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RESPONSE OF PEANUTS TO BIOCHAR TREATMENTS AND ORGANIC FERTILIZATION UNDER SOUTH SINAI CONDITIONS.

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ABSTRACT

World is exposed to an increase in population and a shortage of arable water. So, in dry areas, at El-Tur, South Sinai, Egypt under new reclaimed conditions. Three years experiments were carried out during 2019, 2020 and 2021 summer seasons to study the response of peanuts (*Arachis hypogaea* L.) to biochar and organic fertilization treatments. Each experiment included 16 treatments which were four organic fertilization (OF) *i.e.* OF_0): without organic fertilization; OF_1): 11.905 ton/ha; OF_2): 23.810 ton/ha and OF_3): 35.714 ton/ha. and four biochar treatments (B) *i.e.* B_0): without biochar; B_1): 5.952 ton/ha; B_2): 11.905 ton/ha and B_3): 17.857 ton/ha. Results cleared that significant differences were registered between biochar and organic fertilization treatments during the three seasons in all studied traits *i.e.* leaf chlorophyll content (SPAD), fresh weight/m^2, dry weight/m^2, pods number/plant, weight of pods/plant, 100 seed, seed oil %, seed protein %, seed yield ton/ha; straw yield ton/ha, biological yield ton/ha; L.E seeds (L.E /ha), L.E straw (L.E /ha), total gain (L.E /ha), and net gain (L.E /ha).

The highest seed yield 2.045 ton/ha in the 1st season, 2.152 ton/ha in the 2nd season and 2.217 ton/ha in the 3nd one were produced from organic fertilization by 35.714 ton/ha. Results indicated significantly and steadily increases in all yield traits with adding biochar by 11.905 ton/ha. However, the economic peanuts seed and straw yields could be obtained from organic fertilization by 35.714 ton/ha and application of 11.905 ton/ha biochar under El-Tur area, South Sinai of Egypt. These findings offer an in-depth understanding of the benefits provided by biochar for developing sustainable agriculture.

Key Words: Biochar, organic fertilization, peanuts, productivity, biological, grain return.

INTRODUCTION

Peanuts (*Arachis hypogaea* L.) is nutritious, rich in protein, fibre, unsaturated fats, carbohydrate, and minerals such as calcium (Ca), phosphorus (P), vitamins E, magnesium (Mg), vitamin K and B complex **(Settaluri *et al*., 2012).** Making very lucrative cash crop, consumed as a major source of protein, used as animal feed, and an important fertilizer crop because it fixes nitrogen **(Mukuka and Shipekesa, 2013)**. However, production and yields are low **(FAOSTAT, 2019).**

Previous studies showed that biochar-based fertilizer affected the total biomass, 100-seed weight and harvest index in peanuts, and increase pod and seed **(Abbas *et al.*, 2022).** The addition of biochar combined with mineral fertilizer can improve the most growth parameters of faba bean compared to untreated soil. Also, the addition of biochar led to a significant increase in leaf number, plant height, chlorophyll content, nodule number per plant and shoot biomass **(Sisay and Abebawe 2021).** Biochar by a process called pyrolysis, is the product after any organic material is charred in the presence of limited O_2 **(Abel *et al.*, 2013).** Studies have shown that biochar as a soil amendment has unique properties which allow it to offset some climatic and soil constraints brought about by changing climate, increasing base saturation, increasing organic matter content, neutralizing acidity, sequestering carbon. Biochar can improve the fertility of soil by buffering against temperature fluctuations, increasing cation exchange capacity, improving nutrient retention and increasing moisture retention, when amended to soil **(Cornelissen *et al.*, 2013)**. Constraints affecting groundnut yield such as low soil Ca, soil acidity and exposure to prolonged dry spells have generally been investigated independently. It was found that incorporation of biochar to soils planted with groundnuts significantly increased yields. However, these soil constraints rarely occur independently. Sole and combined effects of gypsum and biochar enhanced water use efficiency, biomass dry matter of the groundnut **(Martinsen *et al.*, 2014 and Xu *et al.*, 2015).** Biochar can potentially increase soil N retention through several mechanisms: increase biological N fixation and change microbial community dynamics related to N transformation, adsorption of NO_3−, NH_4+ and organic N **(Kammann *et al.*, 2017).** Soil NH_3 volatilization is influenced by the combined effects of various factors including pH, aeration, N sources, moisture content and temperature. NH_3 volatilization was reduced by 45% from ruminant urine when biochar had been incorporated in the soil **(Mandal *et al.*, 2016).** Synergistic effects of biochar on soil emissions, NH_3 volatilization and plant N uptake are poorly documented **(Abd El-Aziz *et al.*, 2017).**

Organic fertilizers are frequently recommended firstly for improving soil fertility, from organic sources and can be used as a sole source or as a substitute for inorganic fertilizers. Increasing the yield of groundnuts by using integrated action of both chemical and bio-organic fertilizers was recommended. The composting process significantly changes the physiochemical properties *e.g.*, pH, bulk density, phosphorus ratio, nitrogen, carbon, total carbon: total nitrogen content, nitrogen ratio and plant available nitrogen of organic wastes. Nitrogen mineralization is controlled by compost properties including organic carbon content, C:N, total nitrogen and plant available nitrogen; soil moisture; microbial activity and soil texture **(Cabrera *et al.*, 2005)** to increase soil phosphorus content and plant

available phosphorus **(Eghball *et al.*, 2002).** Groundnut like other legumes forms symbiosis relationship with rhizobia. Results of field trials showed that the un-inoculated peanut had the least nodulation status, N2-ase activity. Inoculation of peanut seeds with bradyrhizobium exerted considerable improvement in number and mass of root nodules, increased the rate of acetylene reduction and all growth characters with combining ¼ recommended dose of NPK with ¾ FYM and bio-fertilizer microbein resulted in the highest seed & pod yield, oil and protein content in poor sandy soils **(Sujanya and Chandra 2011).** Moreover, **Sulfab *et al.*, (2011)** showed that either organic manure alone or with Rhizobium inoculation plus 20 kg N ha^{-1} significantly increased groundnuts nodulation and early pod formation over the control. Besides that urea and organic fertilizers significantly increased most of the yield parameters of faba bean crop compared to the unfertilized control **(Mahrous *et al.*, 2015).** The aim of the present research was to increase the productivity of peanuts by using organic fertilizer and biochar to increase the fertility of new lands and improve soil structure.

MATERIALS AND METHODS

Field Experiments: Three field experiments were carried out at the Agricultural Experiments Desert Station, Desert Research center, El-Tur area, South Sinai, Egypt, during the three successive summer seasons of 2019, 2020 and 2021 under drip irrigation system. The experimental site located between 28°21' 11" and 28°21 '12 " N and between 33°38' 40" and 33°21' 12" E with an altitude of 60 meters above sea level. The objective was to study the effect of organic fertilization and biochar treatments on Giza-6 peanuts cultivar.

1. Organic Fertilization.

Four Organic Fertilization (OF) *i.e*. OF_0): without Organic Fertilization; OF_1): 11.905 ton/ha; OF_2): 23.810 ton/ha and OF_3): 35.714 ton/ha.

2. Biochar treatments.

Four Biochar treatments (B) treatments *i.e*. B_0): without Biochar; B_1): 5.952 ton/ha; B_2): 11.905 ton/ha and B_3): 17.857 ton/ha, were tried on peanuts (Giza-6) which obtained from Research Section, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt. The experiments were designed in a split plot design with four replicates, which included 16 treatments as the combinations between four organic fertilization treatments and four biochar treatments. The sub plot area was 10.5 m^2.

3.Growth traits

A- After 90 days from sowing, one square meter was randomly chosen from each sub plot to estimate:

1- Chlorophyll content (SPAD) total chlorophyll in leaf, was estimated in leaf of ten plants using Minolta camera in SPAD.502 value and the average was calculated.

2- Fresh weight (g) of shoots/m^2.
3- Dry weight (g) of shoots/m^2.

B. At 150 days from sowing, ten guarded plants were chosen from each sub plot and the following characters were estimated:

1- Weight of pods/plant (g)
2- Weight 100 seeds (g),was obtained from the weight of 100 kernels taken at random from each sub plot.
3- Pods number/plant, an average of ten random plants.
4- Seed protein (%);
- One square meter, was randomly chosen from each sub plot and the following characters were estimated:
5- Seeds yield ton/ha; the obtained seeds from each square meter of each sub plot were air dried, then threshed and the grains at 13% moisture were weighed in kg and converted to ton/ha.
6- Straw yield ton/ha, it was estimated by weighing the straw yield
7- Biological yield ton/ha; was determined by weighing plants found in the chosen square meter and converted to ton/ha.

C- Economic evaluation (Table 1)

1- Total gain (LE/ ha.) = seeds yield x price + straw yield x price.
2- Net return (LE/ ha.) = Total gain – costs.
3- The costs data included costs of all farm inputs, labor and farm machinery. Price of peanuts seeds (ton) was 15000 LE. Whereas the price of straw was (ton) = 500 LE.
4- Total costs LE/ha

Table 1: Total costs LE/ha of Organic Fertilization and Biochar.

Treatment	without organic fertilization	11.905 ton/ha organic fertilization	23.810 ton/ha organic fertilization	35.714 ton/ha organic fertilization
without biochar	1667 LE	2857 LE	4048 LE	5238 LE
5.952 ton/ha biochar	3651 LE	4841 LE	6032 LE	7222 LE
11.905 ton/ha biochar	5635 LE	6826 LE	8016 LE	9206 LE
17.857 ton/ha biochar	7619 LE	8810 LE	10000 LE	11190 LE

*** Costs of seeds, tillage and chemicals (1667 LE/ha), organic fertilization (100 LE/ton) and biochar (333 LE/ton).**

4. Soil conditions and agronomic managements

The experiments were carried out during 2019, 2020 and 2021 summer growing seasons at El-Tur area, South Sinai of Egypt, it was located 15 km west of El-Tur city at the (28◦21′ 11″ N, 33◦38′ 41″ E).

Soil samples were taken before sowing to a depth of 0-30 cm and were subjected to physical and chemical analyses by Auger, as shown in Table (2). The experimental field was well prepared through two plowings, compaction division and then divided into experimental units with dimensions as previously mentioned. Calcium superphosphate (15.5% P_2O_5) was applied during soil preparation at the rate of 74 kg P_2O_5 /ha. Before sowing, potassium sulphate (48% k_2O) at the rate of 115 kg k_2O/ha was broadcasted. The rate of 75 kg N/ha was applied at three equal doses prior

irrigation at 25, 50 and 75 days after sowing. The common agricultural practices for growing peanuts were followed according to the recommendations of Ministry of Agriculture.

Meteorological data were obtained from Meteorological station situated in El-Tur area, South Sinai station Desert Research Center in three seasons as presented in Fig. (1). The irrigation water in three seasons was analyzed for pH, EC, cations and anions as shown in Table (2).

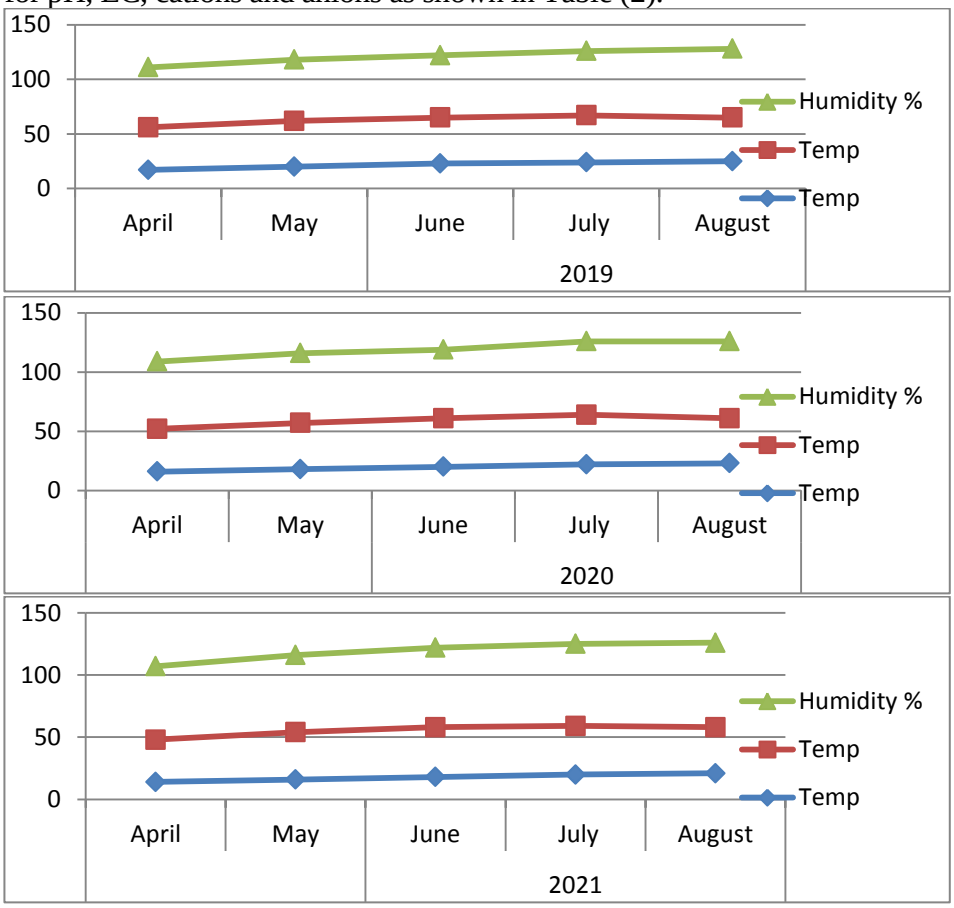

Fig 1: Meteorological parameters of El-Tur area, South Sinai of Egypt. Station, Desert Res in 2019, 2020 and 2021 growing seasons.

Statistical analysis

The obtained data were subjected to statistical analysis using the analysis of variance (ANOVA) for the split plot design as described by **Gomez and Gomez (1984).** Analyses were conducted by the software of SPSS 20.0. Statistical significance was determined when *P < 0.05 and **P < 0.01, respectively.

Table 2: The mean chemical and physical properties of representative soil samples (0-30 cm depth) in the experimental site before sowing and of the irrigation water for the three growing seasons.

Soil property	Value	Irrigation Water	Value
Clay	3.6	pH	6.74
Silt	8.3	EC (dS m^{-1})	0.63
Sand	87.1	Aminouim N (mg L^{-1})	5.64
Texture Grade	Sandy	Nitrate N (mg L^{-1})	22.3
pH (Ext. 1:1)	7.32	Phosphorus (mg L^{-1})	0.08
EC (Ext. 1:1), dS m^{-1}	0.64	Potassium (mg L^{-1})	0.67
Total $CaCO_3$ (%)	33.2		
Total Organic Carbon (%)	0.25		
Total Organic Matter (%)	0.423		
Nitrogen (mg kg^{-1})	17.2		
Phosphorus (mg kg^{-1})	1.58		
Potassium (mg kg^{-1})	45.7		

RESULTS AND DISCUSSION

It is evident from the results of peanuts seed yield and its attributes in the three growing seasons that the results of the third season surpassed that of the first and the second one. These results could be explained that the environmental condition of the third season were more suitable for growing peanuts compared to the first and second season.

1. Effects of organic fertilization treatments on yield traits of peanuts.

The results of analysis of variance ANOVA revealed significant or highly variation between organic fertilization treatments during the three seasons in peanuts of all 15 tested traits.

Effects of organic fertilization treatments on leaf chlorophyll content, fresh weight, dry weight, pods number/plant, weight of pods/plant, 100 seed, seed oil %, seed protein %, are presented in Table (3). Results of statistical analysis of variance revealed significant or highly significant differences between organic fertilization treatments during the three seasons of peanuts for above mentioned traits.

Results indicated that increasing organic fertilization from OF_0, OF_1, OF_2 and OF_3 significantly and gradually increased leaf chlorophyll content from 29.25, 30.12, 30.94 to 31.75 in the first season; from 30.81, 31.81, 32.75 to 33.62 in the second season and from 31.81, 32.81, 33.75 to 34.62 in the third one; fresh weight g/m^2 from 171, 175, 181 to 186 in the first season; from 179, 185, 190 to 196 in the second season and from 185, 190, 196 to 201 in the third one; dry weight g/m^2 from 101, 105, 107 to 111 in the first season, from 107, 110, 113 to 117 in the second season and from 110, 113, 116 to 120 in the third one; pods number/plant from 29, 30, 31 to 32 in the first season, from 31, 31, 32 to 33 in the second season and from 32, 33, 33 to 34 in the third one; weight of pods/plant from 38.13, 39.06, 40.75 to

41.63 in the first season, from 40.13, 41.06, 42.75 to 43.69 in the second season and from 41.13, 42.06, 43.81 to 44.75 in the third one; 100 seed weight from 43.50, 44.75, 46.13 to 47.31 in the first season; from 45.63, 47.00, 48.44 to 49.81 in the second season and from 46.81, 48.31, 49.81 to 51.31 in the third one; seed oil % from 44.00, 45.31, 46.56 to 47.88 in the first season, from 46.06, 47.50, 48.94 to 50.31 in the second season and from 47.25, 48.81, 50.31 to 51.94 in the third one; seed protein % from 21.25, 22.09, 22.53 to 22.93 in the first season, from 22.38, 23.25, 23.71 to 24.14 in the second season and from 23.06, 23.95, 24.42 to 24.86 in the third one. Such increases could be due to role of organic fertilization on physiochemical properties *i.e.* pH, bulk density, phosphorus ratio, nitrogen, carbon, total carbon: total nitrogen content, available nitrogen, soil moisture, microbial activity and soil texture **(Cabrera *et al.*, 2005)**, and to increase soil phosphorus content and available phosphorus (**Eghball *et al.*, 2004)**. Similar results were also found by many investigators **(Mahrous *et al.*, 2015 ; Guangcai *et al.*, 2018 and Fahreza *et al.*, 2019)**.

Table 3: Performance of Organic Fertilization (OF) concerning yield attributes of peanuts during the 2019, 2020 and 2021 seasons.

Organic Fertilization (OF)	chlorophyll content (SPAD)	Fresh weight (g)	Dry weight (g)	Pods number/ Plant	Weight of pods/ plant (g)	100 seeds (g)	Seed oil (%)	Seed protein (%)
	2019							
OF_0): without Organic	29.25	171	101	29	38.13	43.50	44.00	21.25
OF_1): 11.905 ton/ha	30.12	175	105	30	39.06	44.75	45.31	22.09
OF_2): 23.810 ton/ha	30.94	181	107	31	40.75	46.13	46.56	22.53
OF_3): 35.714 ton/ha	31.75	186	111	32	41.63	47.31	47.88	22.93
F. test	*	**	**	*	*	*	*	*
	2020							
OF_0): without Organic	30.81	179	107	31	40.13	45.63	46.06	22.38
OF_1): 11.905 ton/ha	31.81	185	110	31	41.06	47.00	47.50	23.25
OF_2): 23.810 ton/ha	32.75	190	113	32	42.75	48.44	48.94	23.71
OF_3): 35.714 ton/ha	33.62	196	117	33	43.69	49.81	50.31	24.14
F. test	*	**	**	*	*	*	*	*
	2021							
OF_0): without Organic	31.81	185	110	32	41.13	46.81	47.25	23.06
OF_1): 11.905 ton/ha	32.81	190	113	33	42.06	48.31	48.81	23.95
OF_2): 23.810 ton/ha	33.75	196	116	33	43.81	49.81	50.31	24.42
OF_3): 35.714 ton/ha	34.62	201	120	34	44.75	51.31	51.94	24.86
F. test	*	**	**	*	*	*	*	*

**** and * : Significant at 0.01 and 0.05 levels of probability, respectively. N.S: not significant.**

Effects of organic fertilization treatments on seed yield ton/ha, straw yield ton/ha, biological yield ton/ha, L.E seeds (L.E /ha), L.E straw (L.E /ha), total gain (L.E /ha), and net gain (L.E /ha) are presorted in Table (4). Results of statistical analysis of variance revealed significant or highly significant differences between organic fertilization treatments during the three seasons of peanuts for above mentioned traits.

Results indicated that increasing organic fertilization from OF_0, OF_1, OF_2 and OF_3 significantly and regularly increased seed yield ton/ha from 1.387, 1.442, 1.498 to 1.553 in the first season; from 1.460, 1.518, 1.576 to 1.635 in the second one and from 1.503, 1.563, 1.624 to 1.684 in the third season; straw yield ton/ha from 1.999, 2.078, 2.155 to 2.211 in the first season, from 2.105, 2.187, 2.269 to 2.328 in the second one and from 2.168, 2.252, 2.337 to 2.397 in the third season; biological yield ton/ha from 2.773, 2.885, 2.995 to 3.107 in the first season; from 3.564, 3.705, 3.845 to 3.962 in the second one and from 3.008, 3.127, 3.247 to 3.367 in the third season; L.E seeds (L.E /ha) from 20799, 21630, 22465 to 23294 in the first season; from 21893, 22768, 23648 to 24520 in the second one and from 22550, 23451, 24357 to 25256 in the third season; L.E straw (L.E /ha) from 1000, 1039, 1078 to 1106 in the first season; from 1052, 1093, 1134 to 1164 in the second one and from 1084, 1126, 1168 to 1199 in the third season; total gain (L.E /ha) from 21798, 22668, 23543 to 24400 in the first season; from 22946, 23862, 24782 to 25684 in the second one and from 23634, 24577, 25525 to 26455 in the third season and net gain (L.E /ha) from 18303, 18028, 17758 to 17470 in the first season, from 18991, 18744, 18501 to 18241 in the second one and from 17155, 16835, 16519 to 16186 in the third season. Harmony findings were observed by **Gebremedhin *et al.*, (2015) and Guangcai *et al.*, (2018)**. They showed an improvement in the yield traits by adding organic fertilizer to peanut.

Table 4: Performance of Organic Fertilization (OF) concerning yield attributes of peanuts during the 2019, 2020 and 2021 seasons.

Organic Fertilization (OF)	Seed Yield (ton/ha)	Straw Yield (ton/ha)	Biological Yield (ton/ha)	L.E Seeds (L.E /ha)	L.E Straw (L.E /ha)	L.E Total (L.E /ha)	Net Gain (L.E /ha)
	2019						
OF_0): without OF	1.387	1.999	2.773	20799	1000	21798	18303
OF_1): 11.905 ton/ha	1.442	2.078	2.885	21630	1039	22668	18028
OF_2): 23.810 ton/ha	1.498	2.155	2.995	22465	1078	23543	17758
OF_3): 35.714 ton/ha	1.553	2.211	3.107	23294	1106	24400	17470
F. test	**	**	**	**	**	**	**
	2020						
OF_0): without OF	1.460	2.105	3.564	21893	1052	22946	18991
OF_1): 11.905 ton/ha	1.518	2.187	3.705	22768	1093	23862	18744
OF_2): 23.810 ton/ha	1.576	2.269	3.845	23648	1134	24782	18501
OF_3): 35.714 ton/ha	1.635	2.328	3.962	24520	1164	25684	18241
F. test	**	**	**	**	**	**	**
	2020						
OF_0): without OF	1.503	2.168	3.008	22550	1084	23634	17155
OF_1): 11.905 ton/ha	1.563	2.252	3.127	23451	1126	24577	16835
OF_2): 23.810 ton/ha	1.624	2.337	3.247	24357	1168	25525	16519
OF_3): 35.714 ton/ha	1.684	2.397	3.367	25256	1199	26455	16186
F. test	**	**	**	**	**	**	**

**** and * : Significant at 0.01 and 0.05 levels of probability, respectively. N.S: not significant.**

2. Effects of Biochar treatments on yield traits of peanuts.

Effects of biochar treatments on leaf chlorophyll content, dry weight, fresh weight, pods number/plant, weight of pods/plant, 100 seed, seed oil %, seed protein % are presorted in Table (5). Results revealed significant or highly significant variances between biochar treatments during the three seasons of peanuts for aforesaid traits.

Results indicated significantly and gradually increase of all yield attributes traits with increasing biochar from B_0, B_1 to B_2, then decreased in B_3 as follow, leaf chlorophyll content from 28.31, 29.81 32.38 then decreased to be 31.56 in the first season; from 29.63, 31.50, 34.38 to 33.50 in the second one; from 30.63, 32.50, 35.38 to 34.50 in the third season; fresh weight from 154, 170, 201 to 188 in the first season, from 162, 179, 211 to 197 in the second one and from 167, 185, 217 to 203 in the third season; dry weight g/m^2 from 89, 101, 121 to 113 in the first season, from 94, 106, 128 to 119 in the second one and from 97, 106, 132 to 122 in the third season; pods number/plant from increased from 26, 29, 34 to 32 in the first season, from 28, 31, 36 to 33 in the second one and from 29, 32, 37 to 35 in the third season; weight of pods/plant from 35.06, 38.44, 43.94 to 42.13 in the first season, from 37.06, 40.44, 46.00 to 44.13 in the second one and from 38.06, 41.44, 47.13 to 45.13 in the third season; 100 seed weight from 41.19, 43.94, 49.50 to 47.06 in the first season, from 43.19, 46.00, 52.25 to be 49.44 in the second one and from 44.19, 47.13, 54.00 to 50.94 in the third season; seed oil % from 43.06, 44.88, 48.75 to 47.06 in the first season, from 45.06, 47.00, 51.31 to 49.44% in the second one and from 46.13, 48.19, 53.06% to 50.94 in the third season as well as seed protein % from 20.09, 21.89, 23.97 to 22.84% in the first season, from 21.16, 23.04, 25.24 to 24.05% in the second one and from 21.78, 23.73 to 26.00 then decreased to be 24.78 in the third season at B_0, B_1 to B_2 and B_3, respectively. Agreement findings were observed by **Rui1 *et al.*, (2016) ; Fahreza *et al.*, (2019) and Guangcai *et al.*, (2018).**

B. Effect of Biochar:

Table 5: Performance of Biochar (B) concerning yield attributes of peanuts during the 2019, 2020 and 2021 seasons.

Biochar (B)	Chlorophyll Content (SPAD)	Fresh Weight (g)	Dry Weight (g)	Pods Number/ Plant	Weight of Pods/ Plant (g)	Weight 100 seeds (g)	Seed Oil (%)	Seed Protein (%)
	2019							
B_0): without Biochar	28.31	154	89	26	35.06	41.19	43.06	20.09
B_1): 5.952 ton/ha	29.81	170	101	29	38.44	43.94	44.88	21.89
B_2): 11.905 ton/ha	32.38	201	121	34	43.94	49.50	48.75	23.97
B_3): 17.857 ton/ha.	31.56	188	113	32	42.13	47.06	47.06	22.84
F. test	*	**	**	*	*	**	**	*
	2020							
B_0): without Biochar	29.63	162	94	28	37.06	43.19	45.06	21.16
B_1): 5.952 ton/ha	31.50	179	106	31	40.44	46.00	47.00	23.04
B_2): 11.905 ton/ha	34.38	211	128	36	46.00	52.25	51.31	25.24
B_3): 17.857 ton/ha.	33.50	197	119	33	44.13	49.44	49.44	24.05
F. test	*	**	**	*	*	**	**	*
	2020							
B_0): without Biochar	30.63	167	97	29	38.06	44.19	46.13	21.78
B_1): 5.952 ton/ha	32.50	185	106	32	41.44	47.13	48.19	23.73
B_2): 11.905 ton/ha	35.38	217	132	37	47.13	54.00	53.06	26.00
B_3): 17.857 ton/ha.	34.50	203	122	35	45.13	50.94	50.94	24.78
F. test	**	**	**	**	**	**	**	*

**** and * : Significant at 0.01 and 0.05 levels of probability, respectively. N.S: not significant.**

As given in Table (6) results indicated significantly and steadily increases in all yield traits with increasing biochar from B_0, B_1 to B_2, then decreased in B_3 as follow, seed yield ton/ha from 0.934, 1.464, 1.936 to 1.545 in the first season, from 0.983, 1.541, 2.038 to 1.626 in the second one and from 1.013, 1.588, 2.099 to 1.675 in the third season; straw yield ton/ha from 1.622, 2.012, 2.787 to 2.022 in the first season, from 1.707, 2.118, 2.934 to 2.129 in the second one and from 1.758, 2.182, 3.022 to 2.193 in the third season; biological yield ton/ha from 1.869, 2.930, 3.871 to 3.090 in the first season, from 2.690, 3.660, 4.972 to 3.755 in the second one and from 2.027, 3.174, 4.198 to 3.351 in the third season; L.E seeds (L.E /ha) from 14012, 21966, 29037 to 23172 in the first season, from 14750, 23123, 30565 to 24392 in the second one and from 15192, 23816, 31482 to 25124 in the third season; L.E straw (L.E /ha) from 811, 1006, 1394 to 1011 in the first season, from 854, 1059, 1467 to 1064 in the second one and from 879, 1091, 1511 to 1096 in the third season; total gain (L.E /ha) from 14823, 22972, 30431 to 24184 in the first season, from 15604, 24182, 32033 to 25457 in the second one and from 16071, 24907, 32993 to 26220 in the third season and net gain (L.E /ha) from 12151, 18745, 24612 to 16052 in the first season, from 12619, 19470, 25572 to 16815 in the second one and significantly and gradually increased net gain from 11371, 17536 to 23010 then decreased to be 14779 in the third one at B_0, B_1 to B_2 and B_3, respectively. These results are in the same trend with those obtained by **Julia *et al.*, (2010) and Gebremedhin *et al.*, (2015)**.

Table 6: Performance of Biochar (B) concerning yield attributes of peanuts during the 2019, 2020 and 2021 seasons.

Biochar (B)	Seeds (ton/ha)	Straw (ton/ha)	Biological (ton/ha)	L.E Seeds (L.E /ha)	L.E Straw (L.E /ha)	L.E Total (L.E /ha)	Net Gain (L.E /ha)
	2019						
B_0): without Biochar	0.934	1.622	1.869	14012	811	14823	12151
B_1): 5.952 ton/ha	1.464	2.012	2.930	21966	1006	22972	18745
B_2): 11.905 ton/ha	1.936	2.787	3.871	29037	1394	30431	24612
B_3): 17.857 ton/ha.	1.545	2.022	3.090	23172	1011	24184	16052
F. test	**	**	**	**	**	**	**
	2020						
B_0): without Biochar	0.983	1.707	2.690	14750	854	15604	12619
B_1): 5.952 ton/ha	1.541	2.118	3.660	23123	1059	24182	19470
B_2): 11.905 ton/ha	2.038	2.934	4.972	30565	1467	32033	25572
B_3): 17.857 ton/ha.	1.626	2.129	3.755	24392	1064	25457	16815
F. test	**	**	**	**	**	**	**
	2021						
B_0): without Biochar	1.013	1.758	2.027	15192	879	16071	11371
B_1): 5.952 ton/ha	1.588	2.182	3.174	23816	1091	24907	17536
B_2): 11.905 ton/ha	2.099	3.022	4.198	31482	1511	32993	23010
B_3): 17.857 ton/ha.	1.675	2.193	3.351	25124	1096	26220	14779
F. test	**	**	**	**	**	**	**

**** and * : Significant at 0.01 and 0.05 levels of probability, respectively. N.S: not significant.**

3. Effects of interactions between organic fertilization and biochar treatments on peanuts traits.

The results in Table (7) indicated that interactions between organic fertilization and biochar treatments showed highly significant effect on the tested traits.

In general, the highest estimate 2.217 ton/ha of seed yield and 3.122 ton /ha of straw yield were obtained from the interaction between (OF3 and B2) in the third season as well as 5.183 ton /ha for biological yield from (OF3 and B2) in the second season. Similar conclusion was also found by **Gebremedhin *et al.*, (2015) and Abd El-Aziz *et al.*, (2017**).

C. Effect of interactions:

Table 7: Grain, straw and biological yields of peanuts as affected by the interaction between Organic Fertilization and Biochar during the 2019, 2020 and 2021 seasons.

Organic		Seeds yield (ton/ha)			Straw yield (ton/ha)			Biolog. yield (ton/ha)		
Fertilization	Biochar	2019	2020	2021	2019	2020	2021	2019	2020	2021
	B_0	0.882	0.928	0.956	1.552	1.633	1.682	1.764	2.561	1.916
	B_1	1.381	1.454	1.498	1.835	1.932	1.990	2.761	3.386	2.995
OF_0	B_2	1.826	1.922	1.980	2.651	2.790	2.874	3.651	4.712	3.960
	B_3	1.457	1.534	1.580	1.960	2.063	2.125	2.915	3.597	3.160
	F. test	**	**	**	**	**	**	**	**	**
	B_0	0.916	0.964	0.993	1.524	1.604	1.652	1.834	2.568	1.986
	B_1	1.437	1.512	1.557	1.998	2.103	2.166	2.877	3.615	3.115
OF_1	B_2	1.899	1.999	2.059	2.846	2.996	3.086	3.800	4.995	4.119
	B_3	1.515	1.595	1.643	1.942	2.045	2.106	3.030	3.639	3.288
	F. test	**	**	**	**	**	**	**	**	**
	B_0	0.952	1.002	1.032	1.765	1.858	1.913	1.902	2.859	2.064
	B_1	1.492	1.570	1.617	2.071	2.180	2.245	2.984	3.750	3.232
OF_2	B_2	1.973	2.076	2.139	2.773	2.919	3.006	3.945	4.995	4.276
	B_3	1.574	1.657	1.707	2.014	2.120	2.184	3.147	3.777	3.414
	F. test	**	**	**	**	**	**	**	**	**
	B_0	0.987	1.039	1.070	1.648	1.734	1.786	1.974	2.773	2.140
	B_1	1.547	1.629	1.678	2.145	2.258	2.326	3.095	3.887	3.353
OF_3	B_2	2.045	2.152	2.217	2.879	3.031	3.122	4.090	5.183	4.435
	B_3	1.633	1.718	1.770	2.173	2.288	2.357	3.268	4.007	3.540
	F. test	**	**	**	**	**	**	**	**	**

**** and * : Significant at 0.01 and0.05 levels of probability, respectively. N.S: not significant.**

The results in Table (8) indicated that the highest values of seed return (33256 L.E /ha) of straw return (1561 L.E /ha) and net gain (25611 L.E /ha) were recorded from the interaction between OF3 and B2. Harmony findings were observed by **El-Metwally *et al.*, (2010) ; Abd El-Aziz *et al.*, (2018) and Abd El-Aziz and El Sahed, (2021)**.

Table 8: Grain Return (L.E /ha), straw Return (L.E /ha) and Net gain (L.E /ha) of peanuts as affected by the interaction between Organic Fertilization and Biochar during the 2019, 2020 and 2021 seasons.

Organic Fertilization	Biochar	Seeds Return (L.E /ha)			Straw Return (L.E /ha)			Net gain (L.E /ha)		
		2019	2020	2021	2019	2020	2021	2019	2020	2021
	B_0	13224	13920	14338	776	817	841	12333	13070	13512
	B_1	20720	21810	22464	918	966	995	17987	19125	19808
OF_0	B_2	27392	28834	29698	1325	1395	1437	23082	24594	25500
	B_3	21860	23010	23700	980	1032	1063	15221	16423	17144
	F. test	**	**	**	**	**	**	**	**	**
	B_0	13744	14468	14902	762	802	826	11649	12413	12871
	B_1	21553	22687	23368	999	1052	1083	17711	18898	19610
OF_1	B_2	28493	29993	30892	1423	1498	1543	23090	24665	25609
	B_3	22729	23925	24643	971	1022	1053	14890	16137	16886
	F. test	**	**	**	**	**	**	**	**	**
	B_0	14279	15030	15481	883	929	957	11114	11911	12390
	B_1	22380	23558	24265	1035	1090	1122	17383	18616	19355
OF_2	B_2	29590	31148	32082	1387	1459	1503	22961	24591	25569
	B_3	23613	24855	25601	1007	1060	1092	14620	15915	16693
	F. test	**	**	**	**	**	**	**	**	**
	B_0	14802	15581	16049	824	867	893	10388	11210	11704
	B_1	23213	24435	25168	1073	1129	1163	17064	18342	19109
OF_3	B_2	30674	32288	33256	1440	1515	1561	22908	24597	25611
	B_3	24489	25778	26551	1087	1144	1179	14386	15732	16540
	F. test	**	**	**	**	**	**	**	**	**

**** and * : Significant at 0.01 and 0.05 levels of probability, respectively. N.S: not significant.**

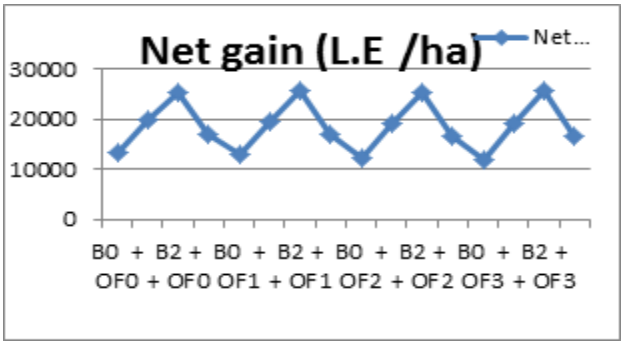

Fig 2: Net gain (L.E /ha) of peanuts as affected by the interaction between Organic Fertilization and Biochar.

CONCLUSION

The Tur Sinai region is considered one of the very dry areas, where the annual rainfall rate does not exceed 20 mm per year, and this rate is not sufficient for any agricultural activity. It was necessary to rely on groundwater whose is 300 ppm to grow peanuts. It could be concluded that organic fertilization 35.714 ton/ha and application of 11.905 ton/ha biochar produced the most economical peanuts production under drought soil condition in El-Tur area, South Sinai region, Egypt.

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إستجابة الفول السودانى لمعاملات البيوشار والتسميد العضوى تحت ظروف جنوب سيناء

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يتعرض العالم لزيادة في عدد السكان ونقص في المياه الصالحة للزراعة بالمناطق الجافة، وقد أجريت ثلاث تجارب خلال الموسم الصيفى لاعوام 2019 و 2020 و 2021 بمنطقة الطور بجنوب سيناء لدراسة استجابة الفول السودانى لمعاملات البيوشار اشتملت كل تجربة على 16

معاملة والتي كانت أربعة معاملات تسميد عضوي (بدون تسميد عضوي ' 11.905 طن / هكتار '23.810 طن / هكتار ' 35.714 طن/هكتار)، وأربع معدلات من البيوشار (بدون بيوشار، 5.952 طن/هكتار، 11.905 طن/هكتار ، 17.857 طن/هكتار) فى اربعة مكررات.

أظهرت النتائج وجود فروق معنوية بين معاملات التسميد العضوي والبيوشار للفول السوداني في الثلاثة مواسم في صفات الوزن الجاف، الوزن الطازج، محتوى الكلوروفيل، عدد القرون / النبات، وزن القرون / نبات، وزن 100 بذرة، نسبة الزيت فى البذور (٪)، عدد الأوراق، نسبة البروتين فى البذور (٪)، وزن البذور طن / هكتار، وزن القش طن / هكتار، الوزن البيولوجي طن / هكتار، دليل المحصول (٪)، ايرادات البذور جنيهاً مصرياً / هكتار ؛ ايرادات القش (جنيه / هكتار) ؛ المكسب الكلي (جنيه / هكتار) ؛ صافي الربح (جنيه / هكتار).

أمكن الحصول على أعلى محصول للبذور 2.045 طن / هكتار في الموسم الأول ، 2.152 طن / هكتار في الموسم الثاني و 2.217 طن / هكتار في الموسم الثالث عند استخدام التسميد العضوي بمعدل 35.714 طن / هكتار مع في الثلاثة مواسم. وأشارت النتائج إلى تحقيق زيادات معنوية في المحصول ومساهماته مع معاملة البيوشار حتي 11.905 طن / هكتار. ومع ذلك ، يمكن الحصول على أعلي محصول بذور الفول السوداني والقش واعلي عائد من استخدام التسميد العضوي للفول السوداني بمعدل 35.714 طن / هكتار وإضافة 11.905 طن / البيوشار في منطقة الطور ، جنوب سيناء، مصر. توفر هذه النتائج فهمًا متعمقًا للفوائد التى تُسهم في تطوير الزراعة المستدامة.