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Effect of Integrated Some Amendments and Bio-Fertilizers with Mineral-N Fertilization on Soil Fertility and Peanut Crop Productivity

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Abstract: Two field experiments were conducted during the two successive summer seasons of 2019 and 2020, on a loamy sand soil at El-Qantra Shark, Ismailia Governorate, Egypt. The aim was to study the effect of nitrogen fertilizer as Urea (46% N) at different rates (15, 20 and 30) kg N fed^{-1} either alone or in a combination with compost at a rate of 5Mg fed^{-1}, bio-fertilizer, (*Rhizobium radiobacter* sp.) as salt tolerant PGPR strain as well as humate substances at a rate of 10 kg fed^{-1} on soil fertility and peanut (*Arachis hypogaea*) crop productivity. The results could be summarized as follow: The soil pH and EC were decreased due to application of compost with 20kg N fed^{-1} compared with the values of such values before planting. Also, in most cases, results reveal that the available content of NPK, after peanut harvest, were significantly influenced due to compost, bio- fertilization and K- humate applied with 20 kg fed^{-1} of mineral N fertilizer compared to mineral fertilizer alone. In most cases, the peanut yield and its components as well as N, P, K, Fe, Mn and Zn uptake of peanut seed were significantly increased due to compost, bio- fertilization and K- humate applied with 20 kg fed^{-1} of mineral N fertilizer compared to other treatments. The highest values of chlorophyll in peanut leaves at 70 days from planting and seed protein content were obtained when applying the 20 kg N fed^{-1}with compost or bio-fertilizer. Also, the proline content was increased with decreasing the rates of mineral N fertilizer in combination with all amendment treatments and the highest content of proline was obtained by application of 15 kg N/ fed^{-1} alone. So, it is worth mentioning the effective role of applied compost at the rate of 5Mg fed^{-1} or bio fertilizer in combination with urea at the rate of 20 kg N fed^{-1} could achieve the highest yield and best quality of peanut plants grown under salinity stress.

Key words: Groundnut · Saline soil · Urea Fertilizer · Bio-fertilizer · Compost · K-humate

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is an important oil and protein crop, it contains about 40-50% oil, 25-30% protein, 20% carbohydrates and 5% fiber and ash, having a substantial contribution to human nutrition [1]. About two third of world production of peanut is used for edible oil and the remaining one third is consumed directly as food [2]. As the production of oil crops in Egypt is insufficient, for local consumption, so it is of great importance to increase peanut productivity, which could be achieved not only through choosing the promising varieties but also through using proper fertilization management. In Egypt, peanut is successfully cultivated in the newly reclaimed sandy soils; however, these soils are mostly deficient in organic matter and poor in plant nutrients so, high rates of chemical mineral fertilizers, especially nitrogen, are used for maximizing seed yield with good quality. The coincident application of organic and bio-fertilizers is frequently recommended firstly for improving biological, physical and chemical properties of soil and secondary to get clean agricultural yield free from undesirable high dose of heavy metals and reduce the chemical fertilizers production cost [3]. In this respect, Hend *et al.* [4] stated that the yield of peanut could be increased by using integrated action of both chemical and bio-organic fertilizers.

Application of organic amendments and bio-fertilizers are universally recognized as an important bioingredient which play immense roles in soil fertility, crop production and land protection from contamination, degradation, erosion and desertification. Also, it is an effective means to help build long-term stable soil organic matter [5]. Hammad [6] found that addition of compost at 5 and/or 10 Mg fed^{-1} increased peanut seed yield, seed oil and nutrient contents than the untreated ones.

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Bio-fertilizers could be as an important component for biological nitrogen fixation. They offer an economically attractive and ecologically sound route for providing nutrient to the plant. Besides, they are low-cost, renewable source of nutrient and have no environmental hazards, so they could be partly the possible substitution for synthetic chemical fertilizers [7, 8]. Peanut like other legumes forms symbiosis with rhizobia. Symbiotic nitrogen fixation plays an important role in sustaining crop productivity and maintaining the fertility of the semi-arid soils [9]. Moreover Abou Hussien *et al.* [10] found that application of *Rhizobium* inoculation in combination with 50 kg N ha^{-1} (~ 20 kg N fed^{-1}) significantly increased dry matter, nitrogen content of seed and pod yield of groundnut crop.

Beneficial plant growth-promoting bacteria (PGPB) enhance plant growth and inoculants can also interfere with soil health and its microbial activity. The main promotion role on plant growth by PGPR may be due to the ability to produce phytohormones as cytokinin's and auxins in the rhizosphere promote seed germination and root elongation, N_2 fixation, antagonism against pathogen, solubilization of minerals and nutrients [11, 12]. Potassium humate has been widely used in the agricultural production applied directly to the soil and/or as a foliar application to the plants. Ihsan *et al.* [13] and Li *et al.* [14] elucidated that humic substances have positive effects on plant through improving soil structure and fertility besides influencing nutrient uptake and root architecture as well as it could act as a substance like hormone. Also, Liu *et al.* [15] found that the application of humic acid improved leaching process that led to reduce EC of the soil and improved yield components and seed quality of sesame under saline conditions. Moreover, Li *et al.* [16] reported that humic acid can improve the peanut yield and quality and chemical, biological and physical properties of the soils.

Soil salinity is one of the most crucial problems in arid and semi-arid regions of the world reducing the yield of wide variety of crops [17]. In this regard, Niaz *et al.* [18] showed that high salt concentrations in the soil reduce absorption of nutrients by wheat plants. Thus, salinity negatively affects the fertility of the soil. Moreover, it could alleviate the adverse effects of soil salinity on both soil and the grown peanut plants by using organic, inorganic and bio fertilizer [19].

The current study aimed to evaluate the effect of compost, bio fertilizer (*Rhizobium radiobacter sp. strain*) and humic acid added in combination with different rates of mineral N fertilizer on yield productivity and quality of peanut seeds as well as, on some soil properties, after harvesting, under saline condition.

MATERIALS AND METHODS

Two field experiments were conducted, during the two successive summer growing seasons 2019 and 2020, on a sandy loam soil at El-Qantra Shark, on the eastern side of the Suez Canal at Ismailia governorate (30.85° N and 32.31° E). This area is irrigated from El-Salam Canal. The objective was to investigate the effect of different mineral N fertilizer rates added in combination with or without compost, bio fertilizer (*Rhizobium radiobacter sp. strain*) and potassium humate on yield productivity and quality of peanut seeds as well as some soil properties after harvesting, under saline condition. The main physical and chemical properties of cultivated soil, before planting, were determined according to the methods described by Piper [20] and Page *et al.* [21]. Soluble cations and anions, pH, organic matter, calcium carbonate, electrical conductivity and available N, P and K, Fe, Mn and Zn were determined as described by Jackson [22]; Black [23] and Lindsay and Norvell [24]. The obtained data of the tested properties of the soil were recorded in Table (1).

The experiment treatments comprised as the following:

Mineral N-fertilizer at the rate of 15kg $Nfed^{-1}$
Mineral N-fertilizer at the rate of 20 kg $Nfed^{-1}$
Mineral N-fertilizer at the rate of 30 kg $Nfed^{-1}$
Compost with 15kg $Nfed^{-1}$ (mineral N-fertilizer)
Compost with 20kg $Nfed^{-1}$ (mineral N-fertilizer)
Bio-fertilizer with 15kg $Nfed^{-1}$ (mineral N-fertilizer)
Bio-fertilizer with 20kg $Nfed^{-1}$ (mineral N-fertilizer)
K-humate with 15kg $Nfed^{-1}$ (mineral N-fertilizer)
K-humate with 20kg $Nfed^{-1}$ (mineral N-fertilizer)

All treatments randomly distributed in a randomized complete block design with three replicates.

Seeds of Peanut (*Arachis hypogaea* L., cv. *Gregory*) were sown on 21^{th} and 15^{th} May in 2019 and 2020, respectively at a rate of 40 kg fed^{-1}. Before sowing, all peanut seeds were inoculated with specific *Rhizobium* for peanut by coating the seeds with the gum media carrying the specific *Rhizobium* on the same day of sowing.

Potassium humate at a rate of 10 kg fed^{-1} and compost was applied at a rate of 5 Mg fed^{-1}; were incorporated with the soil before sowing. A commercial solid product of humic substances (HS); having humic

Table 1: Some Physical and chemical characteristics of the studied soil before planting

Property	Value	Property	Value
Particle size distribution		Soluble ions (mmole L^{-1})	
Clay %	10.03	Na^+	40.78
Silt %	6.80	K^+	0.83
Sand %	83.17	Ca^{++}	15.81
Textural class	Sandy Loam	Mg++	10.68
EC (dSm^{-1})		Cl^-	40.78
in soil paste extract		HCO_3^-	7.14
pH [Soil suspension 1:2.5]	8.06	$SO_4^=$	20.18
Organic matter (%)	0.53		
$CaCO_3$ (%)	1.23		

Available macro and micronutrients (mg kg^{-1} soil)

N	P	K	Fe	Mn	Zn
38.95	3.80	190	1.73	3.39	0.62

Table 2: Some chemical properties of the used compost

					Total macro nutrients (%)			Total micro- nutrients (mg kg^{-1})		
Moisture (%)	EC(dS m^{-1}) 1:10	pH 1:2.5	O.M (%)	C/N ratio	N	P	K	Fe	Mn	Zn
18	4.62	7.61	34.49	21.1	1.89	0.70	2.48	163	46	60

acid (85%), potassium (12%) and fulvic acid (3%) was used. The plots of bio-fertilizer seeds were inoculated with the PGPR using Arabic gum as an adhesive material just prior to sowing. The compost analysis was done according to the standard methods as described by Brunner and Wasmer [25] and chemical composition of compost is shown in Table (2).

Bio-fertilizer *Rhizobium radiobacter* sp. strain (salt tolerant plant growth promoting rhizobacteria, PGPR) having several HQ395610 and *Rhizobium* for peanut were provided by the Soil Microbiology unit at Soils, Water and Environment Res. Inst. Agric. Res. Center Giza, Egypt.

The recommended calcium super- phosphate (15.0 % P_2O_5) at a rate of 200 kg $fed^{-1}$was added during soil preparation. Potassium sulphate (48 % K_2O) at a rate of 100 kg fed^1 was added in two equal doses: 30 and 45 days after sowing. These mineral fertilizer rates were recommended by Egyptian Ministry of Agriculture bulletin. Mineral N fertilizer was applied at rates of 15, 20 and 30 kg N fed^{-1} as urea (46 %N); in three equal doses, after thinning (20 days from sowing), 30 and 45 days later.

After 70 days from sowing, ten plants were randomly taken to determine photosynthetic pigments (Chlorophyll content) according to Witham *et al.* [26] and proline contents in fresh leaves according to Bates *et al.* [27].

Surface soil samples (0-30 cm) were collected from all the experimental plots on harvesting, air dried, crushed and sieved through a 2 mm sieve and analyzed to determine soil EC, pH and available N, P, K, Fe, Mn and Zn contents according to the same methods used for analyzing the initial soil.

At maturity, the middle three rows of each plot were harvested on 16th and 25th September in the first and second season, respectively and air dried to determine the following traits:

Hay yield (Mg fed^{-1}).
Pod yield (Mg fed^{-1}).
Seed yield (Mg fed^{-1}).
100- Seed weight (g).

Seeds were ground and 0.5g was digested by a mixture of concentrated H_2SO_4 and $HClO_4$ acids mixture (1:1) for nutrients determination according to Sommers and Nelson [28]. The plant content of N, P, K, Fe, Mn and Zn was determined in plant digestion using the methods described by Cottenie *et al.* [29] and Chapman and Pratt [30]. Crude protein in peanut seeds was calculated by multiplying total N-content by the converting factor 6.25 [31]. Fe, Mn and Zn were determined by using Atomic Absorption (model GBC 932). Oil seed content was determined using the Soxhelt method [32].

All data were subjected to statistical analysis according to Snedecor and Cochran [33]. The least significant differences (LSD at 0.05) were used to compare the treatment means.

RESULTS AND DISCUSSION

Soil Properties

Soil pH: The effect of compost, bio-fertilizer and K-humate combined with different rates of mineral N fertilizer on soil pH is presented in Table (3). Data show that the soil pH decreased from 8.06 to 7.94 due to application of compost with 20kg N fed^{-1} compared with the value of pH before planting. The obtained findings could be related to the role of compost in enhancing the microbial activity in the soil which accelerates the decomposition of the organic matter and produce organic acids having favorable impact on soil fertility and decreasing soil pH. These results are similar to those found by Siam *et al.* [34] who reported that the decrease in pH was remarkable particularly when N and compost fertilization were combined. These results are in agreement with those reported by Gomaa *et al.* [35] and Shaban *et al.* [36] who found that the application of compost and bio-fertilizer combined with different rates of mineral N fertilizer reduced the soil pH. Also, the data reveal that the soil pH, tended to decrease with increasing the mineral N fertilizer rates either added solely or in combination with compost, bio-fertilizer and /or K-humate. As for the effect of bio-fertilizer, it seems that microorganisms played remarkable role of in decomposing organic matter, releasing hydro carbonic acids and producing several phytohormones such as indole acetic acid and cytokinin's in the rhizosphere led to decreasing in soil pH [37]. These results are similar to those obtained by Armand *et al.* [38]. Regarding the effect of humic acid Bayoumi and Selim [39] found that application of humic acid individually or combined with N fertilizers decreased pH. These results are similar to those obtained by Li *et al.* [16].

Soil EC: Electric conductivity (EC) after planting is given in Table (3). The results showed that the soluble salts were significantly decreased when the compost, bio-fertilizer and humate were applied accompanied with N-fertilizers and the lowest EC value (4.88dSm^{-1}) is recorded with the treatment of compost +20 kg N fed^{-1}. Reductions of electric conductivity resulted from the studied treatments could be arranged as the following: compost > bio-fertilization > humate > mineral N with highest rate (30 Kg N fed.$^{-1}$). These results are in consonance with those reported by Helmy *et al.* [40] who noticed that soluble salts decreased when the compost or bio-fertilizers were applied alone or in combination with N-fertilizer. These results could be related to the influence of compost on total porosity and improving soil aggregation and possible moving salt soil under irrigation water. These results are in harmony with those obtained by Abid *et al.* [37]. In this respect, Chuong *et al.* [41] showed that the role of compost in attenuating EC and the role of bio-fertilizer were stressed by Albdaiwi *et al.* [42] and Yasmin *et al.* [43] who reported that the potential of PGPR to ameliorate the effects of salt stress is linked to the production of phytohormones, such as (IAA, CK, ABA) and activity of the 1-aminocycloprpoane-1-carboxylate (ACC) deaminase enzyme which break down the ethylene precursor ACC then prevent plant from adverse effects of stress ethylene under salt stress. The application of humic acid in improving leaching process and reducing EC values were demonstrated by El-Maaz and Ismail [44].

Available Content of Macro and Micronutrients in Soil after Peanut Harvest: Data presented in Table (3), show the amounts of some available macro and micronutrients namely; N, P and K (mg kg^{-1}) as well as Fe, Mn and Zn in the studied soil after peanut harvest as affected by different treatments. Data, in most cases, reveal that the available content of such parameters, after peanut harvest, were significantly influenced due to compost, bio- fertilization and K- humate applied with 20 kg Nfed^{-1} of mineral N fertilizer. It should be mentioned here that application of compost was superior of all treatments. It is worthwhile speculating on the role of N fixing bacteria, inoculated to peanut, in taking part in elevating soil nitrogen. Nutrients increments over the sole application of 30kg N fed^{-1} resulted from application of compost amendment integrated with 20 kg N fed^{-1} , were 11.31% for nitrogen, 6.56% for phosphorus and 6.98% for potassium. This may be due to the vital role of compost in increasing nutrients availability through the processes of chelating and production of several organic acids during decomposition of compost which lead to release more available micronutrients as reported by Dhaliwal *et al.* [45]. These results are in agreement by Soheil *et al.* [46] and Rady *et al.* [47]. As for the addition of bio-fertilizers, their role in enhancing the microorganism activities in soil and decomposition of organic matter positively affected the availability of these elements in the soil [36]. Furthermore, Seddik *et al.* [48] reported that PGPR as bio-fertilizer helps in fixing N, solubilizing mineral phosphates and other nutrients as well as enhancing tolerance to stress. Moreover, Ennab [49] found that the application of humic acid increased significantly available N, P, K, Fe, Mn and Zn in the saline soil. In this concern, Abobatta and EL-Azazy [12] reported that humic substances effects on the soil due to carboxyl, hydroxyl, amide and other hydrophilic groups, which work as chelating nutrients and improve soil cation exchange and soil properties like holding water, pH and EC.

Table 3: pH, EC and available macro-and micronutrient contents in soil after harvesting of peanut plant (mean of the two seasons)

Treatments	pH(1: 2.5)	EC(dSm^{-1})	Macronutrients (mg kg^{-1}) N	P	K	Micronutrients (mg kg^{-1}) Fe	Mn	Zn
Mineral N-fertilizer at the rate 15kg $Nfed^{-1}$	8.04	6.98	42.0	4.40	194	1.75	4.75	0.67
Mineral N-fertilizer at the rate 20 kg $Nfed^{-1}$	8.03	6.63	42.40	4.70	205	1.93	4.98	0.79
Mineral N-fertilizer at the rate 30 kg $Nfed^{-1}$	8.02	6.15	44.20	4.88	215	2.09	5.99	0.94
Compost with 15kg $Nfed^{-1}$ (mineral N-fertilizer)	8.00	5.48	46.70	4.68	213	1.92	4.96	0.77
Compost with 20kg $Nfed^{-1}$ (mineral N-fertilizer)	7.94	4.88	49.20	5.20	230	2.85	6.14	0.99
Bio-fertilizer with 15kg $Nfed^{-1}$ (N-fertilizer)	8.02	5.79	44.10	4.53	204	1.89	4.92	0.74
Bio-fertilizer with 20kg $Nfed^{-1}$ (mineral N-)	7.98	5.25	45.90	5.13	226	2.01	5.95	0.93
K-humate with 15kg $Nfed^{-1}$ (mineral N-fertilizer)	8.01	5.99	43.50	4.49	202	1.86	4.89	0.71
K-humate with 20kg $Nfed^{-1}$ (mineral N-fertilizer)	7.99	5.34	45.20	5.11	224	2.00	5.55	0.90
L.S.D 0.05	NS	0.49	1.45	0.31	9.56	0.13	0.11	0.09

Peanut Yield and its Components: The beneficial results obtained from soil properties and fertility status logically, were reflected on plants growth and consequently the yield and its components. However, such effects may be depending upon the application of N rates and the nature of the used organic fertilizers. Data of peanut yield and its components are presented in Table (4). The obtained results show that elevating the applied rate of N from 15 to 20 kg fed^{-1} , apart from mineral treatment, significantly augmented the yield and its components. Nonetheless, insignificant increase in pod and seed yields besides pod shelling was noticed, between these two levels, at the sole mineral treatment. It worth mentioning that mineral application at 30 Kg fed^{-1} recorded significant higher increase in the yield and its components compared with the other two lower rates of N applications. Bozorgi *et al.* [50] showed that the highest seed yield of peanut was obtained due to application of 80kg ha^{-1} (~ 33.3 kg N fed^{1}). Also, El-Habbasha [51] on his study on peanut yield reported that a significant increase in weight of seeds per plant, 100-pod weight and 100-seed weight was achieved with two nitrogen rates namely, 60 and 120N kg ha^{-1}(~ 25 and 50 kg N fed^{1}) and the highest value was assigned for the highest N rate.

In the current study, results, in most cases, reveal that the peanut yield and its components were significantly increased due to compost, bio- fertilization and K- humate applied with 20 kg fed^{-1} of mineral N fertilizer compared with other treatments. It is worthy to mention that application of compost amendment with 20 Kg N fed^{-1}resulted in increments over the sole application of 30kg N fed^{-1} by 16.7% for hay yield, 21.19% for pod yield and 31.53% for seed yield. These results resemble those obtained by Kumar *et al.* [52], who found that composting fertilization had an impact on total carbohydrate, total chlorophyll, proteins content, dry weight of shoot and root, pod yields and 100-seed weight in peanut plant. In the current work it is interesting to denote the impact of compost and humate application in elevating the yield of peanuts and its components especially in the soil is considered slightly saline. The role of compost in improving the physical properties of soil was ascertained earlier. Its favorite effects on the yield of peanuts in this study are eminent. This may be due to lessening the EC of soil on one hand and enriching such soil with some macro and micronutrients on the other hand.

The beneficial effects of using bio-fertilizer in the present study were confirmed by the work of some researchers Maral *et al.* [53]; Abou Hussien *et al.*[10] and El-Sayed [54] they reported that PGPR isolates (Plant growth-promoting) significantly enhanced pod yield and haulm yield of peanut over the control. Moreover, other attributes like root length, pod number, 100-kernel were also enhanced. Also, Argaw [55] found that application of *Rhizobium* inoculation in combination with 40 kg N ha^{-1} significantly increased dry matter, nitrogen content of seed and pod yield of peanut crop. The enhanced effect of bio-fertilizer could be due to its effect of improving root growth, enhancing number and weight of nodule, hence, increasing nitrogen fixation and mineral uptake which reflected on better vegetative growth and yield. This may be explained as the application of biofertilizer could produce plant promoting growth substances, like IAA, gibberellin and cytokinin [56].

As for the beneficial effect resulted from application of humate it seems that it played a substantial role in curbing the salinity of the soil in which peanut was grown on. Similarly, Fahramand *et al.* [57] found that the indirect influences of humic acids on plant growth are improving soil properties such as aggregation, aeration, permeability, water holding capacity, hormonal activity, microbial growth, organic matter mineralization and solubilization and availability of microelements (Fe, Zn and Mn) elements. The obtained results of humic acids effect on yield of peanut crop are in agreement with those reported by Li *et al.* [16] and Li *et al.* [14].

Table 4: Yield and its components of peanut (mean of the two seasons)

Treatments	Hay yield (Mg fed.$^{-1}$)	Pod yield (Mg fed.$^{-1}$)	Seed yield (Mg fed.$^{-1}$)	100-seed weight (g)	Podshelling(%)
Mineral N-fertilizer at the rate 15kg Nfed^{-1}	1.255	1.088	0.616	70.94	56.62
Mineral N-fertilizer at the rate 20 kg Nfed^{-1}	1.338	1.102	0.672	72.55	60.98
Mineral N-fertilizer at the rate 30 kg Nfed^{-1}	1.497	1.175	0.885	79.50	75.32
Compost with 15kg Nfed^{-1} (mineral N-fertilizer)	1.387	1.132	0.817	75.81	72.17
Compost with 20kg Nfed^{-1} (mineral N-fertilizer)	1.748	1.424	1.164	82.84	79.63
Bio-fertilizer with 15kg Nfed^{-1} (N-fertilizer)	1.349	1.129	0.796	76.98	70.50
Bio-fertilizer with 20kg Nfed^{-1} (mineral N-)	1.969	1.368	1.081	80.44	79.02
K-humate with 15kg Nfed^{-1} (mineral N-fertilizer)	1.347	1.127	0.761	74.60	67.52
K-humate with 20kg Nfed^{-1} (mineral N-fertilizer)	1.682	1.362	1.059	79.62	77.75
L.S.D 0.05	0.058	0.071	0.074	1.77	1.84

Chlorophyll and Proline in Peanut Leaves as Well as Protein and Oil Content in Peanut Seed: Data in Table (5) revealed that the contents of chlorophyll and protein were significantly increased owing to utilizing of all studied amendments at different rates of nitrogen. The highest values of chlorophyll and protein content were obtained when applying 20 kgNfed^{-1} with compost or bio-fertilizer. The corresponding relative increases of chlorophyll contents in fresh leaves were 9.46% and 5.07% for compost and bio-fertilizer, respectively in combination with 20 kg N fed^{-1} compared with treatment of 30 kg N fed^{-1} alone. The obtained results are in agreement with those reported by Purbajanti *et al.* [58], who found that flower waste compost or *Rhizobium*, compared with NPK fertilizer, significantly increased chlorophyll a and b as well as total chlorophyll in leaves of peanut. Also, in our study the application of humate with different rates of nitrogen increased chlorophyll contents in leaves of peanut. These results agree with those obtained by Li *et al.* [16]. Also, the same treatment achieved 10.20 % in seed protein content over seed content of plants received solely 30 kg N fed.$^{-1}$ (control). The current results are in agreement with those reported by Gomaa *et al.* [35]. The increase in protein content of seed could be attributed to the integrated effect of N-fertilization with bio-fertilizer together on the nutrient's uptake. These results are in agreement with Sharma *et al.* [59] who found that bio-fertilizer with mineral nutrient was more effective in increasing protein content of peanut plants as compared with the individual mineral fertilization.

As for proline content, in leaves at 70 days from planting, the data revealed that there were significant differences among all treatments and their combination. The proline content was increased with decreasing the rates of mineral N fertilizer in combination with all amendment treatments and the highest content of proline was obtained by application of 15kgN fed^{-1} alone. However, the lower values were recorded for 20kgN fed^{-1} integrated with compost. Nour El -Din and Salama [60] reported that proline accumulation is a common metabolic response of higher plants for resistance against salinity stress and found that application of compost decreased the proline accumulation in wheat plants grown in saline soil. Helmy *et al*. [40] studied the effect of nitrogen fertilizer, bio-fertilizer and compost on total proline content in the dry matter of barley grains. They found that the highest proline content obtained by minerals N and the treatments arranged due to their effects on proline accumulation at the following order: mineral nitrogen > Compost +N > bio-fertilizer +N. Their results are in agreement with those reported by Shaban *et al.* [36]. Also, data reveal that a significant decrease in proline content is due to the effect of the combined treatment of the tested humate and the two rates of N fertilizer (15 and 20 Kg N/ fed^{-1}) compared with different rates of N fertilizer solely.

Also, data of oil content in peanut seeds presented in Table (5) revealed that all applied treatments weren't affected significantly on oil percent of peanut seeds. The highest seed oil content was achieved by the treatment of compost integrated with 20 kg N fed^{-1}. These results may be due to the higher N absorption which had enhanced more Acetyl Co-A formation, which was related to oil formation [52].

Macronutrients Content in Peanut Seeds: The entire treatments positively influenced nitrogen, phosphorus and potassium uptake, in peanut seeds in (Table 6). The tested treatments showed a descending increase for N, P and K-uptake in the order: compost > bio-fertilizer > humate > minerals.

The data cleared up that the highest values of N, P and K uptake were achieved due to application of compost or biofertilizer with 20 kg N fed^{-1}. This might be related to the role of compost which created favorable soil

Table 5: Proline and chlorophyll contents in fresh leaves as well as oil and protein contents (%) in seeds of peanut as affected by the treatments (mean of the two seasons)

	Leaves		Seeds	
	Chlorophyll content (mg/g fwt.)	Proline content (µg/g f wt.)	Oil content (%)	Protein content (%)
Mineral N-fertilizer at the rate 15kg $Nfed^{-1}$	4.16	289.3	42.29	17.75
Mineral N-fertilizer at the rate 20 kg $Nfed^{-1}$	5.01	275.3	42.50	18.31
Mineral N-fertilizer at the rate 30 kg $Nfed^{-1}$	5.92	253.2	42.61	20.19
Compost with 15kg $Nfed^{-1}$ (mineral N-fertilizer)	5.89	215.3	42.98	21.31
Compost with 20kg $Nfed^{-1}$ (mineral N-fertilizer)	6.48	195.3	43.52	22.25
Bio-fertilizer with 15kg $Nfed^{-1}$ (N-fertilizer)	5.81	223.3	42.79	20.31
Bio-fertilizer with 20kg $Nfed^{-1}$ (mineral N-)	6.22	207.3	42.99	21.13
K-humate with 15kg $Nfed^{-1}$ (mineral N-fertilizer)	5.17	269.7	42.55	20.19
K-humate with 20kg $Nfed^{-1}$ (mineral N-fertilizer)	5.95	228.3	42.87	21.00
L.S.D 0.05	0.223	5.10	NS	0.86

Table 6: N, P and K-uptake (kg fed^{-1}) of peanut seeds as affected by the studied treatments (mean of the two seasons)

Treatments	N uptake (kg fed^{-1})	P uptake (kg fed^{-1})	K uptake (kg fed^{-1})
Mineral N-fertilizer at the rate 15kg $Nfed^{-1}$	17.49	2.29	16.45
Mineral N-fertilizer at the rate 20 kg $Nfed^{-1}$	19.69	2.70	19.96
Mineral N-fertilizer at the rate 30 kg $Nfed^{-1}$	28.59	3.98	22.08
Compost with 15kg $Nfed^{-1}$ (mineral N-fertilizer)	27.86	4.41	24.28
Compost with 20kg $Nfed^{-1}$ (mineral N-fertilizer)	41.44	6.31	34.59
Bio-fertilizer with 15kg $Nfed^{-1}$ (N-fertilizer)	25.87	4.28	23.00
Bio-fertilizer with 20kg $Nfed^{-1}$ (mineral N-)	36.54	6.10	34.14
K-humate with 15kg $Nfed^{-1}$ (mineral N-fertilizer)	24.58	3.47	21.57
K-humate with 20kg $Nfed^{-1}$ (mineral N-fertilizer)	35.58	5.24	33.02
L.S.D. 0.05	1.512	0.57	1.88

Table 7: Fe, Mn and Zn-uptake of peanut seeds as affected by the studied treatments (mean of the two seasons)

Treatments	Fe-uptake (g fed^{-1})	Zn-uptake (g fed^{-1})	Mn-uptake (g fed^{-1})
Mineral N-fertilizer at the rate 15kg $Nfed^{-1}$	47.89	12.46	20.47
Mineral N-fertilizer at the rate 20 kg $Nfed^{-1}$	60.81	16.06	30.44
Mineral N-fertilizer at the rate 30 kg $Nfed^{-1}$	64.07	17.17	35.34
Compost with 15kg $Nfed^{-1}$ (mineral N-fertilizer)	59.05	16	29.96
Compost with 20kg $Nfed^{-1}$ (mineral N-fertilizer)	92.61	22.66	45.13
Bio-fertilizer with 15kg $Nfed^{-1}$ (N-fertilizer)	56.28	15.82	28.03
Bio-fertilizer with 20kg $Nfed^{-1}$ (mineral N-)	86.67	21.68	43.33
K-humate with 15kg $Nfed^{-1}$ (mineral N-fertilizer)	55.70	16.31	27.44
K-humate with 20kg $Nfed^{-1}$ (mineral N-fertilizer)	84.80	21.04	42.20
L.S.D. 0.05	2.43	1.49	1.64

physical and chemical conditions and hence affecting the solubility and availability of nutrients and the uptake of nutritional elements. These results coincide with the results of Kumar *et al.* [52] who found that plants fertilized with compost showed marked increases in essential macro- and micronutrients that resulted in improving root development and upper seed of growth plant of groundnut.

Also, Li *et al.* [16] found a significant increase in N, P and K content in seed of peanut plants as response to humic acid application. Mondal *et al.* [61] cleared up that the use of bio-fertilization of peanut with mineral fertilization significantly increased yield and yield components of peanut and N, P and K (%) in seed.

Micronutrient Contents in Peanut Seeds: Fe, Mn and Zn uptake by peanut seeds as affected by the studied applications are shown in Table (7). The uptake of Fe, Mn and Zn increased significantly by the addition of all tested treatments. The treatment of compost or biofertilizer or K humate with 20kg$Nfed^{-1}$gave the highest values of Fe, Zn and Mn uptake compared to the other treatments and the percentages increase of Fe, Zn and Mn uptake by peanut seeds over treatment of 30 kg N fed^{-1} were 44.55, 31.97 and 27.70 %, respectively.

However, Shaban *et al.* [62] reported that the application of compost, humic acid and bio-fertilizer combined with mineral N fertilizer caused marked increases in micronutrient contents of Fe, Mn and Zn in sesame seeds. Also, Hend *et al.* [4] found that combined mineral N fertilizer with compost was reflected in the peanut seeds content of N, P, K, Fe, Mn, Zn and protein.

The increased uptake of macro and micronutrient in peanut seeds due to addition of humic acid soil are supported by Li *et al.* [14].

CONCLUSION

Results from the current study indicated that application of organic materials like, compost, bio-fertilizer and K-humate as a partial substitution of the chemical fertilization, improve chemical characteristics of the soil and could in part protect the environment from chemical pollution hazards besides compost being as storehouse for macro and micronutrients. The application of compost, bio-fertilizer and humate led to improve crop productivity and seed quality of peanut with a relatively lower cost. Finally, under the current experimental conditions, it is worth mentioning that effective role of applied compost at the rate of 5 Mg fed^{-1} or biofertilizer in combination with Urea at the rate of 20 kg N fed^{-1} could achieve the highest yield and best quality of peanut plants grown under salinity stress.

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