J. Plant Production, Mansoura Univ., Vol. 8(11): 1205 - 1213, 2017

Effect of Organic Nutritional Supplement on Growth, Nodulation and Yield of Peanut Cultivated Under Different Fertilization Systems

Fatma A. A. Soliman
Central Laboratory of Organic Agriculture, ARC, Egypt

ABSTRACT

In order to study the effect of fertilization systems (100 % NPK, 100 % compost, 50 % compost + 500 kg mineral ores mixture and 50 % compost + 500 kg gypsum) as soil application and organic substances (control, KP, KSi and CT) as foliar application on growth performance, chlorophyll content, nodulation and yield of peanut (*Arachis hypogaea* L., Giza 6 cv.). Two field experiments were carried out in extension field at Quweisna, Menoufia governorate, Egypt during the two growing seasons of 2015 and 2016. Results indicated that adding fertilization systems and organic substances generally had effective roles on enhancement of growth and yield of peanut grown in sandy loam soil. Application of 50 % compost + mineral ores mixture produced the highest growth characters i.e number of main branches and leaves /plant, stem and leaves dry weight/plant and leaf area/plant . However, application of 100 % compost exhibited more total chlorophyll content, number and nodules weight/plant, yield and its components (number of pods/ plant, number of seeds / pod, weight of seed /plant and pod yield per plant and per fed and seed oil percentage compared with other tested fertilization treatments. The response of peanut Chlorophyll and nodulation, yield and oil percentage significantly differed by foliar application of organic substances. Application of Jeta Plus (KP) and Si-ElGhanem (KSi) surpassed the other organic substances for producing highest values of most above mentioned characteristics. However, untreated plants recorded the lowest values of all studied characteristics. The interactions between the fertilization systems and organic substances were found to be significant for most studied traits. The maximum pod yield/fed was obtained by soil application of 100 % compost combined with foliar application with KP, which is found to be the best combination for maximizing peanut productivity. Accordingly, the study recommends the importance of regular use of organic fertilization as soil or foliar application to reduce the need for synthetic commercial fertilizers and reduced soil pollutions.

Keywords: Arachis hypogaea L., Organic nutritional substances, Chlorophyll content, Seed oil.

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is considered the main oil crop grown in Egypt. It is an important oil crop due to its high nutritive value. It contains about 50 % oil, 25-30 % protein, 20 % carbohydrate and 5 % fiber and ash, which makes a substantial contribution to human nutrition (Fageria *et al.,* 1997). Peanut offers ecosystem services such as renewable inputs of nitrogen into crops and soil via biological ambient N_2 fixation (Siam *et al*., 2015). Increasing peanut productivity largely depends on improving the cultural practices such as soil fertility by utilization of organic fertilization, which may help to solve soil problem. Enteshari *et al.* (2012) reported that excessive use of fertilizers disturbs the ecological balance and biological environment and also has caused many environmental hazards. However, using of organic substances reduces the negative effects of chemical fertilizer and improves water retention and enhances soil properties.

Plants use minerals from the soil or external application to build the complex molecules they need to survive and grow.Organic manures improve the behavior of several elements in soils through active groups, which have the ability to retain the elements in complex and chelate form. Uses of organic materials are safe for human health and environmental elements. Organic manures release the elements over a period of time and are broken down slowly by soil microorganisms (Ali *et al*., 2014). The majority of the nutrients in organic fertilizers are organically bound and slowly mineralized, so the potential for exceeding plant nutrient demands and associated environmental contamination that reduced relative to synthetic commercial fertilization (Stratton *et al.,* 1995).

Application of organic fertilization is very important for peanut production because it supplies plants with a part of nutrients requirements, saves a great amount of mineral fertilizers and reduces environmental pollution and production costs. Composting is the most important methods for increasing agricultural output by raising the level of soil fertility, due to (a) long term improvement of structural stability, (b) moisture retention and (c) the supply of plant nutrients. Compost tea is liquid organic product that is rapidly gaining interest as a soil amendment with the hopes of improving soil quality and plant nutrition management (Ali, 2015). The primary benefit of the compost tea will be a supply of soluble nutrients, which can be used as a liquid fertilizer and disease reduction as a form of biological control (El-Shinnawi *et al*., 2011). Whereas, Edwards *et al*. (2006) reported that transition from synthetic fertilization to organic fertilization may be feasible because much of the environmental pollution was happened in recent years.

Gypsum is one of the sources of calcium (Ca) and sulfate (S). Sandy soils are suited to peanut production but often lack sufficient calcium to maximize yield. Calcium is often added to soils in the form of gypsum and it moves upwards in the peanut plant but does not move down in soil. Thus, calcium does not move through the peg to the pod and developing seed. Silicon (Si) has not been proven to be an essential element for higher plants, but its beneficial effects on growth have been reported in a wide variety of crops. Si as a fertilizer may apply to crops for increased productivity and sustainable production (Ma *et al*., 2001).

The objective of the present research were aimed to determine the influence of different organic nutritional supplement on the growth performance, nodulation, yield and quality of peanut grown under different fertilization systems under sandy loam soil conditions.

MATERIALS AND METHODS

A two field experiments were carried out in extension field at Quweisna, Menoufia governorate, Egypt, to evaluate the effect of different organic nutritional supplement on the growth performance, nodulation, yield and is components and quality of peanut (Giza 6 cv.) cultivated under different fertilization systems in sandy loam soil during 2015 and 2016 seasons. The experiment included 16 treatments which were all possible combinations of fertilization systems and organic nutritional supplement as follows:

Fertilization systems (soil application)

1- 100 % mineral NPK "traditional fertilization": 50 kg N/fed in the form of ammonium nitrate (33.5 %) in three equal doses at sowing, first and second irrigation + 31 kg P_2O_5/fed in the form of calciumsuper phosphate (15.5 % P_2O_5) was applied during soil preparation. potassium fertilization was applied at the first irrigation at rate of 24 kg K_2O/fed (48 % K_2O).

2- 100 % Compost: 5 t compost /fed was added during soil preparation.

3- 50 % Compost + 500 kg Mineral Ores Mixture was added during soil preparation.

4- 50 % Compost + 500 kg Gypsum ($CaSO_4$) was added during soil preparation.

Organic nutritional substances (foliar application)

1- Control: tap water only.

2- KP: Potassium citrate (60 % K_2O) + Phosphate (45 % P_2O_5) in commercial substance namely "Jeta Plus" was sprayed at a rate of 600 ml/ 200 liter water.

3- KSi: Potassium oxide (10 % K_2O) + Silicon oxide (25 % SiO_2) in commercial substance namely "Si-ElGhanem" was sprayed at a rate of 1000 ml/200 liter water.

4- CT: Compost tea was sprayed at a rate of 10 liter / 200 liter water.

Compost used in this study was obtained from El-Khalil Factory for Compost at El-Khatatba province, Menoufia Governorate, Egypt. Compost tea was prepared manually by brewing compost and tap water in the ratio of 1:10 w/v (compost: water) using brewing tank fitted with an aquarium pump for continuous aeration (Naidu *et al*., 2010). Ore mixture and organic substances were obtained from Al Ahram Mining company at El – Sadat, Menoufia Governorate, Egypt. The organic nutritional treatments were sprayed twice at 35 and 45 days after sowing. Compost, compost tea and mineral ores mixture properties are presented in Table (1).

The treatments were arranged in a Randomized Complete Block design with four replications arranged in the form of a split plot design.

Table 1. Properties of organic substances used.

Compost		Compost tea		Ores mixture	
Bulk density (kg m^{-3})	600	pH	7.20	P_2O_5 %	7.33
Moisture content %	27.0	EC (ds m^{-1})	1.36	K_2O %	4.24
Water holding compacting %	250	N (mg L^{-1})	98.6	SO_3 %	5.81
pH (1:10 suspension)	7.20	NO_3-N (mg L^{-1})	96.9	CaO %	15.05
EC (1:10 suspension)	1.36	NH_4-N (mg L^{-1})	1.70	MgO %	3.19
Organic matter %	37.4	P (mg L^{-1})	3.21	Na_2O %	1.75
Total N %	1.00	K (mg L^{-1})	32.5	Fe_2O_3 %	4.05
Total P %	0.87	Ca (mg L^{-1})	101.1	MnO %	0.67
Total K %	0.95	Mg (mg L^{-1})	45.6	Al_2O_3 %	7.67
C / N ratio	16:1	Fe (mg L^{-1})	11.8	TiO_2 %	0.80
Available N mg kg^{-1}	620	Zn (mg L^{-1})	5.14	SiO_2 %	39.35
Available P mg kg^{-1}	215	Mn (mg L^{-1})	3.35		
Available K mg kg^{-1}	380	Cu (mg L^{-1})	1.51		
Extractable (Fe) mg kg^{-1}	270	Bacteria (log10 cell ml^{-1})	6.42		
Extractable (Mn) mg kg^{-1}	90	Fungi (log10 cell ml^{-1})	5.55		
Extractable (Zn) mg kg^{-1}	70	Actinomycetes (log10 cell ml^{-1})	5.77		

Soil samples were randomly taken from the experimental field before sowing at 30 cm depth. The mechanical and chemical analysis of the soil was analyzed according to Jackson (1973) and Chapman and Pratt (1978). Soil properties are presented in Table (2).

Table 2. Mechanical and chemical properties of the experimental site.

Properties	Texture class	pH	E.C. ds m^{-1}	O.M. %	Nutrients (ppm) N	P	K
2015	Sandy loam	7.3	0.33	0.41	15.2	3.94	131.1
2016	Sandy loam	7.2	0.31	0.53	16.6	4.01	133.5

Crop management

The experimental field was ploughed twice, harrowed and leveled after wheat harvesting to prepare the seedbed. Soil was ridged into furrows 60 cm width and divided plots. Each experimental plot included five ridges with 3.5 m long. The plot area was 10.5 m^2. Seeds were sown on 15[th] and 19[th] May in first and second seasons, respectively at a rate of 45 kg/fed by putting two seeds per hill with spacing of 20 cm a parts. Peanut seeds were treated before sowing with *Bradyrhizobium spp*. The inoculant was prepared by the Central Laboratory of Organic Agriculture, Agricultural Research Center, Egypt. Treated seeds were left to dry in shadow then sown directly. Surface irrigation was used for applied water during experiment periods. Peanut was manually harvested on 16[th] and 22[nd] September in the first and second season, respectively.

All of the required cultural practices were performed as recommended according to organic farming rules. Also, All seeds were treated with Clean Root (*Bacillus* *subtilis* bacteria) as seed dressing at the rate of 10 g / kg seed before sowing to protects seed agents soil –borne pathogens.

During all season growth , all experimental plots under study were sprayed with Blight Stop (as commercial product) at the rate of 1 L/ 200 L water to foliar diseases control.

In addition to the previous treatment all experimental plots were treated with Anti-insect (a commercial product) used at the rate of 1 L/ 200 L Water to control sucking insects may attack the plants during seasons.

Plant measurements:

Vegetative growth

At 60 days after sowing, ten guarded plants from each plot were taken randomly to estimate plant height, number of main branches/plant, number of total branches/plant, number of leaves/plant, leaf area/plant and stem, leaves and total dry weights/plant.

Total chlorophyll

Total chlorophyll content in peanut leaves (3^{rd} upper leaf) was measured automatically with a hand-held chlorophyll meter (SPAD-502) at 60 days after sowing.

Nodulation

At 70 days after sowing, eight plants were uprooted by mattock at random in each experimental plot. The roots were dipped in water to remove the soil carefully then washed with distilled water and data was recorded on number of nodules /plant and fresh and dry weights of nodules /plant (g.).

Yield and its components

At maturity, ten guarded plants were randomly harvested to determine number of pods/plant, number of seeds/ pod, weight of seeds/ pod, 100-seed weight and pods yield/plant. Pods of inner two redges were harvested and dried to determine the yield and converted intovvv t/fed.

Oil percentage

After harvest, seed samples were dried in air-oven at 70˚C to constant weight before grinding with a mill. The samples were chemically analyzed to determine oil percentage (AOAC, 2000).

Statistical analysis

All measurements data were analyzed according to the methods described by Snedecor and Cochran (1980). Least significant differences (LSD) test was used to compare among the treatments mean at 0.05 probability. Statistical analysis was done using the CoStat package program, version 6.311 (Cohort software, USA).

RESULTS AND DISCUSSION

Growth parameters

Values of plant growth as parameters influenced by fertilization systems and organic substances are given in Table (3). The result demonstrated that the application of fertilization systems caused significant effects in growth parameters during both seasons. The application of 100% compost or 50 % compost + ores mixture exhibited the tallest plants the, highest main branches number/of plant. The results showed that significant increases in number of leaves/plant stem and leaves dry weights/plant and leaf area were obtained by application of 50 % compost + ores mixture more than other fertilization systems in both seasons. However, application of 100 % mineral NPK recorded the lowest values of growth parameters. Leaf area plays an important role in light interception, photosynthesis, water and nutrient use and dry matter production. Larger leaf area that fertilized with organic fertilization could have been linked to increase plant dry weight. Growth characters were improved by the ability of the plants to uptake and receive more nutrients. 100 % compost or 50 % compost + ores mixture were especially beneficial in freeing up nutrients in the soil so that they made this available to the plants as needed (El-Gizawy *et al*., 2013). Compost is generally has higher concentrations of plant available nutrients (NO_3^- and NH_4^+ exchangeable Ca, P and soluble K) and significantly larger and more diverse microbial populations (Tognetti *et al.,* 2005). Several investigators have indicated the importance of compost (El-Shinnawi *et al*., 2011 and Rizk *et al*., 2012), ores mixture (Williams and Holtzhausen, 2001 and Arafa et *al*., 2016) on improving different plant growth parameters.

The results showed the effect of organic nutritional supplement on growth parameters. The results revealed that KSi (potassium oxide + silicon oxide) followed by KP (potassium citrate + phosphate) significantly increased plant height, number of main branches and leaves/plant as well as stem and leaves dry weights, while KP (potassium citrate + phosphate) exhibited the large leaf area/plant in the two seasons compared to other organic nutritional substances. However, control (untreated plants) recorded the lowest values of all growth parameters. The beneficial effects of KSi and KP on plant growth may be attributed to many nutrients such as K, P and O improve nutrients uptake and increased the plant growth. These organic substances contain citrate and silicon in their composition which enhanced the plant tolerance for heat stress under experimental condition. Similar studies have convincingly demonstrated that application of P (Malakondaiah and Rajeswararao, 1979 and Gobarah, 2006) K (Aboelill *et al*., 2012), Si (Shen *et al*., 2014 and Yao *et al*., 2014) and compost tea (El-Gizawy *et al*., 2013) improved plant growth parameters.

The interaction between fertilization systems and organic substances recorded significant values for all growth charactistics in both seasons (Table 3). In this respect, foliar application of KSi (potassium oxide + silicon oxide) under adding 100 % compost to soil gave the maximum tallest plant height as compared with other treatments. However, spraying peanut plants with (potassium oxide + silicon oxide) followed by KP (potassium citrate + phosphate) grown under fertilization system of 50% Compost + Ores mixture resulted in a significant increase in most growth characteristics when compared with other treatments. However, the untreated plants (control) grown under traditional fertilization (100 % NPK) had the lowest values of these traits. This negative effect may be due to that soils with high water infiltration rates and low nutrient retention capacity with low organic matter contents are particularly conducive to nutrient leaching.

The obtained results are in agreement with those achieved by El-Shinnawi *et al.* (2011).

Table 3. Growth parameters of peanut plants as affected by fertilization systems, organic substances and their interaction during 2015 (S1) and 2016 (S2) seasons.

Fertilization systems	Organic substances	Plant height (cm)		No. of main branches/ plant		No. of leaves /plant		Stem dry weight/ plant (g.)		Leaves dry weight/ plant (g.)		Leaf area/plant (cm^2)	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
100%		21.08	24.97	3.25	5.42	134.42	137.25	8.33	9.61	14.16	13.38	8393.32	8580.51
100%		23.92	25.68	4.00	6.92	140.75	173.50	10.35	10.93	18.48	18.04	11069.32	10894.32
50%		22.75	26.92	4.17	6.67	170.08	188.50	16.74	17.53	25.81	25.23	13823.06	11459.31
50%		21.83	26.84	3.42	6.67	164.08	147.92	11.58	11.65	18.91	18.20	9302.03	9202.04
LSD Fertilization systems 0.05		1.08	1.11	0.35	0.25	18.37	8.12	6.21	5.87	6.24	7.91	225.62	192.32
	Control	19.92	24.05	3.08	5.00	127.50	134.83	9.14	9.67	15.64	15.21	9031.40	8726.93
	KP	22.00	26.98	3.75	6.92	181.75	173.92	11.60	13.18	21.10	20.01	11803.70	10780.36
	KSi	24.83	27.49	4.08	7.08	184.17	174.33	14.26	14.11	22.14	20.58	10976.03	10602.28
	CT	22.83	25.89	3.92	6.67	146.75	164.08	11.99	12.76	18.48	19.05	10776.60	10026.60
LSD	Organic	0.98	0.76	0.30	0.37	15.32	7.34	4.30	3.14	6.07	4.08	170.58	176.84
100% mineral NPK	Control	18.67	22.53	2.67	4.00	101.00	104.33	5.44	7.00	8.86	10.11	6814.89	7296.99
	KP	21.33	26.76	3.33	5.33	150.67	149.33	9.59	13.49	16.71	16.43	10775.04	10108.37
	KSi	22.67	26.54	3.67	6.33	149.67	148.67	9.73	9.06	18.54	13.89	7886.37	8753.03
	CT	21.67	24.05	3.33	6.00	136.33	146.67	8.56	8.90	12.54	13.09	8096.99	8163.66
100% Compost	Control	21.33	23.40	3.33	6.00	142.67	145.67	9.53	10.15	16.41	16.01	9461.10	9427.77
	KP	23.00	25.78	4.33	7.67	193.67	180.67	10.59	11.62	20.46	19.83	12773.73	11773.73
	KSi	26.67	29.25	4.00	7.00	197.67	187.67	11.44	11.09	18.98	18.87	10498.80	11165.46
	CT	24.67	24.27	4.33	7.00	152.33	180.00	9.84	10.86	18.07	17.44	11543.66	11210.33
50% Compost + Ores mixture	Control	20.00	25.35	3.33	5.00	125.67	156.33	12.55	12.72	21.00	19.47	12793.08	10793.08
	KP	22.33	27.30	3.67	7.33	196.33	205.67	15.54	17.55	28.52	26.19	13934.19	11840.85
	KSi	26.00	27.08	5.33	7.67	203.67	214.33	22.32	22.95	29.86	29.45	14707.52	12012.53
	CT	22.67	27.95	4.33	6.67	154.67	177.67	16.53	16.89	23.87	25.79	13857.44	11190.78
50% Compost + Gypsum	Control	19.67	24.92	3.00	5.00	140.67	133.00	9.06	8.81	16.31	15.26	7056.54	7389.87
	KP	21.33	28.06	3.67	7.33	186.33	160.00	10.69	10.06	18.73	17.58	9731.83	9398.50
	KSi	24.00	27.08	3.33	7.33	185.67	146.67	13.54	13.36	21.17	20.09	10811.43	10478.10
	CT	22.33	27.30	3.67	7.00	143.67	152.00	13.04	14.39	19.44	19.89	9608.32	9541.65
LSD interaction 0.05		1.96	1.52	0.59	0.74	30.63	14.68	8.60	6.27	12.13	8.15	341.15	353.68

Control : tap water **KP: Potassium citrate + phosphate** **KSi : Potassium oxide + silicon oxide** **CT: compost tea**

Chlorophyll content

The results presented in Table (4) revealed that fertilization systems had a significant effect on total chlorophyll content during the two growing seasons. It was obvious that application of 100 % compost (5 t/fed) surpassed the other fertilization systems in increasing chlorophyll content from (36.28 and 36.07) to (39.25 and 39.58) as compared with traditional fertilization during first and second seasons, respectively. However, the differences between 100 % compost and 50 % compost + gypsum failed to reach the level of significance in both seasons. This emphasizes the role of compost in terms of increasing the availability of plant nutrients, especially magnesium, which enters into the main structure of chlorophyll. Such results came along with those reported by El-Shinnawi *et al.* (2011) and Siam *et al.* (2015).

The results showed that foliar spray with KP (potassium citrate + phosphate) followed by KSi (potassium oxide + silicon oxide) without significance between them had significant effect on photosynthetic pigments of peanut leaves at 60 days after sowing in both seasons. As an average of both seasons, foliar application of KP and KSi enhanced chlorophyll content amounted to 10.73 and 9.75 %, respectively more than untreated plants. Other researchers reported the importance of nutrients such as P and K in enhancing photosynthetic pigments as recorded by Ali (2005) who found that foliar application of 1% K and 1% P produced highest values of chl. a, b and chl.(a+b) as compared with untreated faba bean plants.

The interaction between the fertilization systems and organic substances was found to be significant for photosynthetic pigments in the two seasons (Table 4). The highest values of total chlorophyll (SPAD value) was recorded when plants were treated with 100 % compost and sprayed with KP. Meanwhile, the lowest ones were obtained from fertilized plants with 100 % NPK and unsprayed treatment.

Nodulation

Number and nodules weights as influenced by fertilization systems, organic substances and their interaction are given in Table (4). It is evident that all fertilization systems caused a remarkable increase in number and nodules weights/plant as compared with traditional fertilized plants. Application of 100 % compost exhibited the highest number and fresh and dry weights/plant compared to that recorded by 100 % mineral NPK. The enhancement of nodulation due to applying compost could be attributed to the prominent role of decomposed organic matter for improving the physical, chemical and biological properties of soil, increasing of nutrient availability and microbial activity in rhizosphere zone and enhancing the root proliferation and consequently boosting the nodulation status as compared with unfertilized plants (Rizk *et al.,* 2012 and Soliman, 2013).

Table 4. Chlorophyll and nodulation parameters of peanut plants as affected by fertilization systems, organic substances and their interaction during 2015 (S1) and 2016 (S2) seasons.

Fertilization systems	Organic substances	Total chlorophyll (SPAD value)		No. of nodules /plant		Fresh weight of nodules /plant (g)		Dry weight of nodules /plant (g)	
		S1	S2	S1	S2	S1	S2	S1	S2
100%		36.28	36.07	37.42	36.17	1.330	1.370	0.418	0.723
100%		39.23	39.58	57.50	44.00	1.834	1.836	0.812	1.001
50%		36.75	36.87	54.25	41.33	1.493	1.549	0.569	0.840
50%		38.67	38.45	49.50	39.50	1.573	1.573	0.561	0.889
LSD Fertilization		*1.37*	*1.21*	*8.67*	*5.84*	*0.35*	*0.39*	*0.21*	*0.18*
	Control	36.14	35.06	42.75	32.92	1.065	0.973	0.480	0.693
	KP	39.27	39.57	48.58	37.67	1.837	1.902	0.656	0.957
	KSi	39.05	39.09	52.33	44.33	1.821	1.831	0.638	0.922
	CT	36.47	37.24	55.00	46.08	1.508	1.621	0.586	0.881
LSD	Organic	*1.95*	*2.68*	*7.98*	*4.63*	*0.42*	*0.52*	*0.15*	*0.22*
100% mineral NPK	Control	31.80	33.10	27.67	30.67	0.953	0.740	0.230	0.573
	KP	37.47	36.73	32.33	33.67	1.627	1.430	0.447	0.777
	KSi	40.17	38.77	42.67	39.67	1.313	1.600	0.500	0.753
	CT	35.67	35.67	47.00	40.67	1.427	1.710	0.493	0.790
100% Compost	Control	37.27	36.97	51.67	31.67	1.200	1.150	0.754	0.893
	KP	42.90	43.63	57.00	41.00	2.160	2.200	0.885	1.137
	KSi	38.47	39.60	59.67	50.67	2.030	1.927	0.823	1.037
	CT	38.30	38.10	61.67	52.67	1.947	2.067	0.787	0.937
50% Compost + Ores mixture	Control	38.27	34.40	49.00	35.67	1.050	0.950	0.577	0.620
	KP	37.80	38.07	55.67	34.33	1.590	2.029	0.640	1.008
	KSi	36.77	37.73	55.33	46.33	1.953	1.903	0.573	0.880
	CT	34.17	37.27	57.00	49.00	1.380	1.313	0.487	0.850
50% Compost + Gypsum	Control	37.23	35.77	42.67	33.67	1.057	1.053	0.360	0.687
	KP	38.90	39.83	49.33	41.67	1.970	1.950	0.653	0.907
	KSi	40.80	40.27	51.67	40.67	1.987	1.895	0.653	1.017
	CT	37.73	37.93	54.33	42.00	1.280	1.393	0.577	0.947
LSD interaction 0.05		*3.89*	*5.36*	*15.95*	*9.25*	*0.83*	*1.04*	*0.30*	*0.43*

Control : tap water **KP: Potassium citrate + phosphate** **KSi : Potassium oxide + silicon oxide** **CT: compost tea**

With regard to effect of organic substances, the results showed that the highest values of nodules number was obtained from plants sprayed with CT (compost tea), while the heaviest nodules weight was recorded from plants treated with KP (potassium citrate + phosphate) in both seasons. KP and CT stimulated various aspects of nodulation development resulting in around good health of the legume plants, due to the presence of good amount of P in them. The diffusion coefficient of phosphate ion in the soil is very small, so the uptake of this nutrient is extensively dependent on the concentration gradient and the diffusion conditions of the soil or foliar application of P nutrient (Yadav *et al*., 2007). So, application of these organic substances may cause proliferated root development and enhanced nodulation. In this concern, significant increases in nodulation parameters were observed when plants were treated with compost tea (El-Gizawy *et al*., 2013) and potassium (Der *et al*., 2015) as compared with untreated plants.

Interaction between fertilization systems and organic substances significantly increased nodulation of peanut (Table 4). Significant increase in number of nodules/plant was obtained when plants received 100 % compost and sprayed with compost tea. However, the heaviest fresh and dry weights of nodules were achieved under fertilized plants with 100 % compost integrated with foliar application with KP. However, the lowest values of these traits were obtained by plants which were fertilized with 100% NPK and unsprayed with organic substances.

Yield and its components

The results presented in Table (5) indicated that yield and its components were significantly affected with the tested fertilization systems, organic substances and their interaction in both seasons. It can be noticed that application of 100 % compost (5 t/fed) produced the highest significant values of number of pods/plant, number of seeds/pod, weight of seeds/plant, pod yield/plant and pod yield/fed, whereas the application of 50 % compost + gypsum exhibited the heaviest seeds weight/pod and 100-seed weight. Appling gypsum before planting peanut put Ca in the pegging zone where it's needed. Gypsum gives favorable soil structure for root growth and water movement. Heaviest seed peanuts require plenty of soluble calcium for proper seed development. It can be noticed that the plants when fertilized with 100 % compost, 50 % compost + ores mixture and 50 % compost + gypsum caused increases in pods yield/fed amounted to 16.90, 10.64 and 9.62 % as an average of the two seasons more than traditional fertilized plants (100 % NPK), respectively. Therefore, the increases in yield under organic fertilization treatments found herein were logic, because of the organic fertilization role in increasing chlorophyll, nodulation and yield components as previously discussed. Similar results were reported by other investigators who found that peanut yield and its components were increased by application of compost (El-Sedfy *et al*., 2002; Abdel- Wahab *et al*., 2006 and El-Shinnawi *et al*., 2011) and gypsum (Sistani and Morrill, 1992 and Rahman, 2006).

Yield and its components exhibited positive response to foliar application with organic substances compared to untreated plants in both seasons. The highest values of all yield and its component traits were obtained by application of KP (potassium citrate + phosphate) in both seasons followed by KSi or CT. The superiority of KP treatment yield might be due to its roles in improvement of chlorophyll content and nodulation during growth stage. The application of the previous organic substances may be recommended for promoting plant growth characteristics which led to an encouragement of the seed formation owning to increasing the plant capacity. These results are confirmed by several investigators who found that yield and its components were enhanced by application of K (Umar *et al*., 1999; Aboelill *et al*., 2012 and Mekki, 2015), P (Gobarah, 2006) and CT (El-Shinnawi *et al*., 2011).

The interactions among the fertilization systems and organic substances were found to be significant for yield and its components except for weight of seeds/pod in the two growing seasons. It is evident from Table (5) that number of pods/plant, number of seeds/pod, weight of seeds /plant, pod yield/plant and pod yield/fed had the maximum values when the plants were fertilized with 100 % compost combined with foliar application of KP (potassium citrate + phosphate). However, the lowest significant values were obtained especially when the plants were fertilized with 100 % NPK without spraying any organic substances. On the other hand, soil application of 50 % Compost + Gypsum combined with foliar application of KP recorded the highest values of 100- seed weight in both seasons. The highest values of pods yield/fed (1.918 and 1.493 ton in the first and second seasons, respectively) were obtained by fertilizing peanut plant with 100 % compost (5 ton compost) combined with application of KP, indicating that such treatment is found to be the best treatment for high peanut productivity under the experiment conditions.

Seed oil percentage

Concerning the effect of fertilization systems and organic substances on oil seed percentage, results in Fig (1) showed that there were significant differences in oil percentage by different fertilization systems. Application of 100% compost exhibited the highest values in the two seasons, while 50% compost + gypsum application followed by chemical fertilization take the next rank without significance between them. The beneficial effect of compost on oil seed may be attributed to the promoting effects on nutrients uptake, especially phosphorous. These findings are in harmony with those obtained by El-Shinnawi *et al*., (2011).

It could be concluded also from the data illustrated in Fig (2) that foliar application of different organic substances significantly increased oil percentage compared to untreated plants. Moreover, it can be noticed that spraying of KP and CT found to be the most effective treatments for producing more oil content over the rest of the treatments. Improving oil peanut seed by application of nutrients were previously recorded such as K (Mekki, 2015), P (Gobarah, 2006) and compost tea (El-Shinnawi *et al*., 2011).

The interaction between the tested fertilization systems and organic substances were not significant for oil percentage in the two seasons. So, the data were excluded.

CONCLUSION

The obtained results emphasize the potential of applying organic fertilizers for increasing peanut productivity. Organic substances have positive effect in several metabolic processes, enhancing plant growth and development via playing a major role in increasing photosynthesis and nodulation. Regular use of organic amendments will reduce the need of synthetic fertilizers to the soil and plant. The advantages of organic fertilization are related to their uses for safe food production in sustainable agricultural development system. Finally, it could be concluded that application of 5 ton compost combined with foliar application of KP was the best fertilization system for increasing peanut productivity under the circumstances of this study.

Table 5. Yield and its components of peanut plants as affected by fertilization systems, organic substances and their interaction during 2015 (S1) and 2016 (S2) seasons.

Fertilization systems	Organic substances	No. of pods/ plant		No. of seeds/pod		Weight of seeds/pod		100-seed weight (g.)		Weight of seeds /plant (g.)		Pod yield/ plant (g.)		Pod yield/fed (ton)	
		S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
100% mineral NPK		30.29	37.79	1.60	1.67	1.34	1.16	48.3	41.6	37.3	44.40	54.7	52.3	1.411	1.35
100% Compost		44.63	42.79	1.84	1.80	1.35	1.23	50.4	44.9	48.4	47.51	65.2	57.2	1.777	1.45
50%Compost+Ores mixture		42.42	42.21	1.76	1.78	1.32	1.21	49.6	44.7	46.5	47.25	60.1	54.9	1.679	1.37
50% Compost + Gypsum		38.04	40.75	1.79	1.78	1.43	1.31	51.0	45.2	43.0	45.31	63.0	56.9	1.624	1.40
LSD Fertilization systems		9.51	4.08	0.10	0.09	0.11	0.13	2.14	3.24	8.77	2.51	7.31	3.27	0.120	0.082
	Control	32.75	38.04	1.61	1.50	1.31	1.10	47.63	41.31	37.38	43.96	56.91	51.13	1.390	1.339
	KP	42.13	43.17	1.87	1.90	1.41	1.31	51.03	47.03	49.93	47.66	64.50	58.90	1.784	1.437
	KSi	41.75	42.13	1.68	1.80	1.37	1.26	50.45	44.98	43.78	47.17	60.80	57.24	1.632	1.416
	CT	38.75	40.21	1.84	1.82	1.35	1.25	50.34	43.33	44.22	45.68	60.96	54.18	1.684	1.399
LSD Organic substances 0.05		7.12	3.29	0.16	0.21	0.10	0.19	2.09	4.25	6.21	3.05	6.11	4.62	0.152	0.049
100% mineral NPK	Control	28.00	35.00	1.52	1.40	1.32	1.01	45.89	38.04	33.02	40.26	50.19	45.39	1.052	1.258
	KP	30.00	39.50	1.59	1.85	1.42	1.24	49.72	45.03	40.74	46.89	60.37	56.32	1.597	1.400
	KSi	30.67	37.83	1.65	1.70	1.34	1.20	48.94	43.46	38.31	47.03	52.64	53.82	1.502	1.391
	CT	32.50	38.83	1.62	1.73	1.27	1.21	48.70	40.21	37.24	43.44	55.85	53.68	1.493	1.363
100% Compost	Control	36.33	40.83	1.70	1.57	1.19	1.13	48.38	42.98	43.87	47.46	62.97	54.07	1.661	1.428
	KP	48.67	45.17	2.08	1.98	1.49	1.36	51.47	48.27	54.96	49.89	67.57	61.28	1.918	1.493
	KSi	47.67	43.50	1.67	1.82	1.26	1.23	52.04	46.31	43.63	45.73	65.29	58.78	1.685	1.455
	CT	45.83	41.67	1.90	1.83	1.45	1.22	49.91	42.40	51.16	46.97	64.98	54.73	1.843	1.441
50% Compost + Ores mixture	Control	36.83	39.50	1.65	1.50	1.30	1.12	47.05	41.70	34.32	46.07	52.67	50.78	1.345	1.332
	KP	47.17	44.17	1.78	1.87	1.31	1.28	50.65	46.36	50.71	49.83	64.34	58.91	1.786	1.397
	KSi	48.00	43.67	1.71	1.85	1.37	1.21	49.82	44.79	53.13	47.56	62.93	58.41	1.772	1.366
	CT	37.67	41.50	1.90	1.92	1.31	1.24	51.21	46.24	47.92	45.52	60.82	51.79	1.812	1.422
50% Compost + Gypsum	Control	29.83	36.83	1.59	1.55	1.41	1.16	49.18	42.52	38.31	42.07	61.83	54.29	1.502	1.340
	KP	42.67	43.83	2.00	1.92	1.43	1.35	52.30	48.47	53.32	44.02	65.72	59.07	1.837	1.459
	KSi	40.67	43.50	1.67	1.85	1.50	1.38	51.00	45.36	40.03	48.36	62.36	57.95	1.569	1.454
	CT	39.00	38.83	1.93	1.80	1.39	1.33	51.54	44.46	40.53	46.80	62.19	56.52	1.589	1.371
LSD interaction 0.05		14.23	6.57	0.31	0.42	NS	NS	4.18	8.49	12.43	6.10	12.22	9.24	0.303	0.098

Control : tap water KP: Potassium citrate + phosphate KSi : Potassium oxide + silicon oxide CT: compost tea

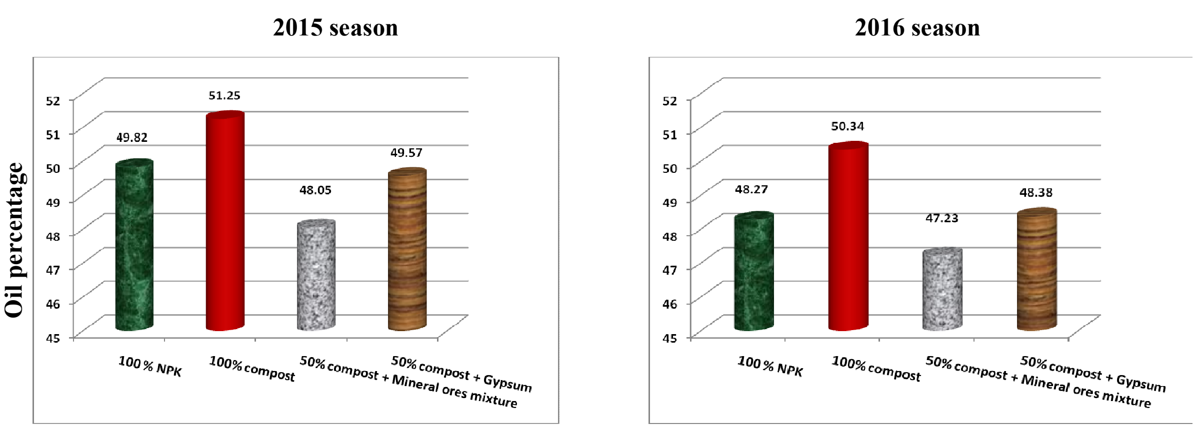

Fig. 1: Oil % as affected by fertilization systems during 2015 and 2016 seasons.

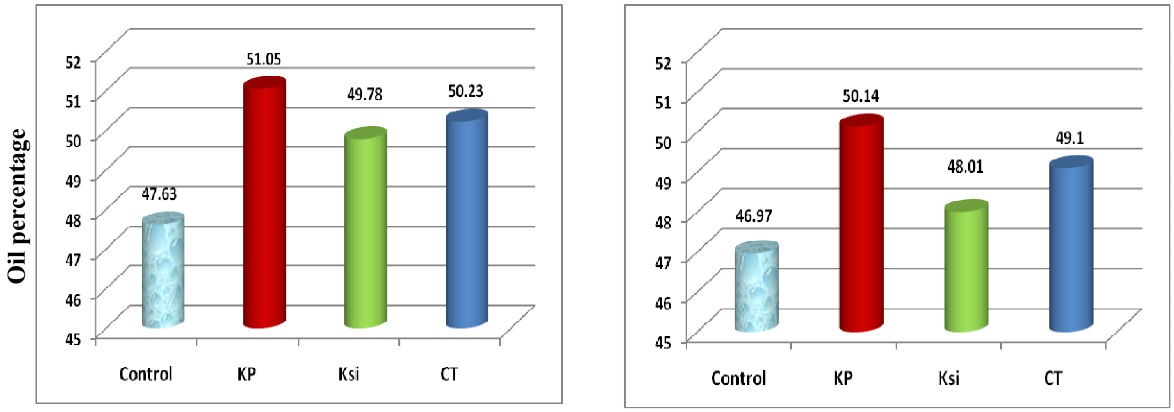

Fig. 2: Oil percentage as affected by organic substances during 2015 and 2016 seasons.

REFERENCES

Abdel- Wahab, A. F., G. A. A. Mekhemar, Heba, Sh. Sh. and A. A. Hanafi (2006). Effect of Plant growth bioprotecting and promoting rhizobacteria and compost on the healthy and productivity of peanut crop in sandy soil. Minufiya J. Agric. Res., 31: 1323- 1348.

Aboelill, A.A.; H.M. Mehanna, O.M. Kassab and E.F. Abdallah (2012). The response of peanut crop to foliar spraying with potassium under water stress conditions. Australian Journal of Basic and Applied Sciences, 6(8): 626-634.

Ali, Aisha H.; M.R. Shafeek, Asmaa R. Mahmoud and M. El-Desuki (2014). Effect of various levels of organic fertilizer and humic acid on the growth and roots quality of turnip plants (*Brassica rapa*). Current Science International, 3(1): 7-14.

Ali, O.A.M. (2005). Physiological studies on growth, flowering and productivity of some faba bean (*Vicia faba* L.) varieties. M. Sc. Thesis, Fac. of Agric., Menoufia Univ., Egypt.

Ali, O.A.M. (2015). Role of humic substances and compost tea in improvement of endogenous hormones content, flowering and yield and its components of faba bean (Vicia faba L.). Annals of agricultural science, Moshtohor, 53 (3): 373-384.

AOAC (2000). Official Methods of Analysis of the Association of Official Analytical Chemist, 17th Ed. Washington, D.C. USA.

Araf, M.M.; H.A. Abdel-Aal, S.I. Shaheen and M.H. Al Hanafy (2016). Effect of some natural compounds on yield, bulb quality and diseases control of two onion cultivars grown under sandy soil conditions. Menoufia J. Plant Prod., 1-15.

Chapman, H.D. and P.F. Pratt (1978). Methods of Analysis for Soils, Plants and Water, Division of Agricultural Sciences, University of California.

Der, H.N.; P.M. Vaghasia and H.P. Verma (2015). Effect of foliar application of potash and micronutrients on growth and yield attributes of groundnut. Ann. Agric. Res. New Series, 36 (3) : 275-278.

Edwards, C.A.; N.Q. Arancon and S. Greytak (2006). Effects of vermicompost teas on plant growth and disease. BioCycle 47, 28–31.

El-Gizawy, E.S.A.; A.A.I. Atwa, N.I.Talha and R.A.I. Mostafa (2013). Effect of compost and compost tea application on faba bean crop and some soil biological and chemical properties. J. Soil Sci. and Agric. Eng., Mansoura Univ., 4 (9): 863 - 874.

El-Sedfy, O.M.F.; A. Sh. A. Osman; I. M. A. Hegazi and Y.H. Awad (2002). Influence of organic amendments application on some physical properties and yield production of peanut and faba bean. Minufiya J. Agric. Res. 27 (2):1067-1080.

El-Shinnawi M.M., A.F.Abdel-Wahab, M.A. El-Howeity and Sh. A. Abdel-Gawad (2011). Potency of composts and their teas applied to sandy soil on controlling damping –off disease and peanut growth and yield. Egypt. J. Microbiol. 46, 153-175.

Enteshari, S.; M. Saadatmand and M. Pirzadeh (2012). Effect of vermicompost (cow manure) and mycorrhizal on some physiological characteristics of turnip (*Brassica rapa* L.) in hydroponic culture. The 1st International and the 4th National Congress on Recycling of Organic Waste in Agriculture 26-27 April in Isfahan, Iran.

Fageria, N.K., Baligar, V.C. and Jones, C. (1997) Growth and mineral nutrition of field crops 2nd Ed. Marcel Dekker, Inc, New York 1001 k, pp: 494.

Gobarah M.E., Mohamed M.H., Tawfik M.M. (2006). Effect of phosphorus fertilizer and foliar spraying with zinc on growth, yield and quality of groundnut under reclaimed sandy soils. J. Appl. Sci. Res. 2(80):491- 496.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall of India, Ltd., New Delhi, India.

Ma, J.F.; Y. Miyake and E. Takahashi (2001). Silicon as a beneficial element for crop plants. 17-39, *In L.E. Datnoff G.H. Snyder and G.H. Korndorfer Chapter 2 "Silicon in Agriculture" Elsevier Science B.V.*

Malakondaiah N. and G. Rajeswararao (1979). Effect of foliar application of phosphorus on growth and mineral composition in peanut plants (*Arachis hypogaea* L.) under salt-stress. Plant and Soil, 52, 41- 48.

Mekki B.B. (2015). Yield and yield components of groundnut (*Arachis hypogaea* L.) in response to soil and foliar application of potassium. American-Eurasian J. Agric. & Environ. Sci., 15 (10): 1907-1913.

Naidu, Y.; S. Meon, J. Kadir and Y. Siddiqui (2010). Microbial starter for the enhancement of biological activity of compost tea. Int. J. Agric. Biol., 12 (1): 51–56.

Rahman MA (2006). Effect of calcium and *Bradyrhizobium* inoculation of the growth, yield and quality of groundnut (*Arachis hypogaea* L.). Bangladesh J. Sci. Ind. Res. 41(3-4): 181-188.

Rizk T.Y; E.M. Soliman, F.E.EL-Araby and Hala A.M. EL-Sayed (2012). Growth response of peanut (*Arachis hypogaea* L.) to inoculation with bradyrhizobium conjugated with rhizobacteria under different levels of organic fertilization on sandy soil. *Egypt. J. Agron.* 34 **(**2): 179-200.

Shen X.F, X. Xiao, Z.Dong and Y. Chen (2014). Silicon effects on antioxidative enzymes and lipid peroxidation in leaves and roots of peanut under aluminum stress . Acta Physiol Plant, 36:3063–3069.

Siam, Hanan S; Safaa A. Mahmoud, A. S. Taalab1and Kh. A. Shaban (2015). Evaluation of nitrogen levels and application methods with or without compost on yield and quality of peanut under the newly reclaimed soils. International Journal of ChemTech Research, 8 (12): 01-12.

Sistani, K.R. and L.G. Morrill (1992). Foliar application of phosphorus and residual effect of gypsum on peanuts. J. of Environmental Science and Health. Part A: Environmental Science and Engineering and Toxicology: Toxic/Hazardous Substances and Environmental Engineering, 27(2): 317-327.

Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods, 7th Ed. The Iowa State Univ. Press, Ames. Iowa, USA.

Soliman, Fatma A. (2013). Maximizing the productivity of faba bean plant under different plant densities and organic agriculture systems. Ph.D. Thesis, Fac. of Agric., Menoufia Univ., Egypt.

Stratton, M.L., A.V. Barker, and J.E. Rechcigl. (1995). Compost. pp. 249- 310. *In*: J.E. Rechcigl (Ed.). Soil Amendments and Environmental Quality. Lewis Publishers, London.

Tognetti, C.; F. Laos, M.J. Mazzarino and M.T. Hernandez (2005). Composting vs vermicomposting: a comparison of end product quality. Compost Sci. Util. 13: 6-13.

Umar, S; S.K. Bansal, Patricia Imas and H. Magen (1999). Effect of foliar fertilization of potassium on yield, quality, and nutrient uptake of groundnut, Journal of Plant Nutrition, 22 (11): 1785-1795.

Williams, N.R. and S. Holtzhausen (2001). The impact of ore characterization and blending on metallurgical plant performance. The Journal of the South African Institute of Mining and Metallurgy, November/December: 437-446.

Yadav, S.S., R. Redden, W. Chen and B. Sharma (2007). Chickpea Breeding & Management. (eds.). Cabi Publishing, 142-159.

Yao X.; L.I. Jing; H.E. Xia; L. Hong; X.F. Shen (2014). Effect of silicon on the morphological and physiological characteristics of peanut seedling under aluminum stress. Chinese Journal of Oil Crop Sciences, 36 (6): 815-818.

تأثير الاضافات الغذائية العضوية على النمو الخضرى وتكوين العقد الجذرية ومحصول الفول السودانى المنزرع تحت أنظمة تسميد مختلفة

فاطمة عبد المقصود أحمد سليمان

المعمل المركزى للزراعة العضوية – مركز البحوث الزراعية - مصر

أجريت تجربتان حقليتان بحقل ارشادى خلال الموسمين ٢٠١٥ و ٢٠١٦ بقويسنا – محافظة المنوفية – مصر بغرض تقييم أثر الإضافة الأرضية لنظم التسميد (١٠٠% NPK تسميد معدنى ، ١٠٠% كمبوست ، ٥٠% كمبوست + ٥٠٠ كجم مخلوط الخامات الطبيعية ، ٥٠% كمبوست + ٥٠٠ كجم جبس زراعى) وبعض المركبات العضوية (بدون للمقارنة ، KP ، KSi ، شاى الكمبوست) على صفات النمو الخضرى ومحتوى الأوراق من الكلوروفيل ، صفات العقد الجذرية و المحصول ومكوناته لنبات الفول السودانى (صنف جيزة ٦). أوضحت النتائج أن لإضافة التسميد والمركبات العضوية أثر فعال فى تحسين نمو وإنتاجية الفول السودانى النامى بتربة رملية طميية .وقد أظهرت النتائج أن إضافة نظام التسميد ٥٠% كمبوست + مخلوط الخامات الطبيعية أدى إلى الحصول على أعلى قيم لصفات النمو الخضري (عدد الأفرع الرئيسية للنبات ، الوزن الجاف لأوراق وسيقان النبات ، مساحة أوراق النبات) بينما تفوقت إضافة المعاملة ١٠٠% كمبوست فى تحسين صبغات التمثيل الضوئى (محتوى الأوراق من الكلوروفيل الكلى) ، صفات العقد الجذرية (عدد وأوزان العقد الجذرية للنبات) ، والمحصول ومكوناته (عدد القرون للنبات ، عدد بذور القرن ، وزن البذور للنبات ، محصول القرون للنبات والفدان) والمكونات الكيميائية للبذور (نسبة الزيت) وذلك مقارنة ببقية نظم التسميد المختبرة .اختلفت استجابة نباتات الفول السودانى معنويا لصفات النمو الخضرى والكلوروفيل والعقد الجذرية والمحصول ومحتوى الزيت بالبذور وذلك برش المركبات العضوية حيث أظهرت النتائج ان كل من المعاملة KP ، KSi قد تفوقت تفوقاً ملحوظاً على بقية المركبات العضوية الأخرى فى إنتاج أعلى قيم للصفات تحت الدراسة. بينما اعطت النباتات غير المعاملة أقل القيم للصفات المدروسة .أوضحت النتائج معنوية التفاعل بين نظم التسميد و المركبات العضوية لمعظم الصفات المدروسة باستثناء وزن بذور القرن و نسبة الزيت بالبذور. هذا وقد تحقق أعلى إنتاجية لمحصول القرون بالفدان بالإضافة الأرضية ١٠٠% كمبوست مقترنا بالرش الورقى للمركب العضوى KP مما يشير إلى أن مثل هذه المعاملة هى الأفضل لتعظيم إنتاجية الفول السودانى وذلك تحت ظروف الدراسة. لذا توصي الدراسة بأهمية الاستخدام المنتظم للإضافة الأرضية والورقية للأسمدة والمركبات العضوية لتقليل الحاجة إلى الأسمدة الكيماوية وإنتاج غذاء آمن خلال نظم التنمية الزراعية المستدامة .