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Effect of Charcoal and Meniral Fertilizer Levels on Growth and Yield of Peas *(Pisum sativum* L.*)* under Sandy Soil Conditions

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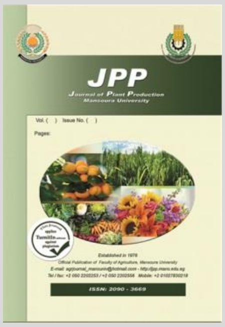
Helmy, M. M. and E. E. M. Ismail*

Veg. Res. Dept., Hort. Inst., Agric. Res. Center, Giza.



ABSTRACT

Two field experiments were carried out during winter seasons of 2017 and 2018, at the Experimental Farm of El Kassasein Horticultural Research Station, Ismailia Governorate, Egypt, to study the effect of NPK levels (50, 75 and 100 % of recommended dose) and charcoal levels (without (control), 500, 1000 and 1500 kg/fed.) on growth, yield and its components and seed chemical constituents of pea cv. Master B grown under sandy soil conditions. Results indicated that increasing NPK fertilizer levels up to 100% recommended dose cause a significant increases in plant growth (plant height, number of branches/plant and number leaves/plant), yield and its components (pod length, number of seeds/pod, weight of 100 seeds and green pods yield/fed) and seed chemical constituents, *i.e.*, N, P, K and protein percentage. Treated plants by using charcoal at 1500 kg / feddan gave the highest values of vegetative growth parameters, yield and its components and seed chemical constituents, *i.e.*, N, P, K and protein percentage. Fertilizing pea plants with 100% NPK and application of 1500 kg/fed charcoal gave the highest values of plant growth parameters, yield and its componen and seed chemical constituents, i.e., N, P, K and protein percentage. Application of 75% NPK and Treated plants by using charcoal at 1500 kg / feddan gave higher values of plant growth and green pod yield per feddan as compared to 100% NPK alone (control) without significant difference between both treatments.

Keywords: Charcoal - NPK fertilizer- Pea – Yield.

INTRODUCTION

Pea (*Pisum sativum* L.) is a very popular vegetable crop and is considered one of the most important legume crops in Egypt for local consumption and exportation. This crop is widely used as a source of protein in human diets due to its high content of protein, ascorbic acid, carbohydrates, balanced amino acids composition and good digestibility. In general, this crop gives high yield and ensures high profits, especially when cultivated for green pods. Therefore, it occupies a prominent position among other legumes in the Egyptian agriculture.

Many investigators reported that increasing NPK fertilizer levels increased vegetative growth characters, yield and its components and seed chemical composition of peas, (Patel *et al.,* 1998; Kakar *et al.*, 2002; Mishra *et al.* 2010; Dawa *et al.*,2013 and Abou El -Salehein *et al.*, 2019) on pea, (El-Bassiony *et al.,* 2010 and El-Awadi *et al.,* 2011) on snap bean.

Fertilizers being vital agriculture input the continues increase in the people population but the main drawbacks by the use and manufacture of chemical viz., energy crisis and unavailability of indigenous effect of chemical fertilizers on our health and environment. All these things have led to research of alternative renewable sources of nutrient for crops . One of these organic sources is charcoal, it call also biochar. What is biochar? biochar is a carbon-rich material obtained from thermochemical conversion (slow, intermediate, and fast pyrolysis or gasification) of biomass in an oxygen-limited environment.

It can be produced from a range of feedstock, including forest and agriculture residues, such as straw, nut shells, rice hulls, wood chips/pellets, tree bark, and switch grass Sohi *et al.* (2009). Biochar has been described as a possible tool for soil fertility improvement, potential toxic element adsorption, and climate change mitigation (Ennis *et al*., 2012 and Stewart *et al.*, 2013). Biochar is an organic amendment produced by the process called pyrolysis, which is the burning of plant biomass in a limited oxygen environment. Researches on field crops production system have shown promising results with biochar treatment, but the research on vegetables is scarce. Biocharhas been found to reduce fertilizers need, and to maintain or improve crop productivity. Moreover, biochar addition to mineral fertilizers significantly increased plant growth, compared to mineral fertilizer alone (Schulz and Glaser,2012; Biederman and Harpole, 2013;Crane-Droesh *et al.*, 2013 and Youseef *et al.*,2017*),* and also improve the water availability and retention properties of both sandy and clay soils (Jha *et al.,* 2010; Jeffery *et al.,* 2011 and Sun and Lu, 2014). In addition, biochar can be used for enhancing soil water storage which may increase crop productivity. In this respect, using biochar with tomato positively enhanced plant height and leaf size (Graber *et al.,* 2010). Furthermore, addition of biochar increased the soil moisture contents, which consequently improved physiology yield, and quality of tomato, as compared with the non biochar applications (Akhtar *et al.,* 2014). Biochar increased the final biomass, root biomass, plant height and number of leaves of lettuce and cabbage plants (Carter *et*

* **Corresponding author.**
E-mail address: ismaileltamemy@gmail.com
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al., 2013). Biochar improves fertility of the soil, improvenutrient and water use efficiencies and also has the potential to mitigate climate change by sequestering carbon into soils (Hale, 2014).

MATERIALS AND METHODS

Two field experiments were carried out during winter season of 2017 and 2018, at the Experimental Farm of El Kassasein Horticultural Research Station, Ismailia Governorate, Egypt to study the effect of charcoal and mineral fertilizer levels on growth, seed chemical constituents, and yield and its components of pea cv. Master B grown under sandy soil conditions.

The physical and chemical properties of soil are shown in Table 1.

Table 1. The physical and chemical properties of the used soil in the two seasons.

Properties	First season	Second season
1- Physical analyses		
Sand (%)	87.13	87.02
Silt (%)	7.24	7.42
Clay (%)	5.63	5.56
Soil texture	Sandy	Sandy
Available water (%)	5	5
Saturation (capacity) percent (%)	25	25
Field capacity %	11	11
Wilting coefficient (point) (%)	6	6
Organic matter (OM) (%)	0.01	0.03
2- Chemical properties :		
EC dS_m^{-1}	1.6	1.5
pH	7.08	7.09
Cations (meq/l) :		
Ca^{2+}	5.7	5.4
Mg^{2+}	2.6	2.6
Na^{+}	7.0	7.02
K^{+}	0.8	0.7
Anions (meq/l) :		
Cl^{-}	7.6	7.4
CO_3^{2-}	0	0
HCO_3	2.8	2.9
SO_4^{2-}	5.6	5.1
3-2- Available elements :		
Nitrogen (mg/kg)	7.1	7.3
Phosphorus (mg/kg)	2.1	2.8
Potassium (mg/kg)	13.4	13.9

1. Layout of the experiment and treatments:

The experiments were arranged in split plot design with three replicates. NPK levels treatments were assigned at random in the main plots, while sub plots were devoted charcoal levels. Each experiment included 12 treatments, which were combination between (NPK) levels and charcoal levels as follows:

A. (NPK) levels:

1- 50% NPK (20 kg N_2, 15 kg P_2O_5 and 25 kg K_2O).
2- 75% NPK (30 kg N_2, 22.5 kg P_2O_5 and 37.5 kg K_2O).
3- 100% NPK (40 kg N_2, 30 kg P_2O_5 and 50 kg K_2O) recommended mineral fertilizer.

Three levels of NPK fertilizers, namely 50, 75 and 100% of the recommended dose as the recommendation of Ministry of Agriculture and Land Reclamation for pea. Nitrogen at 40 Kg/fed as a form of ammonium sulphate (20.5% N), phosphorus at 30 Kg /fed as a form of calcium superphosphate (15.5 % P_2O_5) and potassium at 50 Kg /fed as a form of potassium sulphate (48 % K_2O).

B. charcoal levels:

1- Without (untreated).
2- 500 kg/fed.
3- 1000 kg/fed.
4 - 1500 kg/fed**.**

Four levels of charcoal which call also bio char, namely without, 500, 1000 and 1500 kg/fed. Were mixed with soil before sowing during soil preparation, it added to 10 – 15 cm layer of soil surface.

The experimental unit area was 10.5 m^2 and it contains 3 dripper's lines with 5 m length for each and 70 cm width. The distance between drippers was 15 cm. Seeds were sown in hills (2 seeds /hill) at spacing 10 cm between plants on 20th October for 1st and 2nd seasons. All plots received farmyard manure by rate of 20 m^3/fed. The seeds were obtained from Horticultural Research Institute, Agriculture Research Center.

2. Data recorded

The obtained data in this study were as follows.

A. Plant growth parameters

Six plants from each plot were taken at random from each plot at 45 days after sowing to evaluate the following vegetative characters.

- Plant height (cm)
- Number of branches/plant
- Number of leaves/plant

B. Yield and its components

Mature green pods were continuously harvested at suitable maturity stages and the following data were calculated:

- Average pod length (cm)
- Average pod diameter (cm)
- Number of seeds/pod
- Average weight of 100 seeds (gm)
- Individual plant green pods yield (gm)
- Total green pods yield per feddan (ton/fed)

C. Seeds chemical constituents

Seed minerals contents (N P K %)

At second harvest, random samples of green seeds were taken from every plot and oven dried at 70 ^0C till constant weight. The dry matter of seeds was finely ground and wet digested with sulfuric acid and perchloric acid (v/v) (3:1). (NPK) were determined as previously mentioned in leaves.

Total crude protein (%)

The previously determined nitrogen of dry seeds was used for calculating total crude protein percentage by multiplying N-values by 6.25 (A.O.A.C., 1980).

3. Statistical analysis

The collected data were subjected to statistical analysis of variance using the normal (F) test and the means separation were compared by using Least Significant Difference (LSD) at 5% level according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

The obtained results are presented under separate headings, characters of vegetative growth, yield and its components and seeds chemical composition as influenced by various treatments, i.e., NPK levels, charcoal and their interactions**.**

1. Vegetative growth

Effect of NPK levels

Data in Table (2) show the effect of NPK levels on vegetative characters of pea plants during 2017 and 2018 seasons expressed as plant height, number of branches per plant and number of leaves per plant.

It is obvious from such data that vegetative growth parameters were increased with increasing NPK levels. Using NPK fertilizers at 100% as a recommended dose gave the highest significant value of vegetative growth parameters as compared to other levels.

Using NPK-fertilizers at 100% of the recommended dose gave the highest significant value of vegetative growth parameters as compared with adding 75% or 50% of the recommended dose.

This increment in vegetative growth of pea plant growth may be attributed to the beneficial effects of nitrogen on stimulating the merestimatic activity for producing more tissues and organs, since it plays major roles in the synthesis of structural proteins and other several macro molecules, in addition to *its vital contribution in several biochemical processes that related to plant* growth (Marschner, 1995). The promoting effect of phosphorus application on growth parameters could be attributed to phosphorus as structural part of high energy compounds (Sarg, 2004). It is also a constituent of the cell nucleus and is essential for cell division and the merestimatic tissues development (Frank, 2002). Potassium is present within plants as the cation K^+, plays an important role in regulation of the osmotic potential of plant cells and activates many enzymes involved in respiration and photosynthesis (Marschner, 1995 and Lincoln and Zeiger, 2002).

These results are in harmony with those reported by Kakar *et al.* (2002), Mishra *et al.* (2010) and Dawa *et al.* (2013) on pea plant, De Souza *et al.* (2008), El-Bassiony *et al.* (2010) and El-Awadi *et al.* (2011) on snap bean who reported that the vegetative growth of plants was improved by increasing the levels of NPK fertilizers application.

Effect of charcoal treatment.

Data in Table (2) show the effect of charcoal levels on vegetative characters of pea plants during 2017 and 2018 seasons expressed as plant height, number of branches per plant and number of leaves per plant. It is clear from such data that vegetative growth parameters were increased with increasing charcoal levels. Using charcoal at 1500 kg / feddan gave the highest significant value of vegetative growth parameters except number of branches per plant in both seasons as compared to other levels, while the treated without adding charcoal (control) gave the lowest value of them. These results are true in both growing seasons.in this regard , Graber *et al. (*2010) found that, biochar treatments positively enhanced plant height on tomato and increased Parameters (height and canopy) for both pepper and tomato under biochar treatment. Moreover, Saleem *et al*. (2014) showed that addition of biochar improved plant growth of tomato as compared with non- biochar control.

Table 2. Effect of NPK levels, and charcoal treatment on vegetative characters of pea plants during 2017 and 2018 seasons.

Seasons	2017			2018		
Characters	Plant height(cm)	No. of branches /plant	No. of leaves / plant	Plant height(cm)	No. of branches /plant	No. of leaves / plant
Treatments						
NPK levels.						
N P K 50%	36.58	2.58	20	37.66	2.66	23.08
N P K 75%	42.33	3.5	26.33	43.58	3.33	31.33
N P K 100%	49.33	4.16	37.25	51.33	4.41	39.83
L.S.D 0.05	2.67	0.46	2.02	3.26	1.2	2.21
Charcoal levels						
Without	38.83	2.88	23.66	40.22	3	26.77
500 kg/fed	41.05	3.22	25.33	42	3.33	29.66
1000 kg / fed	43.77	3.44	29.11	45.33	3.77	32.11
1500 kg / fed	47.33	4.11	33.33	49.22	4	37.11
L.S.D 0.05	1.91	0.70	1.43	2.08	ns	1.88

Effect of interaction between NPK levels and charcoal treatment.

It is evident in Table (3) that interaction between NPK levels and charcoal treatment had a significant effect on plant height and number of leaves per plant in both growing season, while number of branches in both growing seasons had no significant effect. The highest values of vegetative growth were observed withe addition charcoal at 1500 kg / feddan and using NPK-fertilizers at 100% of the recommended dose. This may be because charcoal serves as a carrier substract for nitrogen (N) which increased the effectiveness of charcoal by retation and preventing the leaching of N beyond to plant utilization.(Rondon *et al.*,2007 and Steiner *et al.*,2008). In this regard, Chan *et al.* (2007) found that plant growth increased when the biochar was applied with N fertilizer, moreover EL-Shimi and Byan, (2015) found that the superior values of vegetative growth were observed withe fertilizer addition charcoal plus charcoal. In this regard Youseef *et al.* (2017) found that treated garlic plants by using biochar positively enhanced plant growth, compared to fertilization with mineral.

Table 3. Effect of interaction between NPK levels and charcoal treatment on vegetative characters of pea plant during 2017 and 2018 seasons.

Seasons		2017			2018		
Characters Treatments		Plant height(cm)	No. of branches /plant	No. of leaves / plant	Plant height(cm)	No. of branches /plant	No. of leaves / plant
N P K 50 %	Without	34.66	2	16.66	36	2.33	20.33
	500 kg/fed	35.66	2.33	18	36.33	2.33	21
	1000 kg / fed	37	2.66	21.33	37.66	2.66	23
	1500 kg / fed	39	3.3	24	40.66	3.33	28
N P K 75 %	Without	38.16	3	22.66	39.33	3	23.66
	500 kg/fed	41. 16	3.33	23.66	42	3.33	31
	1000 kg / fed	44	3.33	26	45	4	33.33
	1500 kg / fed	46	4.33	33	48	3.66	37.33
N P K 100 %	Without	43.66	3.66	31.66	45.33	3.66	36.33
	500 kg/fed	46.33	4	34.33	47.66	4.3	37.66
	1000 kg / fed	50.33	4.33	40	53.33	4.6	40
	1500 kg / fed	57	4.66	43	59	5	46
L.S.D at 0.05		5.73	ns	4.3	6.25	ns	5.66

2. Yield and its component

Effect of NPK levels

The effect of NPK levels on yield and its components of pea plants are presented in Table (4). Results showed that there were significant effects on pod length, number of seeds per pod, weight of 100 seeds and green pods yield per fed in both seasons. Total yield and its components were gradually increased with increasing NPK fertilizer level. The maximum values were recorded with 100% NPK as recommended dose.

These results may be due to the role of mineral fertilizer such as nitrogen on chlorophyll, enzymes and protein synthesizes, phosphorous on root growth and development and potassium on promotion of enzymes activity and enhancing the translocation of assimilates (Yadav *et al*., 2005). Also the increase of pea yield may be due to increment of vegetative growth parameters as shown in Table (2). Similar results were found by Kakar *et al.* (2002) and Dawa *et al.* (2013) on pea, Kehinde *et al.* (2011) on eggplant, and Imamsaheb *et al.* (2011) on tomatoes.

Effect of charcoal treatment.

Data in Table 4 showed that addition charcoal levels increased yield and its components compared with control (without). Results clear that there were significant effects on pod length, number of seeds per pod, weight of 100 seeds and green pods yield per fed in both seasons, While number of seeds per pod on both growing seasons had no significant. It is clear that, charcoal improve plant productivity directly as result of its nutrient content and release characteristics, as well as indirectly, via improved retention of nutrient, improved soil physical properties and alteration of soil microbial population and functions. Addition of biochar improved yield and quality of tomato and eggplant (Salem *et al.,* 2014 and EL-Shimi and Byan, (2015). Similar results were found by Youseef *et al.* (2017) Treated garlic plants by using biochar positively enhanced plant growth.

Table 4. Effect of NPK levels and charcoal treatment on yield and its components during 2017 and 2018 seasons.

Characters	Pod length (cm)		Pod diameter (cm)		No. of seeds/pod		Wt. of 100 seeds (gm)		Green pod yield tons/feddan	
Treatments	Seasons									
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
	NPK levels									
N P K 50%	9.07	9.73	1.56	1.58	8.25	8.33	42.3	43.62	3.344	3.344
N P K 75%	9.31	10.27	1.68	1.66	9.25	9.33	47.22	48.27	3.819	3.797
N P K 100%	9. 67	10.76	1.77	1.76	10	10.25	52.71	53.51	4.33	4.357
L.S.D 0.05	0.048	0.103	0.029	0.068	0.69	0.49	1.60	1.25	0.089	0.055
	Charcoal levels.									
Without	9.18	9.95	1.60	1.60	8.77	8.33	45.25	45.60	3.566	3.622
500 kg/fed	9.27	10.17	1.64	1.65	9	9.11	46.65	47.58	3.746	3.764
1000 kg / fed	9.39	10.33	1.69	1.70	9.22	9.33	47.17	49.14	3.919	3.899
1500 kg / fed	9.56	10.55	1.74	1.72	9.33	9.88	50.56	51.55	4.029	4.062
L.S.D 0.05	0.081	0.077	0.04	0.057	0.58	0.68	1.62	1.23	0.075	0.046

3. Effect of interaction between NPK levels and charcoal treatment.

Such results in Table (5) indicate that interaction between NPK levels and charcoal treatment had a significant effects on pod length at first season and green pods yield per fed in both seasons, While pod length in second season, pod diameter, number of seeds per pod, weight of 100 seeds number of seeds per pod on both growing seasons had no significant effects. The best interaction between NPK and charcoal were recorded with application of 100% NPK and addition biochar at 1500kg per feddan. This result may be due to that charcoal helps and allow better uptake of nutrients and fertilizers added to the soil which reflect for producing superior plants as well as high yield. Similar results were found by Saleem *et al.* (2014) on pea and EL-Shimi *and* Byan, (2015) on eggplant. Also Youseef *et al.,* (2017) regard that treated garlic plants by using biochar positively enhanced yield quality, compared to fertilization with mineral.

3. Seeds chemical composition

1. Effect of NPK levels

Data in Table (6) show the effect of NPK levels on pea seed chemical constituents, i.e., N, P, K, and protein during 2017 and 2018 seasons.

The results show that seed chemical composition parameters were significantly affected by the NPK fertilizer levels. The results had the same trend in both growing seasons. The results showed also that all treatments of charcoal gave the higher seed chemical composition parameters in both season than control (without charcoal). Application of 100 % NPK fertilizer levels being the most effective treatments and recorded the highest value of N, P, K and protein of pea seeds.

2. Effect of charcoal treatment.

Data in Table (6) show the effect of charcoal treatment on pea seed chemical constituents, i.e., N, P, K, and protein during 2017 and 2018 seasons.

It is obvious from such data that pea seed chemical constituents, i.e., N, P K and protein significantly affected by addition of charcoal compared to control (without charcoal). The highest significant value of seed chemical composition parameters of pea seeds showed when addition charcoal at 1500kg per feddan similar trend was obtained in both growing seasons. This result may be due to that charcoal helps and allow better uptake of nutrients and fertilizers added to the soil.

3. Effect of interaction between NPK levels and charcoal treatment.

Results in Table (7) show the effect of interaction between NPK levels and charcoal treatment on pea seed chemical constituents, i.e. N, P, K and protein during 2017 and 2018 seasons. Such results indicate that interaction between NPK levels and charcoal treatment had a significant effect on seeds chemical composition of pea plant except P percentages on both seasons. The maximum values of seeds chemical composition, i.e., N, P, K and protein percentage were recorded with application of 100% NPK and addition charcoal at 1500 kg / feddan .

Table 5. Effect of interaction between NPK levels and charcoal treatment on yield and its components during 2017 and 2018 seasons.

Characters Treatments		Pod length (cm)		Pod diameter (cm)		No. of seeds/ pod		Wt. of 100 seeds (gm)		Green pod yield tons/ feddan	
NPK levels	Charcoal levels	Season									
		2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
N P K 50 %	Without	8.9	9.37	1.50	1.51	8	8	40.13	41.31	3.083	3.124
	500 kg/fed	9.05	9.62	1.51	1.58	8	8.33	41.3	42.49	3.283	3.334
	1000 kg / fed	9.07	9.83	1.62	1.6	8.33	8.33	42.36	44.57	3.434	3.478
	1500 kg / fed	9.24	10.07	1.63	1.6	8.66	8.66	45.4	46.13	3.576	3.640
N P K 75 %	Without	9.21	9.98	1.58	1.61	8.66	8.66	45.56	44.83	3.544	3.566
	500 kg/fed	9.25	10.19	1.67	1.64	9	9	46.33	47.64	3.646	3.698
	1000 kg / fed	9.33	10.32	1.65	1.71	9	9.33	46.66	48.83	3.896	3.924
	1500 kg / fed	9.45	10.6	1.78	1.71	9.66	10.33	50.66	51.8	4.194	4.260
N P K 100 %	Without	9.39	10.51	1.70	1.71	9.33	10	50.06	50.06	4.072	4.141
	500 kg/fed	9.50	10.71	1.74	1.74	10	10	52.33	52.63	4.31	4.380
	1000 kg / fed	9.78	10.81	1.8	1.78	10.33	10.33	52.83	54.03	4.428	4.490
	1500 kg / fed	10	11	1.84	1.82	10.33	10.66	55.63	56.72	4.511	4.582
L.S.D at 0.05		0.24	ns	ns	ns	ns	ns	ns	ns	0.225	0.243

Table 6. Effect of NPK levels and charcoal treatment on pea seed chemical constituents during 2017 and 2018 seasons.

Seasons	2017				2018			
Characters	N %	P %	K%	Protein%	N%	P%	K%	Protein%
Treatment								
				NPK levels.				
N P K 50%	2.77	0.37	1.79	17.32	2.87	0.37	1.82	17.95
N P K 75%	3.20	0.4	1.86	20.02	3.27	0.41	1.90	20.47
N P K 100%	3.54	0.44	2.00	22.16	3.63	0.45	2.05	22.69
L.S.D 0.05	0.099	0.010	0.037	0.62	0.054	0.008	0.037	0.33
				Charcoal levels				
Without	2.96	0.38	1.82	18.52	3.05	0.39	1.86	19.09
500 kg/fed	3.09	0.39	1.86	19.35	3.16	0.40	1.89	19.80
1000 kg / fed	3.22	0.41	1.92	20.13	3.32	0.41	1.93	20.79
1500 kg / fed	3.41	0.43	1.95	21.32	3.48	0.43	2.002	21.80
L.S.D 0.05	0.066	0.014	0.035	0.41	0.039	0.011	0.031	0.24

Table 7. Effect of interaction between NPK level and charcoal treatment on pea seed chemical constituents of pea plants during 2017 and 2018 seasons.

Seasons		2017				2018			
Characters / Treatments		N%	P%	K%	Protein%	N%	P%	K%	Protein%
NPK	Charcoal								
N P K 50 %	Without	2.61	0.35	1.74	16.14	2.71	0.36	1.78	16.93
	500 kg/fed	2.68	0.36	1.78	16.70	2.75	0.373	1.81	17.20
	1000 kg / fed	2.72	0.37	1.81	16.95	2.86	0.38	1.83	17.91
	1500 kg / fed	3.06	0.40	1.83	17.58	3.16	0.4	1.85	19.75
N P K 75 %	Without	2.95	0.38	1.82	18.87	3.00	0.39	1.85	18.77
	500 kg/fed	3.16	0.39	1.85	19.77	3.23	0.40	1.87	20.18
	1000 kg / fed	3.30	0.41	1.87	20.47	3.39	0.43	1.91	21.18
	1500 kg / fed	3.39	0.43	1.91	20.81	3.52	0.44	1.98	21.75
N P K 100 %	Without	3.32	0.41	1.90	20.83	3.45	0.42	1.95	21.56
	500 kg/fed	3.44	0.44	1.94	21.52	3.52	0.44	2.01	22.02
	1000 kg / fed	3.63	0.45	2.07	22.70	3.72	0.46	2.07	23.27
	1500 kg / fed	3.78	0.46	2.11	23.52	3.82	0.48	2.17	23.91
		0.200	ns	0.105	1.25	0.119	Ns	0.095	0.74

CONCLUSION

The results obtained give a great important to get a good yield with high quality of Pea as well as minimizing usage of mineral fertilizers which in turn reduce environmental pollution and decrease production costs. In spite of the highest pea yield was obtained from the treatment of 100% NPK and application of 1500 kg/fed charcoal, but we recommend treatment of 75% NPK and Treated plants by using charcoal at 1500 kg / feddan where it gave more yield than 100% NPK alone without significant difference between both treatments and gave the highest values of pea pods quality parameters without significant difference between both treatments. Since this treatment reduce environmental pollution and decrease production costs.

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تأثير اضافة الفحم النباتي ومستويات من التسميد المعدني علي النمو والمحصول لنباتات البسله النامية تحت ظروف الاراضي الرملية

محمود محمد حلمي و التميمي السيد محمد اسماعيل*

قسم بحوث الخضر- معهد بحوث البساتين – مركز البحوث الزراعية

أجريت تجربتان حقليتان خلال موسمى 2017 و 2018 بمزرعة محطة بحوث البساتين بالقصاصين، محافظة الإسماعيلية, لدراسة تأثير مستويات مختلفة من التسميد المعدنى و اضافة الفحم النباتي والتفاعل بينهم على النمو والمحتوى الكيماوى للبذور والمحصول ومكوناته لنباتات البسلة صنف ماستر بى تحت ظروف الأراضي الرملية . أدت زيادة كمية التسميد المضافة حتى أعلى مستوى 100 % من النيتروجين والفوسفوروالبوتاسيوم الموصى به إلى زيادة معنوية للنموالخضرى (ارتفاع النبات وعدد الافرع و الاوراق للنبات) و المحصول الاخضر للقرون ومكوناته(طول القرن وعدد البذور للقرن ،وزن 100 بذرة و محصول القرون الخضراء للفدان.)وكذلك بالنسبة للمحتوى الكيماوى للبذور من(النيتروجين و الفوسفور و البوتاسيوم و البروتين). معاملة النباتات بالفحم النباتي أدت الى زيادة للنموالخضرى و المحصول الاخضر للقرون ومكوناته وكذلك بالنسبة للمحتوى الكيماوى للبذور زيادة معنوية مقارنه بالنباتات التي لم تعامل به. ادى تسميد نباتات البسله بمعدل 100% من التسميد المعدنى مع اضافة الفحم النباتي بمعدل 1500 كيلو جرام للفدان الى الحصول على أعلى زيادة للنموالخضرى و المحصول الاخضر للقرون ومكوناته وكذلك بالنسبة للمحتوى الكيماوى للبذور مقارنة بباقى المعاملات وبالرغم من ذلك نوصى باستخدام التسميد المعدنى بمعدل 75% مع اضافة اضافة الفحم النباتي بمعدل 1500 كيلو جرام للفدان حيث أدت هذه المعامله الى تسجيل قيم عالية للمحصول مقارنة بالتسميد بمعدل 100% من التسميد المعدني بدون اضافات (كنترول). وكذلك أدت هذه المعاملة الى تقليل استخدام الاسمدة المعدنية التى تسبب التلوث البيئى وُتزيد من تكاليف الانتاج.