levels of application may cause creating different growth conditions for plant growth and availability of nutrients which may leads to increase in SPAD value. These results agree with (Iriyani and Nugrahani, 2014), because photosynthesis process is very important of plant growth and development, additionally it plays a great role in the vegetative, forming flower, quality of postharvest and seed filling (Pangaribuan and Hendarto, 2018).

Several points shown in table (8):

a. Protein content was affected by treatments especially poultry manure. This may be due to high Nitrogen content of poultry manure as mentioned before that caused increase in protein content since nitrogen is a part of amino acid(Faisal et al., 2013), in many researchers reported that humic substances have a great role in uptake efficiency for plant water, improvement of nutrition and content of grain protein, the result agree with (Turan et al., 2011)

b. Most treatments (a2, a3, a4 and a5) were exceeding on control (a1) in total soluble solids (TSS%), total P concentration in seed and plant dry matter, this may be due to the role of treatments in increasing nutrient availability especially phosphorus , the significant correlation between TSS% and concentration of P in seed and plant dry matter with the correlation coefficient values of r

=0.69*, 0.76* respectively ,this explains the role of treatments in increasing nutrient availability then increase in sweet corn quality (figure 5,6)

Table (9) the significant differences recorded between interaction treatments recorded between a4b4 and a5b5 in their effect on oil percentage, this may be due to dilution effect , since the treatments had great effect of yield for this reason conversion oil% to oil yield (oil yield = oil% * yield) the difference becomes significant for example the amount of oil yield from a5b5 was equal to 19.13 *5.93% = 1.134 ton per hectare or 1134 kg oil ha^{-1}.while in control treatment the oil yield ha^{-1} =16.45 * 5.60 % = 0.921 ton per hectare or 921 kg oil ha^{-1}. While for the lowest yield value (a2b2) the oil yield ha^{-1} =14.58 * 5.60 % = 0.816 ton per hectare or 816kg oil ha^{-1}. It means the best indicator is the oil yield per hectare not oil percentage

5. Conclusion

The results of applying of some Biochars and organic fertilizers on growth yield and quality of sweet corn indicated to the highest effect of poultry manure on (yield, biomass, ear length, leaf chlorophyll, protein, and earliest days to 50% silking and tasseling) compared to other treatments, also bio chars give the best result on (plant high, leaf area, TSS%, concentration of P in seed and plant). The Biochars and organic fertilizers are better than chemical fertilizers such as triple super phosphate.

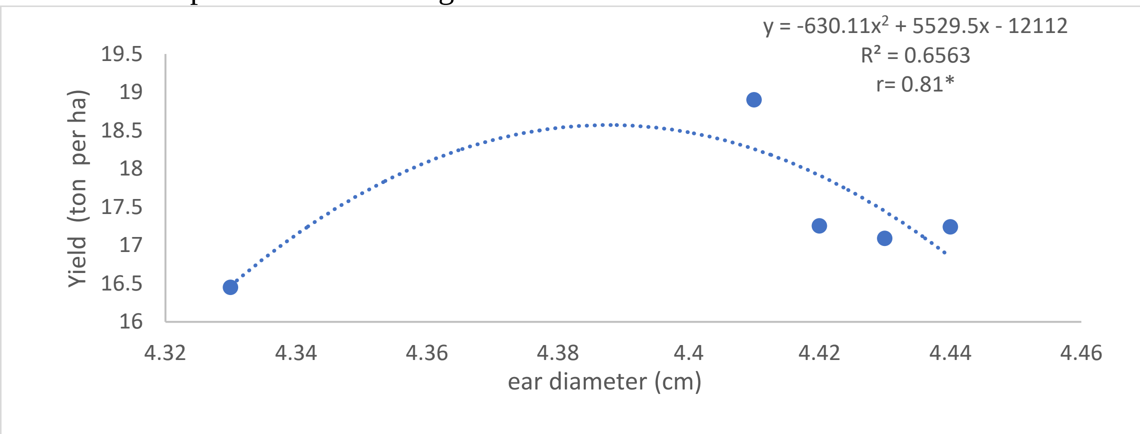

Figure 1. The relation between yield and ear diameter

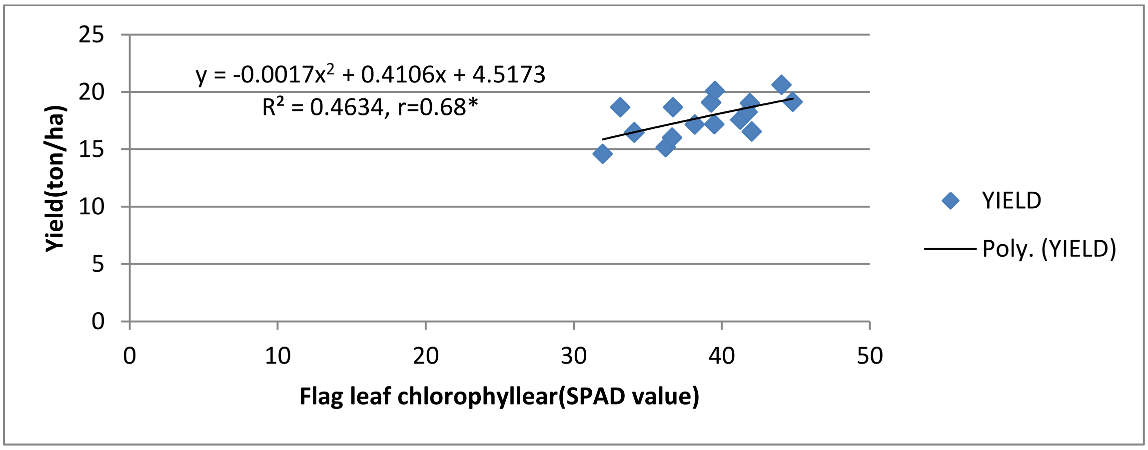

Figure 2.the relation between yield and flag leaf chlorophyll (SPAD value)

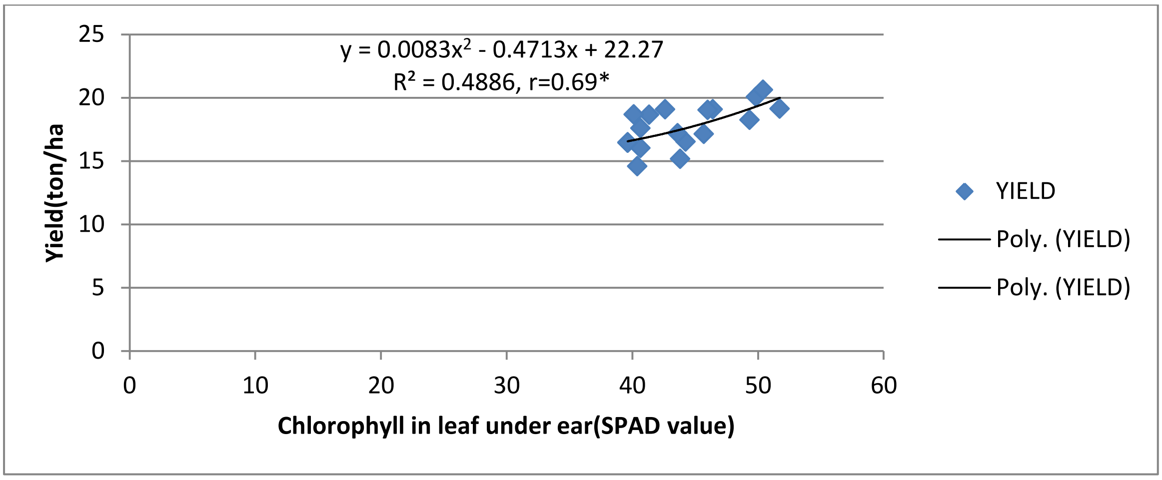

Figure 3.the relation between yield and leaf under ear chlorophyll (SPAD value)

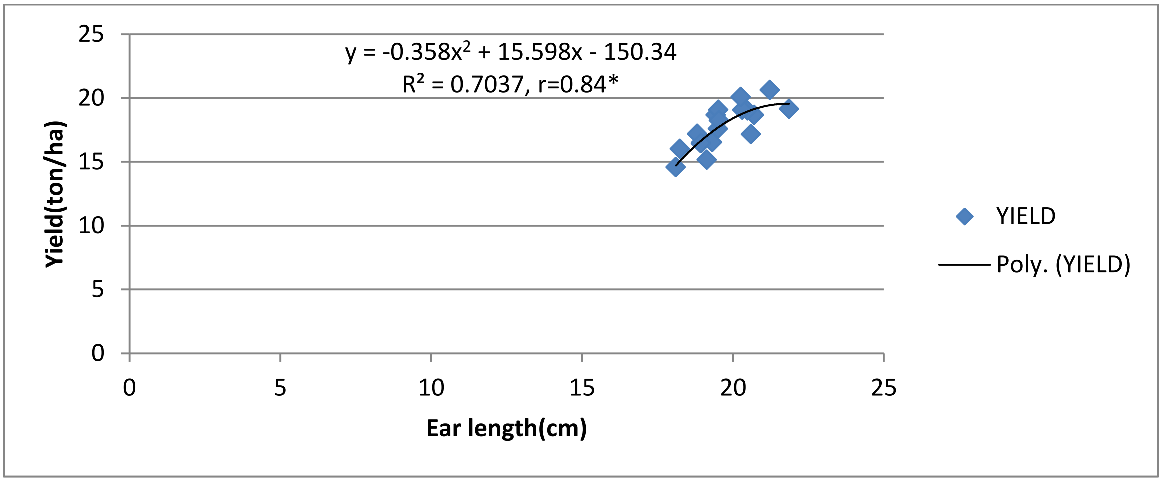

Figure 4.The significant correlation between yield for interaction treatments and ear length

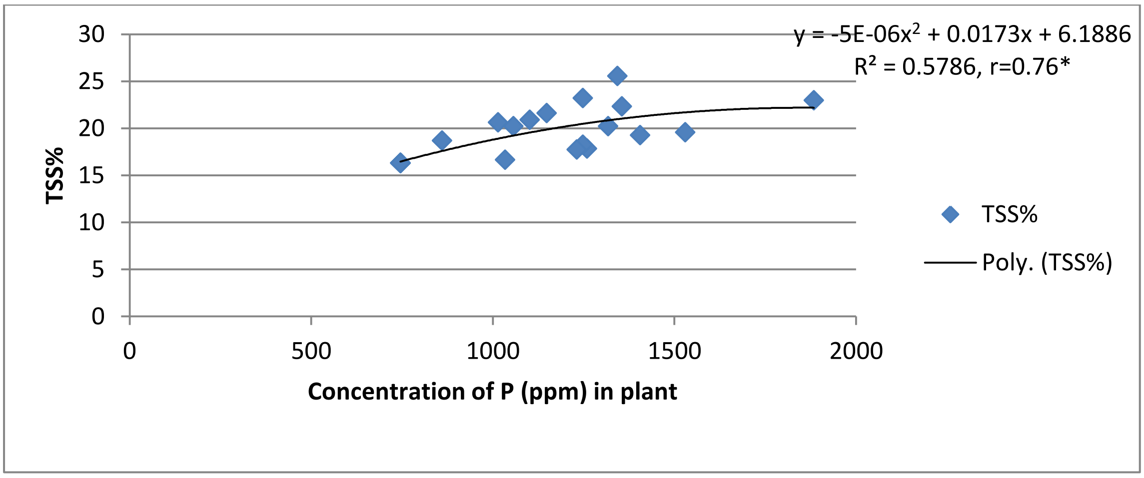

Figure 5. The relation between TSS% and concentration of P (ppm) in plant

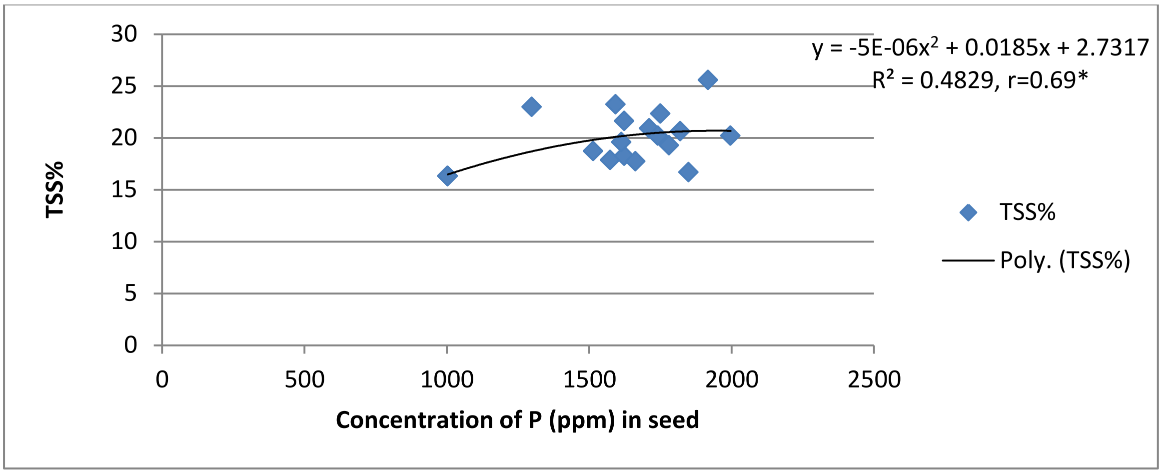

Figure 6. The relation between TSS% and concentration of P (ppm) in seed

Table (1) shows some chemical and physical properties of the studied soil and irrigation water.

Soil Chemical Properties	Unites	Values	Soil Physical Properties	Unites	Values
EC	dS.m^{-1}	0.4	Depth	Cm	30
pH		7.8	Sand	g.kg^{-1}	88.3
Ca^{2+}	mmol$_c$.L^{-1}	3.6	Silt		502.8
Mg^{2+}		0.2	Clay		408.9
Na^{+}		0.137	Texture		Silty Clay
K^{+}		0.138	**Water Chemical Properties**	**Unites**	**Values**
Cl^{-}		0.3	EC	dS.m^{-1}	0.45
HCO_3^{-}		3.5	pH		8.1
CO_3^{2-}		0.15	K^{+}	mg.kg^{-1}	1.5
P	mg.kg^{-1}	22.14	Ca^{2+}	mmol$_c$.L^{-1}	2.3
			Mg^{2+}		2.2
O.M		16.6	Cl^{-}		0.5

$CaCO_3$	$g.kg^{-1}$	250	HCO_3^-		3.5
N		2.3	CO_3^{2-}		0.5

Table (2) Effect of [biochars - organic fertilizers] and additional levels on plant high, leaf area, number of days 50%silking and 50%tasseling of sweet corn.

Treatment	Plant height(cm)	Leaf area(cm^2)	No of days 50%silking	No of days 50%tasseling
a1	190.66b	51.51c	59.00a	49.33a
a2	195.62ab	63.79b	57.13b	46.73b
a3	199.10a	75.42a	57.40ab	46.66b
a4	196.13ab	57.65bc	57.66ab	47.33b
a5	197.18ab	73.86a	54.73c	43.80c
b1	190.66b	51.51b	59.00a	49.33a
b2	197.42ab	66.56a	57.26b	46.93b
b3	189.98b	66.42a	57.86ab	46.80b
b4	202.06a	67.42a	56.60bc	46.40b
b5	198.57a	70.32a	55.20c	44.40c

Table (3) Interaction effect of biochars - organic fertilizers]and their levels on plant high, leaf area, number of days 50%silking and 50%tasseling of sweet corn.

Treatment	Plant height(cm)	Leaf area(cm)	No of days 50%silking	No of days 50%tasseling
a1b1	190.66a	51.51c	59.00ab	49.33a
a1b2	190.66a	51.51c	59.00ab	49.33a
a1b3	190.66a	51.51c	59.00ab	49.33a
a1b4	190.66a	51.51c	59.00ab	49.33a
a1b5	190.66a	51.51c	59.00ab	49.33a
a2b1	190.66a	51.51c	59.00ab	49.33a
a2b2	187.33a	57.18bc	57.00a-c	46.66ab
a2b3	194.93a	70.55a-c	57.66a-c	45.66a-d
a2b4	206.26a	66.99a-c	57.00a-c	47.33ab
a2b5	198.93a	72.70a-c	55.00a-d	44.66b-e
a3b1	190.66a	51.51c	59.00ab	49.33a
a3b2	201.73a	79.72a-c	59.33a	49.33a
a3b3	186.93a	72.67a-c	59.00ab	48.33ab
a3b4	210.13a	83.15ab	55.66a-d	44.66b-e
a3b5	206.06a	90.08a	54.00b-d	41.66ef
a4b1	190.66a	51.51c	59.00ab	49.33a

a4b2	199.13a	68.56a-c	57.33a-c	47.00ab
a4b3	186.06a	55.07bc	58.66ab	48.00ab
a4b4	200.46a	56.99bc	56.66a-c	46.00a-c
a4b5	204.33a	56.11bc	56.66a-c	46.33ab
a5b1	190.66a	51.51c	59.00ab	49.33a
a5b2	208.26a	75.81a-c	53.66cd	42.33d-f
a5b3	191.33a	82.30ab	55.00a-d	42.66c-f
a5b4	202.80a	78.44a-c	54.66a-d	44.66b-e
a5b5	192.86a	81.23ab	51.33d	40.00f

Table (4) Effect of [biochars - organic fertilizers] and their levels on fresh yield, biomass, ear length, ear diameter, No of kernels/ear and dry matter of sweet corn.

Treatment	Fresh yield(ton/ha)	Biomass (ton/ha)	Ear length(cm)	Ear diameter(cm)	No of kernels/ear
a1	16.45b	64.43c	18.94b	4.33a	608.55a
a2	17.09ab	74.15b	19.55ab	4.43a	620.71a
a3	17.24ab	74.81b	19.48ab	4.44a	591.86a
a4	17.25ab	69.86bc	19.16ab	4.42a	607.11a
a5	18.90a	84.35a	20.36a	4.41a	613.22a
b1	16.45b	64.43b	18.94a	4.33b	608.55ab
b2	17.34ab	75.44a	19.39a	4.50a	606.55ab
b3	16.60ab	71.51a	19.29a	4.33b	589.17b
b4	18.47a	79.09a	19.98a	4.45ab	636.48a
b5	18.09ab	77.13a	19.91a	4.43ab	600.69ab

Table (5) Effect of Interaction between [biochars - organic fertilizers] and additional levels on fresh yield, biomass, ear length, ear diameter, No of kernels/ear and dry matter of sweet corn.

Treatment	Fresh yield(ton/ha)	Biomass (ton/ha)	Ear length(cm)	Ear diameter(cm)	No of kernels/ear
a1b1	16.45ab	64.43d	18.94a-c	4.33ab	608.55a
a1b2	16.45ab	64.43d	18.94a-c	4.33ab	608.55a
a1b3	16.45ab	64.43d	18.94a-c	4.33ab	608.55a
a1b4	16.45ab	64.43d	18.94a-c	4.33ab	608.55a
a1b5	16.45ab	64.43d	18.94a-c	4.33ab	608.55a
a2b1	16.45ab	64.43d	18.94a-c	4.33ab	608.55a
a2b2	14.58b	68.19cd	18.11c	4.44ab	590.66a
a2b3	17.14ab	74.42b-d	20.60a-c	4.27b	609.55a
a2b4	18.65ab	83.07a-d	20.70a-c	4.65a	658.77a
a2b5	18.66ab	80.65a-d	19.43a-c	4.48ab	636.00a
a3b1	16.45ab	64.43d	18.94a-c	4.33ab	608.55a
a3b2	16.53ab	75.81b-d	19.31a-c	4.58ab	595.11a

a3b3	15.15ab	79.82a-d	19.13a-c	4.25b	540.89a
a3b4	19.06ab	84.22a-c	19.52a-c	4.51ab	633.55a
a3b5	19.02ab	69.80cd	20.48a-c	4.55ab	581.22a
a4b1	16.45ab	64.43d	18.94a-c	4.33ab	608.55a
a4b2	19.07ab	73.18b-d	20.31a-c	4.58ab	643.55a
a4b3	16.01ab	63.67d	18.24bc	4.40ab	576.22a
a4b4	17.57ab	74.18b-d	19.51a-c	4.36ab	620.66a
a4b5	17.18ab	73.83b-d	18.82a-c	4.43ab	586.55a
a5b1	16.45ab	64.43d	18.94a-c	4.33ab	608.55a
a5b2	20.06ab	95.60a	20.26a-c	4.55ab	594.89a
a5b3	18.23ab	75.22b-d	19.54a-c	4.39ab	610.66a
a5b4	20.61a	89.54ab	21.22ab	4.39ab	660.89a
a5b5	19.13ab	96.96a	21.86a	4.37ab	591.11a

Table (6) Effect of [biochars - organic fertilizers] and additional levels on chlorophyll in flag leaf and leaf under ears of sweet corn

Treatment	Chlorophyll in flag leaf(SPAD)	Chlorophyll in leaf under ear(SPAD)
a1	34.10b	39.63d
a2	34.83b	41.44cd
a3	38.71a	44.01b
a4	38.16a	42.46bc
a5	40.86a	48.16a
b1	34.10b	39.63b
b2	37.93a	43.34a
b3	37.39a	43.82a
b4	39.09a	44.71a
b5	38.69a	44.22a

Table (7) Effect of Interaction between [biochars - organic fertilizers] and their levels on chlorophyll in flag leaf and leaf under ears of sweet corn

Treatment	Chlorophyll in flag leaf (SPAD)	Chlorophyll in leaf under ear (SPAD)
a1b1	34.10bc	39.63e
a1b2	34.10bc	39.63e
a1b3	34.10bc	39.63e
a1b4	34.10bc	39.63e
a1b5	34.10bc	39.63e
a2b1	34.10bc	39.63e
a2b2	31.96c	40.40de

a2b3	38.2a-c	45.70a-e
a2b4	36.73a-c	41.33de
a2b5	33.16bc	40.13de
a3b1	34.10bc	39.63e
a3b2	42.03ab	44.23b-e
a3b3	36.23a-c	43.80b-e
a3b4	39.30a-c	46.40a-d
a3b5	41.90ab	46.00a-e
a4b1	34.10bc	39.63e
a4b2	39.30a-c	42.60de
a4b3	36.66a-c	40.66de
a4b4	41.26a-c	40.66de
a4b5	39.50a-c	43.60c-e
a5b1	34.10bc	39.63e
a5b2	39.56a-c	49.83ab
a5b3	41.76ab	49.33a-c
a5b4	44.06a	50.40a
a5b5	44.80a	51.73a

Table (8) Effect of [biochars - organic fertilizers] and additional levels on protein, oil, TSS, total P in seed and sweet corn.

Treatment	Protein%	Oil%	TSS%	Total P in seed(ppm)	Total P in plant(ppm)
a1	11.96c	5.60a	16.30c	1002.95c	745.69c
a2	13.05ab	5.66a	18.75b	1632.25a	1060.47b
a3	12.79b	5.68a	21.17a	1476.90b	1296.21a
a4	12.85b	5.64a	19.56ab	1600.79ab	1067.37b
a5	13.48a	5.71a	18.68b	1504.43b	1180.83ab
b1	11.96b	5.60a	16.30b	1002.95b	745.69c
b2	12.92a	5.67a	18.69a	1529.99a	1082.44b
b3	13.02a	5.65a	19.60a	1612.59a	1099.00b
b4	13.14a	5.64a	19.78a	1583.09a	1039.12b
b5	13.09a	5.74a	20.08a	1488.69a	1384.32a

Table (9) Effect of Interaction between [biochars - organic fertilizers] and additional levels on protein, oil, TSS, total P in seed and sweet corn.

Treatment	Protein%	Oil%	TSS%	Total P in seed(ppm)	Total P in plant(ppm)
a1b1	11.96d	5.60ab	16.30c	1002.95e	745.69f
a1b2	11.96d	5.60ab	16.30c	1002.95e	745.69f

a1b3	11.96d	5.60ab	16.30c	1002.95e	745.69f
a1b4	11.96d	5.60ab	16.30c	1002.95e	z745.69f
a1b5	11.96d	5.60ab	16.30c	1002.95e	745.69f
a2b1	11.96d	5.60ab	16.30c	1002.95e	745.69f
a2b2	12.83b-d	5.60ab	20.90a-c	1710.92a-c	1102.02c-f
a2b3	13.03b-d	5.60ab	16.66c	1848.58a-c	1034.23c-f
a2b4	14.23ab	5.76ab	20.63a-c	1819.08a-c	1014.48d-f
a2b5	13.20b-d	5.76ab	19.26bc	1779.75a-c	1405.92bc
a3b1	11.96d	5.60ab	16.30c	1002.95e	745.69f
a3b2	13.53bc	5.73ab	17.83bc	1573.26b-d	1259.58a-c
a3b3	13.26b-d	5.76ab	23.20ab	1592.92b-d	1248.56a-c
a3b4	12.70cd	5.70ab	25.56a	1917.41ab	1343.29b-d
a3b5	12.50cd	5.63ab	22.96ab	1297.94de	1883.96a
a4b1	11.96d	5.60ab	16.30c	1002.95e	745.69f
a4b2	13.10b-d	5.80ab	20.20a-c	1740.42a-c	1056.67c-f
a4b3	13.70a-c	5.53ab	20.20a-c	1996.07a	1317.70b-d
a4b4	12.60cd	5.50b	18.70bc	1514.26cd	860.95ef
a4b5	12.90b-d	5.76ab	22.33a-c	1750.25a-c	1355.86b-d
a5b1	11.96d	5.60ab	16.30c	1002.95e	745.69f
a5b2	13.16b-d	5.63ab	18.23bc	1622.42b-d	1248.26b-d
a5b3	13.16b-d	5.76ab	21.60a-c	1622.42b-d	1148.26c-e
a5b4	14.20ab	5.63ab	17.73bc	1661.75a-c	1231.19b-d
a5b5	14.90a	5.93a	19.56bc	1612.59b-d	1530.18b

Table (10) chemical analysis of poultry manure and bio char

	P%	**N%**
Poultry manure	**1.52**	**7.28**
Rice husk Bio char	**0.0708**	**1.98**

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