J.Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 9(1): 47- 53, 2018

Influence of Application Methods of Biochar and Poultry Manure on Yield and Nutrients Uptake of Sunflower Plant Fertilized with Different Nitrogen Rates.

Abd-Elhamied, A. S.[1] and K. F. Fouda[2]
[1]Soil Sci. Dept., Fac. of Agric., Damietta Univ., Egypt.
[2]Soil Sci. Dept., Fac. of Agric., Mansoura Univ., Egypt.
ahmedsalah@du.edu.eg
P.O.BOX 34511, Damietta, El-Usar– Corniche El-Nile - Egypt.
Tel: 0572350549-057361858 -Fax: 057361858

ABSTRACT

Egypt considers the biggest imported food oils country in the world especially sunflower oil. A field experiment was carried out to study the influence of two organic fertilizers (biochar and poultry manure) applied by two methods (mixed and lined addition) and three nitrogen rates (0, 40 and 60 kg fed^{-1}) on sunflower plant growth, yield, yield component and nutrients uptake. The experimental design was split split block design. Plant height, head diameter (cm), seed weight plant^{-1} , 1000 seed weight, stem diameter (cm),leaves number plant^{-1}, straw and seeds yields (kg fed^{-1}), oil percentage, oil yield (kg fed^{-1}), harvest index (%), biological yield (kg fed^{-1}) and nutrients uptake by straw and seeds were determined. The obtained results indicated that all the previous parameters significantly increased by all used treatments except harvest index and phosphorus uptake by seeds where it decreased with biochar and poultry manure. In addition, the combination between 40 kg N fed^{-1} and biochar gave the highest 1000 seed weight value (54.35g) while, the maximum seed yield value (2296.7 kg fed^{-1}) was occurred with the treatment of biochar applied by mixed method at the rate of 40 kg N fed^{-1} without any significance over the combination of poultry manure, lined addition method and 60 kg N fed^{-1}. The highest oil yield (927.7 kg fed^{-1}) was recorded with the combination between poultry manure, mixed adding methods and 40 kg N fed^{-1} without significance over the treatment of biochar, mixed method and 60 kg N fed^{-1}. It could be concluded that adding both poultry manure and biochar by mixed and lined methods improved sunflower oil yield, seeds yield and nutrients uptake.

Keywords: Sunflower- biochar- poultry manure- oil yield- nutrients uptake.

INTRODUCTION

Egypt considers the biggest imported food oil country in the world especially sunflower oil. Egypt's oil consumption has increased over recent years. Our production of seed oils still less than the current needs, where it covers about 10% of the consumption (El-Fayoumy *et al*., 1999). To meet the gap between consumption and production, it must increase the production and the area of seed oils crops especially that of sunflower which grown in different soils and climate conditions. It can do this by increasing soil fertility which achieves by adding different materials such as biochar, poultry manure, and nitrogen fertilizers. So, to sustainable agriculture and maintain soil fertility, biochar was used to the soil which is considered an organic compound, carbon-rich material, produced by fast or slow pyrolysis. The organic C content of biochar could achieve a lot of benefits to soil such as improving physical and chemical properties, Schulz and Glaser (2012), enhancing water holding capacity regarded to hydrophobicity and surface area of biochar (Verheijen *etal*.,2009), improving nutrient availability, Taghizadeh-Toosi *et al*.,(2012) and Alburquerque, *et al*. (2014), modifying biological activity (Lehmann, *et al*.,2011). The previous benefits of biochar depend upon pyrolysis temperature, production conditions and biochar age (Fang *et al*., 2014 and Houben *et al*., 2014). In addition, It can be used different materials to produce biochar such as crop residues, woody materials, poultry litter, tree clippings, lawn grass cuttings, sludge and manures (Melo *et al*., 2015 and Qayyum *et al*., 2015). For saving the environment from pollution, the woody residues from furniture industry was used to produce biochar. In addition, poultry manure is identified as a suitable organic fertilizer, the most valuable of all animal manures and it used for soil fertility maintenance (Adekiya and. Agbede 2009,). On the other hand, many researchers stated that nitrogen fertilizers significantly increased sunflower plant height, dry matter, seed production, oil yield (Oyinlola *et al*., 2010; Sincik *et al*., 2013; Salih, 2013). However, other investigator found that seed oil percentage decreased with increasing nitrogen fertilizer rates (El-kady *et al*.,2010 and Osman, and Awed 2010). The study aimed to investigate the effect of biochar, poultry manure, nitrogen fertilizers rates and their adding methods on sunflower yield, yield components and nutrients uptake.

MATERIALS AND METHODS

A field experiment was carried out in a private farm, Damietta Governorate, Egypt to investigate the effect of two organic fertilizers (biochar and poultry manure), two methods of application (mixed and lined method), nitrogen fertilizer rates (0, 40,and 60 kg fed^{-1}) and their interaction on sunflower nutrients uptake, plant growth parameter, yield and its components. The used biochar was produced from the furniture residues by slow pyrolysis. The mixed application method of biochar or poultry manure were added to surface layer (0-20cm) then mixed and soil lined while the second method (lined method), soil was lined then biochar or poultry manure were added to every line then coated by soil.

The used soil had loamy sand texture and some chemical and physical properties of studied soil were listed in Table 1.

Table 1. Some physical and chemical properties of the experimental soil.

$CaCO_3$ %	pH (1:2.5)susp.	EC (dSm^{-1})	Field capacity %	Saturation Percent (%)	Available nutrients (mg/kg) N	P	K
0.70	7.95	3.82	18	37.6	31.20	5.00	66.63
Texture	Coarse sand %	Fine Sand %	Silt %	Clay %			
Loamy Sand	10.63	70.71	5.33	13.33			

Sunflower seeds (*Helianthus annuus* L.) cv Sakha -53 were collected from Agricultural Research Centre, Egypt. The treatments were arranged in split split block design with three replications. The experimental plot was 5.7 m^2 consisting of three rows. Biochar and poultry manure were added at the rate of 8 ton fed^{-1} with two ways of addition. The chemical analysis of biochar and poultry manure was listed in Table 2.

Table 2. Some chemical analysis of biochar and poultry manure.

Treatment	pH (1:10) susp. extract extract	EC(dSm^{-1}) (1:10) extract	Total organic carbon, g kg^{-1}	Total nitrogen (%)	Available nutrients (mg/kg) N	P	K
Poultry manure	9.45	3.7	444	1.5	700	60	500
Biochar	8.22	0.4	894	1	105	15	250

Space between hill and the other one was 25 cm within the row. Seeds were sown at 3-4 seeds in each hill. Plants were thinned after 21 days from sowing to two plants. Urea (46.5%) at the rate of 0, 40 and 60 kg fed^{-1} were applied after thinning and elongation stage. Potassium and phosphorus fertilizer were added as recommended doses.

At harvest time, plant height (cm) stem diameter (mm), head diameter (cm), seeds weight $head^{-1}$ (g), 1000 seeds weight, seeds weight (g), straw and seed yield (kg fed^{-1}) and biological yield kg fed^{-1} were determined. The samples were separated into shoots and head which dried at 70 ^{O}C. Total nitrogen, phosphorus, and potassium were determined in the digested solution according to the method described by Cottenie *et al.,* (1982).

N, P, and K uptake were calculated separately by the following formula: Nutrient uptake in kg fed^{-1} = Nutrient % in seed or straw*dry matter of grain or straw in kg fed^{-1} /100 (Sharma, *et al*. 2012)

Soil analysis

Particle size distribution was determined using the international pipette method as described by Haluschak (2006). Electrical conductivity and soil pH values were determined in soil suspension as described by Carter and Gregorich (2007). Field capacity and saturated percentage were determined as described by Black, (1965). Soil was extracted by using 2.0 N KCl according to van Reeuwijk (2002) to determine the available nitrogen using half automatic kjeldhal apparatus. While, the soil was extracted by using 0.5 N $NaHCO_3$– at pH, 8.5 according to van Reeuwijk (2002) to estimate available phosphorus in this extraction. Available potassium in soil was extracted by using 1.0 N $(CH_3)COONH_4$ according to Hesse (1971) and estimated by using the Flame photometer model PFP7.

Statistical analysis

All data were statistically analyzed according to the technique of analysis, variance (ANOVA), the least significant difference (LSD) method and Correlation coefficient analysis were used to compare the differences between the means of treatment values according to methods described by Gomez and Gomez (1984). All measurable investigations were performed utilizing an examination fluctuation procedure by method of CoSTATE PC programming.

RESULTS AND DISCUSSION

Plant height.

Data in Table (3) show that plant height (cm) was significantly affected by poultry manure, furniture residues biochar, its adding methods and nitrogen fertilization rates. Sunflower plant height was higher with poultry manure (224.1cm) treatment than the other ones. Adding organic fertilizers in the line then cover with soil reduce plant height value compared with the mixed method with soil. These results may be due to an increase in the connection area between plants root and organic fertilizers. On the other hand, plant height increased with increasing nitrogen rates where, the application rate of nitrogen fertilizer (40 kg fed^{-1}) recorded the highest plant height (223.8 cm) compared with control (N0). These result may be regarded to nitrogen role in encouraging plant cell for division, growth and elongation. These results are in line with those obtained by El-kady, *et al*.,2010 and Osman, and Awed (2010).Meanwhile, the interactions between treatments are significantly affected plant height where, it increased with the interaction between mixed method and organic fertilizers. The highest plant height value (231.5cm) was found with the interaction between adding mixed method and biochar. Also, the interaction between biochar mixed adding method and 60 kg N fed^{-1} gave the highest plant height value (236.3 cm). This result may be due to nitrogen role and the ability of biochar to absorb nutrients and increases available nutrients (Verheijen *et al*., 2010).

Head diameter (cm)

Head diameter data was shown in Table (3). All used treatments increased significantly sunflower head

diameter (cm) compared with control treatment. Also, adding poultry manure increased head diameter (cm) compared with adding biochar. These results may be due to the poultry manure higher content from nutrient which reflected on plant growth (Adekiya and Agbede 2009).

The mixed method also recorded the higher head diameter value (19.81 cm) compared with the other one. In addition, head diameter increased with increasing nitrogen fertilizer rates compared with the control (N0) treatment (17.22cm).The interaction between organic fertilizers and nitrogen rates significantly increased sunflower head diameter (Fig1). In addition, the combination between biochar treatment and 60 kg fed^{-1} nitrogen recorded the highest head diameter value (21.33cm). While the interaction between all used treatments was not significantly affected the sunflower head diameter. The highest head diameter value (23.33cm) was found at the interaction between biochar, mixed method and 60 kg N fed^{-1}.

Table 3. Effect of the used treatments on sun flower plant height, head diameter, seed weight head^{-1},1000 seed weight, stem diameter and leaves number plant^{-1}.

Treatmeants	Plant height (cm)	Head diameter (cm)	Seed weight head^{-1} (g)	1000 seed weight (g)	Stem diameter (cm)	Leaves number plant^{-1}
With out addition	199.00	18.11	54.11	49.20	2.04	17.66
Poultry manure	224.10	20.44	62.78	52.37	2.35	20.33
Biochar	228.10	19.33	60.75	50.85	2.35	19.66
LSD at 5 %	6.31	0.867	1.12	0.327	0.041	0.999
Mixed method	219.04	19.81	62.07	51.75	2.35	19.37
Lined method	215.20	18.77	56.35	49.85	2.14	19.07
LSD at 5 %	2.94	0.362	0.11	0.105	0.046	NS
N0(0kg fed^{-1})	210.70	17.22	48.57	49.34	2.02	17.72
N1 (40 kg fed^{-1})	223.80	19.77	61.77	52.73	2.39	21.11
N2(60 kg fed^{-1})	216.60	20.88	67.29	50.35	2.32	18.83
LSD at 5 %	2.41	0.834	0.539	0.5629	0.064	1.35
			INTERACTION			
Control	185.00	15.66	29.27	48.70	1.90	17.00
0 organic + N1	215.00	18.33	60.33	51.40	2.13	18.33
0 organic + N2	197.00	20.33	72.71	47.50	2.11	17.66
P L N0	225.00	19.00	59.33	49.90	2.20	18.00
P L N1	220.00	20.33	59.83	51.70	2.36	21.66
P L N2	220.00	21.00	71.33	52.00	2.23	20.00
P M N0	217.30	19.00	59.00	56.40	2.06	20.00
P M N1	229.60	22.33	61.11	53.20	2.43	23.33
P M N2	232.60	21.00	66.11	51.00	2.83	19.00
C L N0	224.60	16.00	47.00	43.40	1.83	16.00
C L N1	227.30	19.00	57.44	53.10	2.50	24.33
C L N2	222.30	19.33	49.88	51.00	2.00	18.66
C M N0	227.30	18.00	67.55	48.90	2.26	18.33
C M N1	236.30	20.33	71.61	55.60	2.80	20.66
C M N2	231.00	23.33	71.00	53.10	2.70	20.00
LSD at 5 %	5.90	NS	1.32	1.378	0.091	NS

P= poultry manure, C= biochar, M= mixed method, L= lined method, Feddan = 4200 m^2

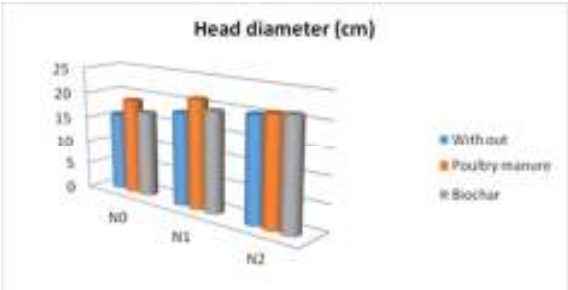

Fig 1. Effect of the interaction between poultry manure, biochar and nitrogen fertilizer rates on sunflower head diameter.

Seed weight head $^{-1}$(g)

Data in Table (3) show that seed weight head $^{-1}$(g) significantly increased by all used treatments where, the treatments of poultry manure, mixed addition method and nitrogen fertilizers rates increased seed weight head $^{-1}$(g) values compared with the control treatment. Using nitrogen at a rate of (60 kg fed $^{-1}$) recorded the highest seed weight head $^{-1}$(67.29 g). These results are in contrast with those of Mahrous, N. M. *et al*.(2014). On the other hand, the interactions between the used treatments significantly increased seed weight head $^{-1}$ (g) as shown in Fig (2). The highest seed weight head $^{-1}$(g) value (72.71 g) was found at the nitrogen fertilizer rate of 60 kg fed^{-1}, without significant with the treatment of 40 kg N fed^{-1}, mixed adding method and biochar.

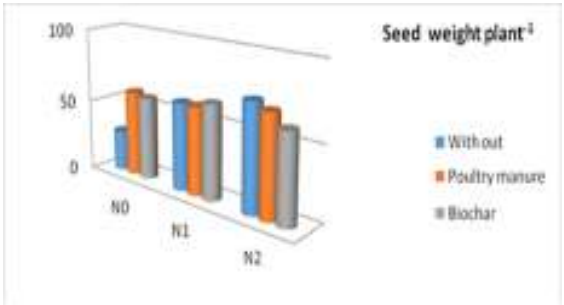

Fig.2. Effect of the interaction between poultry manure and biochar and nitrogen fertilizer rates on sunflower seeds weight plant^{-1}.

1000 seed weight (g)

The weight of 1000 seed significantly increased by using organic fertilizers, mixed adding method and nitrogen rates. The nitrogen rate of 40 kg fed^{-1} gave the highest 1000 seed weight value (52.73g). The increase in 1000 seed weight may be due to the increase in plant height, leaf area, nutrients uptake and photosynthesis which stored in seeds as result of nutrients availability. These results are in agreement with those of El-kady *et al*.,(2010). The interactions between treatments significantly increased the weight of 1000 seed where the combination between 40 kg N fed^{-1} and biochar gave the highest 1000 seed weight value (54.35g). The combined between biochar, mixed adding methods and 40 kg N fed^{-1} showed the best weight of 1000 seed. These results may be a cause to biochar role in saving nutrients, increasing CEC and increasing nutrient availability by increasing surface area with mixed adding method (Yasin, *et al*. (2013)

Stem diameter(cm) and leaves number plant^{-1}

Stem diameter and leaves number plant^{-1} (Table 3) significantly increased with all used treatments. The nitrogen rate of 40 kg N fed^{-1} recorded the highest stem diameter and leaves number plant^{-1}. These results are in agreement with those of Yassen *et al*.(2011)

Sunflower seed yield (kg fed^{-1})

The presented data in Table (4) reveal that sunflower seed yield (kg fed^{-1}) significantly increased by all used treatments, where the treatment of poultry manure gave the highest seed yield (2013.75 kg fed^{-1}) compared with the other treatments. Also, the nitrogen rate of 60 kg fed^{-1} recorded the best seed yield value (2158.30 kg fed^{-1}) compared with the control treatment. These results may regard to nitrogen role in activating the growth and yield components. These results are in line with that of Osman and Awed 2010 and Sincik, *et al*. (2013). They studied the effects of different nitrogen rates (0, 40, 80, 120, 160, 200 and 240 kg ha^{-1} N) on the yield, its components and the quality characters of sunflower. They found that as the N rate increased, all of the traits measured significantly increased, except the oil content and the highest seed yield (2713.6 to 2751.2kg ha^{-1}) and crude oil yield (1012.7 to 1042.5 kg ha^{-1}) were obtained using 160 kg ha^{-1} N. On the other side, the interaction between organic fertilizers and application methods significantly increased seed yield and the integration between furniture residues biochar and mixed adding methods gave the highest seed yield value (2246 kg fed^{-1}) Fig (3). Meanwhile the interaction among all used treatments also significantly increased seed yield compared with the control treatments (939 kg fed^{-1}).The highest seed yield value (2296.7 kg fed^{-1}) was found at the treatment of biochar, mixed method and 40 kg N fed^{-1}without any significant with the combination between poultry manure, lined adding method and 60 kg N fed^{-1}. These results may be due to treatments effects on head diameter, stem diameter, plant height and leaf area which reflected on seed yield where they correlated significantly with seed yield by R= 0.72, R=0.57, R= 0.51 and R= 0.77, respectively.

Table 4. Effect of the used treatments on sunflower seed and straw yield, oil percentage, oil yield (kg fed^{-1}), biological yield (kg fed^{-1}) and harvest index (%).

Treatments	Straw yield (kg fed^{-1})	Seeds Yield (kg fed^{-1})	oil percentage (%)	Oil yield kg fed^{-1}	Biological yield (kg fed^{-1})	Harvest index (%)
With out addition	2450	1735	37.87	658.41	4185	37.20
Poultry manure	3546	2013	38.92	781.09	5560	36.58
Biochar	3453	1948	33.69	665.71	5401	36.22
LSD at 5 %	133.1	35.86	1.724	32.43	167.5	1.274
Mixed method	3484	1991	37.41	741.87	5475	36.69
Lined method	2815	1807	36.25	661.61	4622	38.82
LSD at 5 %	54.93	3.39	NS	26.25	53.68	0.272
N0(0kg fed^{-1})	2741	1557	34.85	546.00	4299	35.66
N1 (40 kg fed^{-1})	3453	1981	40.70	801.88	5434	36.80
N2(60 kg fed^{-1})	3255	2158	34.95	757.33	5413	40.81
LSD at 5 %	65.20	17.29	1.643	27.77	74.19	0.546
			INTERACTION			
Control	2030	939.0	35.93	337.26	2969	31.63
0 organic + N1	3080	1935.0	43.73	845.90	5015	38.66
0 organic + N2	2850	2232.0	33.96	792.06	5182	45.10
P L N0	2660	1903	41.56	791.30	4563	41.70
P L N1	3080	1919	37.26	715.00	4999	38.40
P L N2	3570	2287	37.53	858.13	5857	39.06
P M N0	3570	1892	38.53	729.33	5462	34.63
P M N1	4620	1959	47.30	927.70	6579	29.76
P M N2	3780	2120	31.36	665.10	5900	35.96
C L N0	2730	1507	23.80	358.90	4237	35.60
C L N1	3010	1842	39.80	732.90	4852	37.96
C L N2	2940	1600	32.70	522.90	4540	35.26
C M N0	3430	2166	33.33	721.90	5596	38.76
C M N1	3850	2296	32.36	743.86	6146	37.36
C M N2	4760	2277	40.16	913.70	7037	32.36
LSD at 5 %	159.72	45.47	4.025	68.03	181.7	1.34

P= poultry manure, C= biochar, M= mixed method, L= lined method, Feddan = 4200 m^2

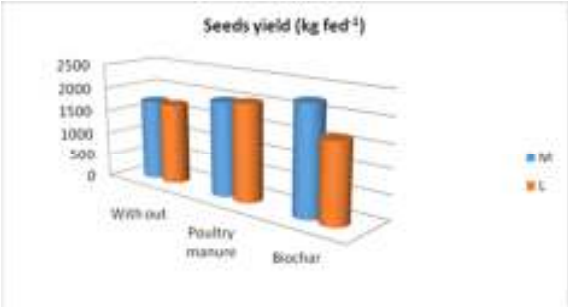

Fig. 3. Effect of the interaction between poultry manure and biochar and application methods on sunflower seeds yield.

Sunflower straw yield

Results in Table (3) show that sunflower straw yield (kg fed^{-1}) took the same trend where it increased with all used treatment compared with control treatment. The highest straw yield value (4760 kg fed^{-1}) was found with the treatment of biochar, mixed adding methods and 60 kg N fed^{-1}. These results are in agreement with those of Ali *et al*. (2012) and Nasim *et al*. (2012) who reported that increasing sunflower yield with increasing nitrogen fertilizer rates.

Oil percentage and oil yield (kg fed^{-1})

Data as shown in Table (4) illustrate that oil percentage and oil yield (kg fed^{-1}) were significantly affected by all used treatments, where they increased with increasing nitrogen rate and the highest oil percentage and oil yield (kg fed^{-1}) values (40.7% and 801.88 kg fed^{-1}) were found with the nitrogen fertilizer rate of 40 kg fed^{-1}. These results are in line with those of El-kady *et al*.,2010 and Sincik, *et al*. (2013)

The interactions between all used treatments were significantly affected oil percentage and oil yield (kg fed^{-1}) where oil percentage decreased with the biochar interactions except with the nitrogen rate of 60 kg fed^{-1}, it increased compared with the control. These results may be due to incomplete decomposition of biochar and low content of nitrogen. Similar results were found with Alburquerque, *et al*. (2014) who stated that the effects of biochar addition on plant dry biomass were greatly dependent upon the biochar-application rate and biochar type, mainly associated to its nutrient content due to the low fertility of the soil used.

However, oil yield (kg fed^{-1}) increased with all used treatments interactions (Fig 4). These results may be due to increasing seed yield with the used treatment compared with the control treatment and the increment in head diameter which correlated significantly with oil yield (R=0.72). The highest oil percentage and oil yield (927.7 kg fed^{-1}) were recorded with the combination of poultry manure, mixed adding methods and 40 kg N fed^{-1} without significant with the treatment of biochar, mixed method and 60 kg N fed^{-1}.

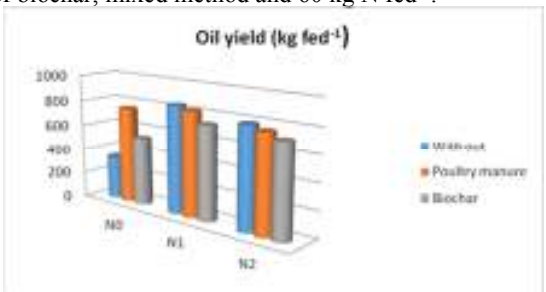

Fig. 4. Effect of the interaction between poultry manure and biochar and nitrogen fertilizer rates on sunflower oil yield.

Biological yield (kg fed^{-1}) and harvest index (%)

Data presented in Table (4) show that biological yield (kg fed^{-1}) and harvest index (%) were significantly affected by organic fertilizers, adding methods and nitrogen rates. Biological yield increased with all used treatments and their interactions over control treatment where it increased by 26.4% and 25.9% with the treatment of 40 and 60 kg N fed^{-1} respectively, compared with control (N0). These results are in the same line with Abd El- Rahman, *et al*. (2016). On the other hand, the interaction between nitrogen rates and organic fertilizers (Fig.5) significantly increased biological yield (kg fed^{-1}). The highest biological yield value (7037 kg fed^{-1}) was recorded with the interaction between biochar, mixed adding method and 60 kg N fed^{-1}. Meanwhile, harvest index takes the same trend with nitrogen rates where it increased with increasing nitrogen rates. The highest harvest index value (45.1%) was occurred with the treatment of 60 kg N fed^{-1} while, the lowest one (29.76%) was recorded with the combination between poultry manure, mixed adding method and 40 kg N fed^{-1}. These results may be regarded to the increases in the straw yield in these treatments.

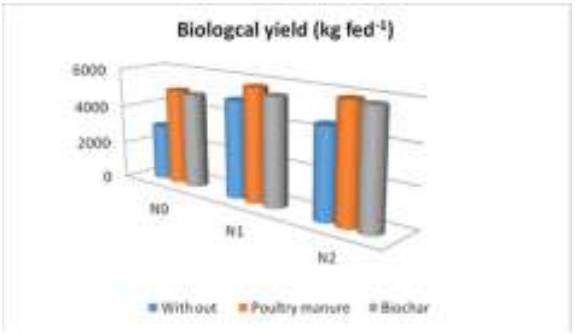

Fig. 5. Effect of the interaction between poultry manure and biochar and nitrogen fertilizer rates on sunflower biological yield.

Nutrients uptake by sunflower plant

Data presented in Table (5) show N, P, and K uptake by seeds and straw of sunflower plant. Potassium uptake by straw was significantly increased by 44.48 and 45.16% with using poultry manure and biochar compared with the control treatment (without organic fertilizers). In addition, the mixed adding method increased potassium uptake by straw by 21.19% compared with the other one. On the other hand, it increased by 25.96 % and 23.33% with the nitrogen treatments of 40 and 60 kg N fed^{-1} compared with the control treatment (N0). These results are in the same line with Yassen, *et al*.(2011)

The interactions among all used treatments were significantly affected potassium uptake by straw. The interaction between biochar, mixed adding methods and 60 kg N fed^{-1} gave the highest potassium uptake by straw value (230.6 kg fed^{-1}). Potassium uptake by seeds was significantly affected by all tested treatments and take the same trend of potassium uptake by straw.

Nitrogen uptake by sunflower straw and seeds was significantly increased by all investigated treatments, where nitrogen uptake by straw increased from 18.29 kg fed^{-1} at without organic fertilizers to 29.12 kg fed^{-1} with the biochar treatment. These results may be due to the ability of organic fertilizer to save adding nitrogen and gave nutrients to plants. Nitrogen uptake by sunflower seeds was increased by 48.16 and

53.45% with the treatments of 40 and 60 kg fed^{-1} respectively, compared with the control treatment. Similar results were found with those of Yassen *et al*.(2011).On the other hand, the interactions between all tested treatments significantly increased nitrogen uptake by sunflower straw and seeds. The highest nitrogen uptake by sunflower seeds (70.27kg fed^{-1}) was recorded at the combination between biochar, mixed adding method and nitrogen rate of 40 kg fed^{-1}.

Phosphorus uptake by sunflower seeds significantly decreased by using organic fertilizer compared with untreated one. These results may regard to phosphorus integrated with organic matter or consumption in building soil organisms bodies. In contrast, increasing nitrogen rates increased phosphorus uptake by seeds by 96.11 and 61.36% with the treatments of 40 and 60 kg fed^{-1} respectively, compared with the control treatment. These results may be due to the stimulation relation between nitrogen and phosphorus nutrient. These results are in agreement with those of Abd El- Rahman, *et al*. (2016). The highest phosphorus uptake by seeds (12.53 kg fed^{-1}) was recorded with 40 kg N fed^{-1}. However, phosphorus uptake by straw significantly increased by using organic fertilizer, adding methods and nitrogen rates. Mixed adding method increased phosphorus uptake by straw by 18.02% compared with lined adding methods. These results may be due to the increment in reaction of surface area in the mixed method. The interaction between poultry manure, lined adding methods and 60 kg N fed^{-1} recorded the highest phosphorus uptake by straw value (21.26kg fed^{-1})

Table 5. Effect of the tested treatments on the means of nitrogen, phosphorus and potassium uptake by sunflower seeds and straw (kg fed^{-1}).

Treatments	Potassium uptake (kg fed^{-1})		Nitrogen uptake (kg fed^{-1})		Phosphorus uptake(kg fed^{-1})	
	Straw	Seeds	Straw	Seeds	Straw	Seeds
With out addition	116.90	25.55	18.29	44.96	10.70	8.92
Poultry manure	168.90	25.29	29.10	53.84	16.16	9.20
Biochar	169.70	28.47	29.12	50.05	15.24	7.63
LSD at 5 %	7.23	0.385	1.36	0.797	0.531	0.192
Mixed method	166.40	27.67	27.85	52.56	15.19	8.35
Lined method	137.30	25.21	23.15	46.66	12.87	8.14
LSD at 5 %	3.91	0.225	0.728	0.331	0.236	0.019
N0(0kg fed^{-1})	130.40	21.34	23.01	37.06	12.94	5.41
N1 (40 kg fed^{-1})	164.26	27.07	26.08	54.91	14.65	10.61
N2(60 kg fed^{-1})	160.90	30.91	27.42	56.87	14.51	9.726
LSD at 5 %	3.159	0.306	0.780	0.672	0.324	0.086
			INTERACTION			
Control	92.25	15.06	13.9	22.94	8.98	2.65
0 organic + N1	143.50	30.72	21.76	54.95	13.87	12.53
0 organic + N2	115.10	30.88	19.22	56.99	9.25	11.58
P L N0	121.10	25.69	23.53	46.92	10.14	9.54
P L N1	152.32	25.42	24.51	57.24	13.35	9.71
P L N2	193.40	31.66	26.76	64.46	21.16	8.28
P M N0	154.18	19.60	29.06	47.48	15.18	5.67
P M N1	216.93	20.96	37.37	50.69	18.67	10.14
P M N2	175.89	28.44	33.39	56.24	18.48	5.86
C L N0	135.35	20.09	26.78	32.51	12.25	5.77
C L N1	146.82	21.27	22.73	41.37	10.70	9.73
C L N2	135.80	26.08	29.20	42.62	16.19	3.53
C M N0	187.39	32.55	30.89	49.59	22.16	6.19
C M N1	182.31	33.34	28.33	70.27	17.44	9.04
C M N2	230.60	37.50	36.77	63.92	12.72	11.53
LSD at 5 %	7.73	1.75	3.31	2.85	1.37	0.367

CONCLUSION

It could be concluded that all tested treatments and their interactions significantly affected the most studied parameters. The highest oil yield value (927.7 kg fed^{-1}) was recorded with the combination between poultry manure, applied with mixed method and recommended rate of nitrogen fertilizers (40 kg fed^{-1}) without significance with the treatment of biochar, mixed method and nitrogen rate of 60 kg fed^{-1}. Also adding poultry manure and biochar through mixed and lined method improved sunflower oil yield, seeds yield and nutrients uptake.

REFERENCES

Abd El- Rahman, L. A.; D. A. Sayed and M. A. Ewais (2016) Seed yield and quilty of sunflower (*Helianthus annuus L.*) as influenced by integrated mineral and organic nitrogen fertilization systems. J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 7 (1): 53-63.

Adekiya, A.O. and T.M. Agbede. (2009). Growth and yield of tomato (*Lycopersicon esculentum* Mill) as influenced by poultry manure and NPK fertilizer. Emir. J. Food Agric., 21 (1) pp. 10-20

Alburquerque, J. A.; J. M. Calero1, V. Barrón, J. Torrent, M. C.Campillo, A. Gallardo, and R.Villar.(2014) Effects of biochars produced from different feedstocks on soil properties and sunflower growth. J. Plant Nutr. Soil Sci. 177, 16–25.

Ali, A., A. Ahmad, T. Khaliq and J. Akhtar. (2012). Phenology and yield of sunflower (*Helianthus annuus* L.) hybrids as affected by varying plant spacing and nitrogen levels under semiarid conditions of Sargodha, Punjab. Pakistan Journal of Science, 64(2): 98-105.

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

Carter, M.R. and E.G. Gregorich (2007) "Soil Sampling and Methods of Analysis". Second Edition, Canadian Society of Soil Science.

Cottenie, A. M. VerIoo, L. Kiekens, G. VeIgh and R. Camerlynck (1982). "Chemical Analysis of Plants and Soils" State Univ. Ghent Belgium, 63.

El-Fayoumy ME, K. M. Hammad and H. M. Ramdan (1999) Soil salinity effects on performance of some canola varieties (*Brassica napus L.*) under calcareous soil conditions at Nubaria region. Alexandria Exchange Science 20, 201-220.

El-kady, F.A.; M. M. Awad and E. B. A. Osman (2010) Effect of nitrogen fertilizer rates and foliar fertilization on growth, yield and yield components of sunflower. J. of plant production, vol. 1 (3): 451 - 459

Fang, Y., B.P. Singh and B. Singh. (2014). Temperature sensitivity of biochar and native carbon mineralization in biochar-amended soils. Agri. Ecosys. Environ., 191: 158-167. Gomez, K.A. and A.A. Gomez, (1984). Statistical Procedures for Agricultural Research (2 ed.). John Wiley and Sons, New York, 680p.

Haluschak, P. (2006). Laboratory methods of soil analysis. Canada Manitoba soil survey p.12.

Hesse, P. R. (1971). "A textbook of Soil Chemical Analysis" Toon Murry (publishers) Ltd, 50 Albemarle Street, London. p. 299.

Houben, D., P. Sonnet and J.T. Cornelis.(2014). Biochar from Miscanthus: a potential silicon fertilizer. Plant Soil, 374(1-2): 871-882. Lehmann, J., M. C. Rillig, J. Thies, C. A. Masiello, W. C. Hockaday and D. Crowley (2011) Biochar effects on soil biota -A review. Soil Biology & Biochemistry 43, 1812-1836.

Melo, L.C., A.P. Puga, A.R. Coscione, L. Beesley, C. A. Abreu and O. A. Camargo.(2015). Sorption and desorption of cadmium and zinc in two tropical soils amended with sugar cane-straw-derived biochar. J. Soils Sediment., pp 1-9.

Mahrous, N. M.; A. A. Ragab; H. H. Abotaleb; M. H. Taha and M .S. El-Metwally (2014) Effect of inorganic, organic and bio fertilizers on yield and yield components of sunflower under newly reclaimed soils. J. Plant Production, Mansoura Univ., Vol. 5 (3): 427-441, 2014

Nasim, W., A. Ahmad, H. M.Hammad, H.J. Chaudhary and M.F. H.Munis. (2012). Effect of nıtrogen on growth and yıeld of sunflower under semı-arıd condıtıons of Pakıstan. Pakıstan Journal Botanic, 44(2): 639-648.

Osman, E.B.A. and M. M. M. Awed (2010) Response of sunflower (*Helianthus annuus L.)* to phosphorus and nitrogen fertilization under different plant spacing at new valley. Ass. Univ. Bull. Environ. Res. Vol. 13 No. 1.

Oyinlola, E.Y., J.O. Ogunwole and I.Y. Amapu (2010) Response of sunflower (*Helianthus annuus* l.) to nitrogen application in a savanna alfisol. HELIA, 33, Nr. 52, p.p. 115-126.

Qayyum, M.F., M. Abid, S. Danish, M.K. Saeed and M.A. Ali. (2015). Effects of various biochars on seed germination and carbon mineralization in an alkaline soil. Pak. J. Agri. Sci., 51(4): 977-982.

Salih, M.N.T.(2013) Response Of sunflower (*Helianthus Annuus L*) To phosphorus and nitrogen fertilization under rainfed conditions, blue Nile state-Sudan. Helia, 36, nr. 58, p.p. 101-110.

Schulz, H. and B. Glaser. (2012) Effects of biochar compared to organic and inorganic fertilizers on soil quality and plant growth in a greenhouse experiment. Plant Nutr. Soil Sci., 175, 410–422.

Sharma,. N. K., Raman. J. Singh, and K. Kumar (2012). Dry matter accumulation and nutrient uptake by wheat (*Triticum aestivum L.*) under poplar (Populus deltoides) based agroforestry system. ISRN Agronomy.Vo1.2012

Sincik, M., A. T. Goksoy and R. Doga (2013) Responses of sunflower (*Helianthus annuus*L.) to irrigation and nitrogen fertilization rates. Zemdirbyste -Agriculture, vol. 100, No. 2, p. 151–158Taghizadeh, T.A., T.J. Clough, R.R. Sherlock and L.M. Condron. (2012). Biochar adsorbed ammonia is bioavailable. Plant Soil, 350(1-2): 57-69.

Van Reeuwijk, L. P. (2002). 'Procedures for Soil Analysis' (International Soil Reference and Information Centre (ISRIC): Wageningen.

Verheijen, F., S. Jeffery, A. Bastos, M. Van der Velde and I. Diafas.(2009). Biochar application to soils - acritical scientific review of effects on soil properties. Processes and functions, European commission joint research Centre for scientific and technical reports, pp 51-68.

Yassen, A.A; E.F. Abdallah and M.S. Gaballah.(2011) Response of sunflower plants to nitrogen fertilizers and phytohormones under drainage water irrigation. Aust. J. Basic & Appl. Sci., 5(9): 801-807

Yasin, M., A. Mahmood, A. Ali, M. Aziz, M.M. Javaid, Z. Iqbal and A. Tanveer (2013). Impact of varying planting patterns and fertilizer application strategies on autumn planted sunflower hybrid.Cercetari Agro. in Moldova 46 (2), 39-51

تأثير طرق إضافة الفحم الحيوي وسماد الدواجن علي محصول وامتصاص العناصر الغذائية لنبات دوار الشمس تحت معدلات مختلفة من السماد النيتروجيني٠

أحمد صلاح عبدالحميد[١] و كريم فكري فودة[٢]

[١] قسم علوم الأراضي – كلية الزراعة – جامعة دمياط – مصر

[٢] قسم علوم الأراضي – كلية الزراعة – جامعة المنصورة – مصر

تعتبر مصر من أكبر الدول المستوردة لزيوت الطعام في العالم وخصوصا زيت دوار الشمس٠ أقيمت تجربة حقلية لدراسة إضافة الفحم الحيوي (البيوشار) وسماد الدواجن بطريقتين (طريقة الخلط والطريقة الخطية) تحت ثلاثة معدلات من التسميد النيتروجيني (صفر ، ٤٠ ، ٦٠ كجم نيتروجين فدان$^{-1}$) علي محصول نبات دوار الشمس ومكوناته وكذلك العناصر الممتصة بواسطة الحبوب والقش٠ صممت التجربة في القطع المنشقة مرتين في ثلاثة مكررات ٠ وقد تم تقدير وقياس كلا من طول النبات (سم) و متوسط قطر الرأس (سم) و وزن البذور علي الرأس بالجرام و وزن ١٠٠٠ بذرة و قطر الساق (سم) و محصول البذور والقش (كجم فدان $^{-1}$) و النسبة المئوية للزيت ومحصول الزيت (كجم فدان $^{-1}$) و العناصر الممتصة بواسطة القش والبذور(كجم فدان $^{-1}$)٠أظهرت النتائج المتحصل عليها أن جميع الصفات السابقة ازدادت معنويا مع جميع المعاملات المستخدمة ماعدا دليل الحصاد والفوسفور الممتص بواسطة البذور فقد انخفضت مع الفحم الحيوي وسماد الدواجن٠ بالإضافة الي ذلك سجل التداخل بين الفحم الحيوي و ٤٠ كجم نيتروجين فدان $^{-1}$ أعطي أعلي قيمة لوزن ١٠٠٠ بذرة بينما أقصي قيمة لمحصول البذور (٢٢٩٦ كجم فدان$^{-1}$) وجدت مع معاملة التداخل بين الفحم الحيوي المضاف خلطا مع ٤٠ كجم نيتروجين فدان$^{-1}$ وذلك بدون فرق معنوي مع معاملة سماد الدواجن المضاف خطيا مع ٦٠ كجم نيتروجين فدان$^{-1}$ ٠ سجلت أعلي قيمة لمحصول الزيت (٩٢٧ كجم فدان $^{-1}$) مع معاملة سماد الدواجن المضاف خلطا مع التربة و ٤٠ كجم نيتروجين فدان$^{-1}$ بدون فرق معنوي مع معاملة الفحم الحيوي المضاف خطيا مع ٦٠ كجم نيتروجين فدان$^{-1}$ ٠ نستنتج من النتائج السابقة أن إضافة الفحم الحيوي وسماد الدواجن بطريقتي الخلط والطريقة الخطية أدي الي تحسين محصول الزيت والعناصر الممتصة بواسطة نبات دوار الشمس ٠