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Evaluation of Nitrogen Levels and Application Methods with or without compost on Yield and Quality of Peanut under the Newly Reclaimed Soils.

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Abstract: Two field experiments were conducted to study the effect of levels of nitrogen and efficient application method in the production of peanut (*Arachis hypogaea* L.). Using four levels of urea soil application (0, 10, 20 and 40 kg/acre) and four levels of urea foliar application (0, 1.25, 2.5 and 5%), the experiment was laid out in a split-plot design, where the main plots were used to determine the effective method of application and the sub plot used to detect the influence of N levels on the yield. Two different application methods (soil application and foliar spray) treated with or without organic compost. The average data obtained after two years of study indicated an increase in seeds yield, pods yield and weight of 100 seeds irrespective of the method used of urea application. The seeds yield increased from 350 to 790 kg/acre in the plots that were treated with 40 kg N/acre compared with the control plots.

The soil application method, producing an average seeds yield of 927 kg/acre was found to be superior to the foliar spray method with an average seeds yield of 859 kg/acre. Also, these results indicated that addition of compost increased weight of seeds yield, pods yield and weight of 100seeds as compared to plants which untreated with compost. Also, there was a markedly increase yield parameters, as well as chlorophyll (a+b) except proline decrease when addition of compost. Also, increasing levels of nitrogen either soil application or foliar application gradually increased all mentioned parameters. Furthermore increasing of N rate as foliar spraying with compost fertilizer was more effective and increased N,p,k content and quality parameters ,i.e. oil and protein in seeds peanut plants if compared to the other treatments . In addition the soil pH and Ec in soil after peanut harvest decrease value were increase rate of N fertilizer in the presence of compost fertilizer.

In regard to the nutrient content, it can be interfered that soil application and foliar spray urea application increased the content of some nutrients, oil and protein as compared with control.

Key words: foliar spray, seeds yield, N level, protein content, oil, compost, soil application.

Introduction:

Peanut is considered one of the important oil crops in Egypt. It has high nutritive values demand for a good human health, whereas it contains about 30% protein, 5% oil in addition to reaching vitamins A, B and C[1].

Soils in Egypt are poor on organic matter around 2%. In the newly reclaimed land areas, where sandy soils, organic matter would help not only physical characters of the soil, but also sustain and increase soil fertility. It would preserve the environments as clean as possible and ensure edible with no hazards of or bed

residual effect on human health [2,3] . So, composting is a method utilized for the reduction, recycling, and reutilization of crop residues[4] and compost is a rich source of nutrients with high organic matter content enhanced rice and wheat crops in sodic soil [5].

Also, *Rashad et al*.,[6] and Seddik *et al*.,[7] found that compost application to soil decreased EC values compared to untreated soil.

Also Sarwar *et al*., [8] and El-Quesni *et al*.,[9] indicated that application of compost alone or in combination with mineral fertilizer reduced soil pH significantly as compared to control after harvesting rice and wheat.

Nasef *et al*., [10] found that the application of mineral nitrogen and compost led to increase in soil nutrient contents in more relating to the residual of organic compounds that are directly decomposed which led to the release of more available nutrients.

Nitrogen is an essential element for plant nutrition and in bio-molecules such as amino acids, proteins, nucleic acids, phytohrmones and a number of enzymes and coenzymes [11] found that increasing the application of rate of N fertilizer from 60 to 90-150 kg ha^{-1} increased N content in the soil. Although inorganic N fertilization plays an essential role in increasing peanut yield and quality in there conditions, N - may become a potential environmental problem [12].

On the other hand, Hossain *et al*., [13] reported that application of N and K increased the accumulation of protein. Also, El-Quesni et al.,[9] showed a decreased in proline concentration under compost application.

However, application of N-fertilizer as urea foliar spray may decrease losses of N. In addition, the enhancing effect of urea foliar application was also reported on legumes by several investigators among of them [14]

In addition, the beneficial effect of foliar nutrition of N, P and K in mineral form compounds or humic acid containing N, P, K [15].

The interaction in foliar application methods such as rapid and efficient response to the plant needs.

It is also recognized the supplementary foliar fertilization during crops growth can improve the mineral status of plants and increase the crop yield [16].

A high penetration rate is one of the pre-requisites for efficient foliar nutrition, urea, due to its intrmsic characteristics such as small molecular size, non ionic nature and high solubility, is usually taken up rapidly through the leaf cuticle, urea can be supplied to plants through the foliage, facilitating optimal N-management, which minimizes N losses to the environment. Most plants absorb foliar applied urea rapidly and hydrolyze the urea in the cytosol [17] .The beneficial effect of foliar urea application in content of nutrients and an improvement of crop quality were reported by [16]. So, foliar spry of these element (NPK) is the best method of fertilizer application to control their losses from the soil and make them more and easily quality of wheat grain [18, 19].

On the other hand, Hossain *et al*., [13] reported that application of N and K increased the accumulation of protein. Also, Ahmed [20] suggested that the positive influence of the nitrogen form on the proline content of leaves could be observed since an increase ammonium conc.

AbdEl-Gader *et al*.,[21] found that urea application resulted in properties significant increase in biomass yield for two varieties of wheat with increasing application rates from 0 to 43 and 129 kg N/ha. The N levels significantly affected 100 seeds weight in three seasons under saline soils conditions. Siam *et al*., [22] showed that applying N increased significantly fresh, dry weights and height of maize plants.

Esmaili *et al*., [23] suggested that the effect of N fertilizer (urea) on mineral nutrient conc. and their uptake in plant tissues as well as the nutrient uptake and conc. of N, P, K and Cl were significant due to interactive effect of salinity and N fertilizers.

The objective of this study was to evaluate methods application of nitrogen as urea fertilizer when the application at different rates combined with or without compost on soil salinity and peanut crop productivity or quality under newly reclaimed soil at Sahl El-Tina.

Materials and methods

Two field experiments were carried out during the summer seasons of 2013 and 2014 at Sahle El-Tina, North Sinai Governorate, Egypt. The site lies in the North- west in coast of Sinai, between 32-35 and 32 – 45 E and 31- 00 and 31 – 25 N, [24]. The experiment was conducted in a spilt spilt plot design with three replicates. The compost application (residual plant) assigned to the main plot; the rates of urea fertilizer assigned to the sub main plot and method application (soil or foliar application) was sub sub plot. The physical and chemical properties of the cultivated soils are presented in Table (1).

Table (1): Some physical and chemical properties of soil used.

Sand (%)	**Silt(%)**	**clay(%)**	**Texture**		**O.M(%)**	**$CaCO_3$**		
75.36	6.79	17.82	Sandy loam		0.58	7.69		
PH(1: 2.5) (soil: water suspension)	EC(ds/m)	Soluble cat ions (mmolc L^{-1})				Soluble Anions (mmolc L^{-1})		
		Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	Hco_3^{-}	Cl^{-}	SO_4^{-2}
8.08	6.28	7.96	12.55	42.29	0.86	5.12	28.62	29.06
Available macronutrients (mg kg^{-1})								
N		P				K		
330		2.78				173.69		

The compost was applied by rate of 10 ton/acre before 20 days from peanut planting during soil tillage. The analysis of compost was carried out according to standard methods are presented in

Table (2): Some chemical properties of compost used in this study.

Moisture (%)	**pH**	**EC(dsm^{-1}) (1:5)**	**C/N**	**N**	**P**	**K**
20-25	7.49	3.26	16.5	%		
				1.89	0.76	2.16

The area of each experimental pilot unit was 5*10 m which divided into rows with 50 cm^2. The experimental plots were divided into two main groups. The first main group was without compost treatments, where the second main group was treated by compost at application rate of 10 ton $acre^{-1}$. The plots of each main group were divided plots of the sub groups. The plots of first sub group were treated by soil application nitrogen rates 0, 10, 20, 40 kg N/$acre^{-1}$ which applied as urea (46%N), where the plots of second sub group were treated by foliar N fertilizer at rates 1.25, 2.5 and 5 % urea solution was made up with water containing tween 20 (0.02%) as surfactant (polyoxyethylene) sorption monolaurate. Peanut (Arachis hypogaea L.), the tested cultivar was which obtained from crop Institute Agriculture research centre, Giza, Egypt. The seeds were sown in the 25th and 30th of April 2013 and 2014 seasons, respectively. The plants were thinned to two plants per hill and then were singled to one plant per hill after 30 days of sowing. Urea was applied spraying two times during the vegetation at 30 and 40 days after sowing [1] and soil application urea were added in two equal doses after 30 and 50 days from sowing. Calcium super- phosphate (15.5% P_2O_5) was added at rate 31 kg P_2O_5 $acre^{-1}$ during soil preparation. Potassium sulphate (48%K_2O) at rate of 70kg K_2O $acre^{-1}$.

At harvested stage, the plants straw and seeds sample were subjected at random from the three middle rows of each plot of three replication to determine pod weight, 100grain weight and weight of seeds. A 0.5 g of each oven dried ground plant sample was digested using H_2SO_4 and $HClO_4$mixture according to the method described by [25]. The plant content of N, P and K was determined in plant digestion using the methods described by [26, 27, 28] .

Photosynthetic pigments Chlorophyll (a+ b) was estimated in fresh leaves as described by[29]. Proline content was estimated according to the methods by [30].

Resulted and Discussion

Yield and yield components:

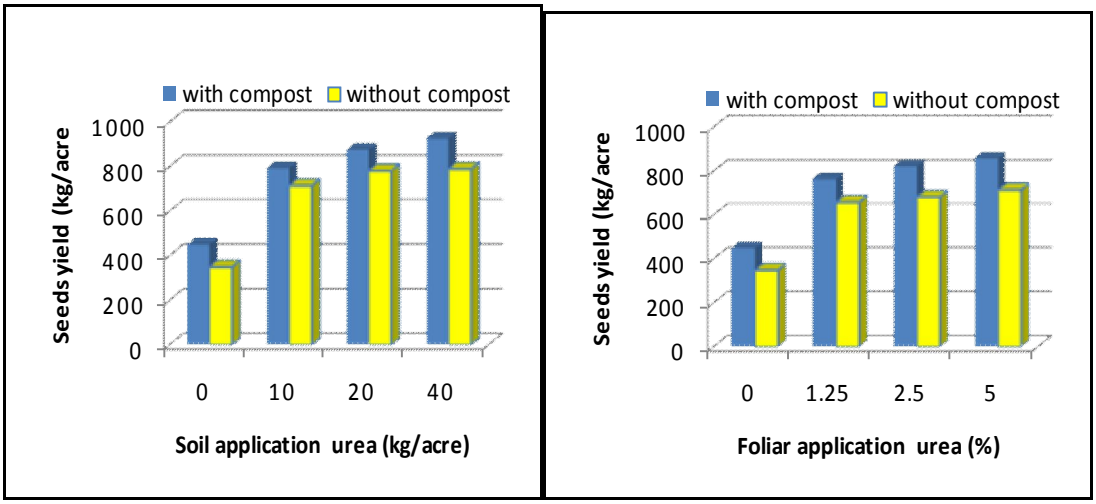
The weight of seed, weight of pods (kg/acre) and weight of 100 seed (g) of peanut plant (Fig.1and Table 3) as affected by any rate and methods of urea application with or without compost fertilizer had increased than the control, seed yield , weight of pods and weight of 100 seeds increased significantly was increasing the rate of foliar or soil urea application .Seeds yield was significantly increased when soil urea application was at rate 40kg/acre ,by 2.3 and 2.5 times than of the control, respectively. While in foliar application, the seed yield was increased by 2 and 2.2 times than of the control, respectively. Combination of urea fertilizer and compost increased the seeds yield as compared to the urea fertilizer treatment alone. The highest mean values of weight of seed yield, pods yield and weight of 100 seeds were (790, 987and 82), respectively at the first season for soil application urea at 40 kg /acre, and 2nd season take the same trend.

Concerning the effect of methods of urea application and its rates on the seeds yield, the results indicated that, soil application nitrogen gave the highest values at any level of N, while the least values were obtained for foliar application (Table 3).

The yield of seeds has increase in soil application urea when compared with the foliar application urea.

Also, data in Table (3) indicated that, there is positive relationship between urea rates and yield components

First season



Second season

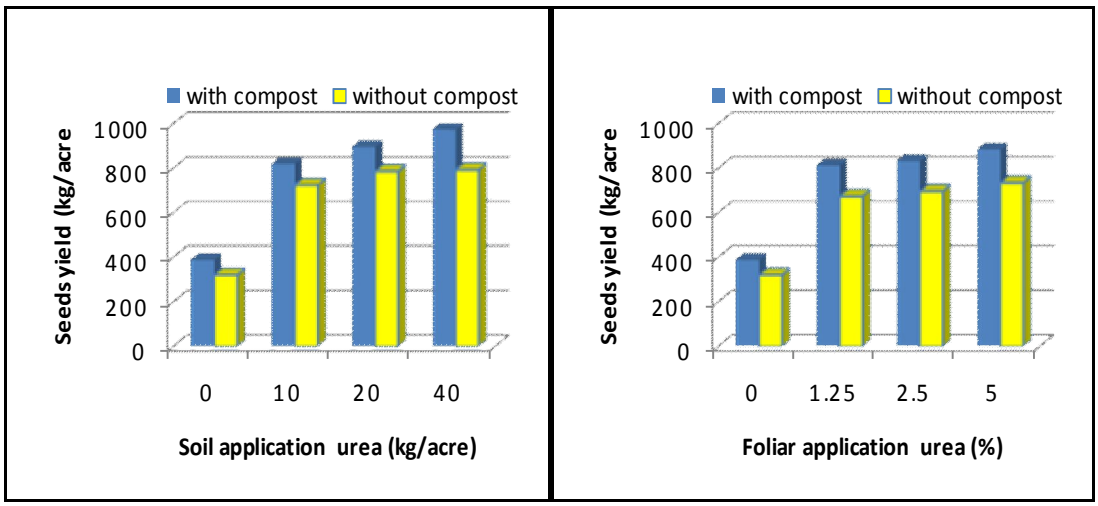


Fig. (1): Seeds of peanut as affected by urea levels and application methods with or without compost

Table (3) Yield and quality of peanut plants as affected by urea levels and application methods with or without compost

Treatments	Rate of urea kg /acre	Weight of seed yield (kg acre		Weight of pods yield (kg acre^{-1})		Weight of 100 seeds (g)		Chlorophyll a+b (mg/g.dwt)		Proline (µg/g. dwt)	
Without compos											
Seasons growin		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Urea soil application	0	350	322	452	416	36	44	2.76	2.85	332	305
	10	715	726	926	938	75	82	3.04	3.08	249	226
	20	782	788	949	958	78	87	3.09	3.15	198	186
	40	790	795	986	992	82	89	3.17	3.24	182	160
Mean		659.25	657.75	828.25	826	67.75	75.5	3.015	3.08	240.25	219.25
Urea foliar application	0	350	322	452	416	36	44	2.76	2.85	332	305
	1.25 %	659	675	817	834	67	68	2.89	2.96	283	235
	2.5 %	683	698	859	879	72	73	2.97	3.05	220	200
	5 %	715	736	882	885	77	78	3.02	3.09	195	185
Mean		602	608	753	754	63	66	2.91	3.0	258	602
LSD 5%Nrates		52	41	54	50	2.1	3.6	ns	ns	42	53
LSD 5%Methods		37	29	38	36	1.5	2.56	ns	ns	ns	ns
Rate*Methods		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
With comp											
Urea soil application		450	390	583	504	47	41	2.85	2.93	285	270
	10	793	821	994	1059	89	90	4.43	4.58	238	216.
	20	876	897	1125	1134	93	96	4.88	5.09	179	153
	40	927	975	1248	1259	96	97	5.02	5.96	157	139
Mean		762	770.75	987.5	989	81.25	81	4.295	4.64	214.75	761.5
Urea foliar application	0	450	390	583	504	47	41	2.85	2.93	285	270
	1.25 %	765	813	977	989	83	85	4.23	4.36	250	236
	2.5 %	823	835	983	997	80	89	4.63	4.88	189	175
	5 %	859	885	997	1059	82	93	4.89	5.02	142	153
Mean		724.25	730.75	885	887.25	73	77	4.15	4.2975	216.5	724.25
LSD5%Nrates		42	24	62	41	1.74	7.6	1.13	0.92	56.3	56
LSD5%Methods		29.6	16.96	44	29.4	1.23	5.37	ns	ns	ns	ns
LSD5% Rate*method		ns	**	**	**	***	ns	ns	ns	ns	ns

These results may be due to the variation of N level, which reflect that a higher absorption of N from soil by peanut plant. These results were in harmony with the results obtained by [31,32,33,34]. Also, Abd El Gader *et al*., [21] found that urea application resulted in proportion significant increase in biomass yield of peanut with increasing application rates.

In this concern, the inferiority of soil application than foliar spraying of urea on peanut plants were studied in Pakistan which were reported by[35] who mentioned that foliar spraying of urea was not superior to soil applications, however, this means that the N applied through foliar feeding without any quantities of soil-N applied are not fairly enough to face the requirements of peanut plants. These results are in agreement with those obtained by [36, 37, 35] who stated that crops required a very high amount from macronutrients, and plants leaves are only able to take it by very small amounts. Data showed clearly that using compost with urea resulted an increase in weight of seeds, pods [kg/acre] and weight of 100 seeds (g) than without compost treatment.

Adding of compost gave a significant effect on yield component of peanut. These values were (859.24, 997.36 kg/acre) and(82.3g), for seed, pods weight (kg/acre) and 100 seeds (g), respectively as foliar spray at 5% urea solution and 715.6, 882 kg/acre and 77.38 gm for foliar application at the same rate without compost in first season.

At soil application with compost the value weight of seed and weight of pods are 822 and 1065 kg/acre compared to 737, 929 Kg/acre without compost in the 1st season

These increase may be attributed to the organic compost organic compost has two effects it provides nutrients rich in organic carbon for the microbial biomass which converts unavailable nutrients in plant residues

to ones available and it enhances biodiversity of soil microbial populations can be increased by inserting different green manure selections in crop rotation programs .these results were indicated by[3, 9].

Seeds nutrients status of peanut plants:

Data presented in Table (4) reveal that N, P and K content in seeds of peanut plants were affected by methods application and urea rates fertilizers enriched with compost treatments. Nitrogen, P and K content in seeds yield were increased with increase urea-rates as foliar spray as compared to soil application. The highest values of N,P and K content for seeds with urea foliar spray with compost at 5% urea solution were 3.25, 0.46and 2.52% respectively in the first season and the second season were 3.39, 0.48 and 2.58%, respectively . While the minimum N, P and K content in seeds was recorded in control (no spray) and plants treatment with 10urea/acre as soil application in two seasons. This might be due to the fact the crop get more nutrients through foliar application which in return produced more nutrient content[19].

Table (4): Oil, Protein and macronutrients concentration in seeds peanut as affected by urea levels and application methods with or without compost

Treatments	Rate of urea kg /acre	Oil (%)		Protein (%)		Macronutrients (%)					
						N		P		K	
Without compost											
Seasons growing		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Urea soil application	0	38.25	38.66	16.19	16.38	2.59	2.62	0.26	0.27	2.28	2.30
	10	39.76	39.84	17.88	18.44	2.86	2.95	0.29	0.33	2.34	2.36
	20	40.33	40.59	18.63	19.06	2.98	3.05	0.34	0.39	2.38	2.42
	40	40.85	40.93	19.50	19.81	3.12	3.17	0.36	0.40	2.42	2.47
Mean		39.80	40.01	18.05	18.42	2.89	2.95	00.31	0.35	2.36	2.39
Urea Foliar application	0	38.30	38.88	16.31	16.94	2.61	2.71	0.30	0.32	2.30	2.33
	1.25 %	39.94	40.10	18.31	19.00	2.93	3.04	0.35	0.38	2.38	2.41
	2.5 %	40.66	40.89	19.00	19.94	3.04	3.19	0.38	0.41	2.43	2.48
	5 %	41.00	41.14	19.88	20.13	3.18	3.22	0.42	0.44	2.48	2.53
Mean		39.98	40.25	18.38	19.00	2.94	3.04	0.36	0.39	2.40	2.44
LSD5% N Rate		ns	ns	1.18	1.52	ns	ns	0.045	0.042	0.025	ns
LSD5% Methods		ns	ns	1.05	1.07	ns	ns	ns	0.03	0.035	ns
N Rate*Methods		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
With compost											
Urea soil application	0	38.94	40.00	16.63	16.75	2.66	2.68	0.32	0.33	2.35	2.36
	10	40.15	41.25	19.63	19.94	3.14	3.19	0.36	0.38	2.41	2.45
	20	40.79	41.77	19.94	20.19	3.19	3.23	0.41	0.42	2.48	2.52
	40	41.38	41.83	20.13	20.56	3.22	3.29	0.45	0.46	2.53	2.56
Mean		40.32	41.21	19.08	19.36	3.05	3.10	0.39	0.40	2.44	2.47
Urea Foliar application	0	38.52	40.25	16.81	17.19	2.69	2.75	0.35	0.36	2.38	2.40
	1.25 %	40.55	41.76	19.81	20.50	3.17	3.28	0.39	0.43	2.44	2.47
	2.5 %	41.36	41.82	20.13	20.88	3.22	3.34	0.42	0.44	2.49	2.55
	5 %	41.88	41.95	20.31	21.19	3.25	3.39	0.46	0.48	2.52	2.58
Mean		40.58	41.45	19.27	19.94	3.08	3.19	0.41	0.43	2.46	2.50
LSD5% N Rate		ns	ns	2.46	2.99	0.25	ns	0.05	0.025	ns	ns
LSD5% Methods		ns	ns	1.74	2.11	ns	ns	ns	0.018	ns	ns
N Rate*Methods		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

In fact, it was determined that foliar fertilization dose not replace soil applied fertilizer completely but it does increase the uptake and hence the efficiency of the nutrients applied to the soil [38].

Also Yildirim *et al*., [39]pointed out that a repeated application of small units of foliar fertilizers stimulates plant metabolism and an increased nutrient uptake via the roots can be observed, it was concluded that the absorption of urea, by the leaves of most crops is greater and faster than that of organic N forms.

A high penetration rate is one of the pre-requisites for efficient foliar nutrition, urea, due to its intrmsic characteristics such as small molecular size, non ionic nature and high solubility, is usually taken up rapidly through the leaf cuticle, urea can be supplied to plants through the foliage, facilitating optimal N-management, which minimizes N losses to the environment. Most plants absorb foliar applied urea rapidly and hydrolyze the urea in the cytosol[17] the beneficial effect of foliar urea application in content of nutrients and an improvement of crop quality were reported by [16].

In this concern data in Table (4) showed the application of compost with urea increased N, P and K content in seeds compared without compost. This might be reflect to the improvement of physical conditions of the soil provided energy for microorganisms activity and increase the availability and uptake of N,P and K, which was positively reflected on the growth [40]. addition of 5% of urea as foliar spray with compost gives a significant beneficial effect on macronutrients (N,P,K) in seeds peanut plants compared to control and soil urea application. Siam et al., [3] indicated that the importance of organic matter addition in combination with inorganic fertilizer resulted in a significant increases of NPK.

Siam *et al*., [31] who reported that the highest percentage of N, P and K in seeds as major elements and increased significantly by were obtained when addition of urea as nitrogen forms at 100 Kg N/Fed. When increasing N levels. Also, the data obtained in this study concur with those of [41] who stated that mineral soil N fertilization increased N,P,K,Ca and Mg conc. in leaves of broccoli.

Also, Siam et al.,[3] indicated that the importance of organic matter addition in combination with inorganic fertilizer resulted in a significant increases of N P and K . These results agree with those obtained by [42,43].

Also, El-Quesin*et al*., [9] reveal that a positive effect of compost occurred on NPK conc. and uptake in peanut seeds plants, as compared with control.

These results confirmed with[44] mentioned that application of FYM contains microorganisms has that ability to supply plants with fixed N,P and release phytohormones which could increase the growth and dry weight and in turn increase NPK and content in tissues of tomato plants.

Chemical constituents of peanut grains:

N-protein content:

Data presented in Table (4) show application of N by soil application or foliar spray increased protein (%) content compared with control, while application urea as foliar spray gave the highest values.

Grain Protein is affected by methods of N application and the rate of nitrogen fertilizer enriched with compost. Grain protein content was found to be significantly influenced by methods of N-application, rate and compost fertilizers as compared with control.

Protein content increased with increasing urea application during two seasons. The positive response was observed when N level was increased to 5% urea solution this may be due to a higher N utilization by the crop with adequate supply of N. These results are in agreement with[45] reported that crude protein content in grains of wheat increased by increasing N level.

These values were 19.88 and 20.13% for first and second seasons, respectively for foliar application without compost at rate 5% urea solution and 18.63 and 19.06% for soil application at 20 kg urea/acre.

Data also reveal that applying the urea with compost as highly increased (%) protein in grains compared to urea fertilizer alone at the same rate.

The best treatments when addition compost with 5% urea solutions as foliar spray increasing the grain protein content by about 2.16% if compared to foliar application at the same rate without compost .

Oil Concentration

Applied urea at rate 5% urea solution with compost as foliar spray recorded the highest of oil content (Table 4.) These values were (41.88 and 41.95%) for first and second season, respectively of both seasons .This trend is in agreement with that obtained by [46]

Total chlorophyll

Total chlorophyll increased with increasing the rate of urea application (Table 3).

In this concern, the highest mean values of chlorophyll content in peanut plant were obtained with urea soil application combined with compost for first and second season. Also, the increase of levels of urea fertilizer application led to increase of chlorophyll content in peanut plants. Statistical analysis showed that the

impact of compost and N-rates on chlorophyll was significant in both seasons; the highest values were 5.02, and 5.96 at rate 40 kgN/acre.

These results are in agreement with those of [47, 48] showed that ear leaf chlorophyll content in maize plants were significantly affected by N fertilizer levels.

Proline concentration:

Concerning the effect of different methods or rates of N-application alone or in combination with compost on proline in peanut plants were clearly negative effects if compared with control (Table 3).

On the other hand, the effect of the N rates and methods application was not significant effect on proline in the two seasons. The impact of compost and added rates showed significant effect on proline in the second seasons[9].

Proline concentration decreased with increasing the rate of urea with or without compost. The lowest values of proline content were recorded 142 and 153 ppm with foliar of urea at rate of 5% urea solutions with first and second season, respectively.

Generally, the highest values were noticed when addition low rate of urea as foliar fertilizers without compost.

Soil salinity (EC)

Results in Table (5) revealed that the lowest values of EC were obtained when soil treated with compost at rate 40 kg/fed. (2.18 and 2.07) for first and second season as compared with the same treatment without compost . These results are in agreement by [6] who confirmed that the application of compost alone or combination with nitrogen fertilizers led to reduce EC values. The means values of foliar urea were (4.68, 4.57) and (3.79, 3.63) for soil application 1st season and the 2nd season, respectively. El-Etr *et al*., [49] considered the formation of the stable aggregates in the soil due to compost application enhanced salt removal to deep layers. It could be due to the application of N at different rates in combination with compost as soil application led to improve soil aggregation and possible leaching of salt. These results are in agreement with [50]who found that physical properties (hydrolic conductivity, bulk density and total porosity) of salt affected soil greatly improved when compost was applied.

Table (5): Soil pH and EC as affected by urea levels and application methods with or without compost after harvest.

Treatments	Rate of urea kg /acre	pH (1:2.5)		EC (dSm^{-1})	
Without compost					
Seasons growing		1st	2nd	1st	2nd
Urea soil application	0	8.06	8.02	4.36	4.19
	10	8.03	8.00	4.29	4.02
	20	8.01	7.96	3.40	3.29
	40	8.00	7.92	3.10	3.01
Mean				3.79	3.63
Urea Foliar application	0	8.06	8.02	5.17	4.98
	1.25 %	8.07	8.06	4.72	4.70
	2.5 %	8.05	8.04	4.53	4.49
	5 %	8.04	8.04	4.28	4.10
Mean				4.68	4.57
LSD5% N Rate		-	-	ns	0.89
LSD5% Methods		--	-	ns	0.63
N Rate*Methods		-	-	ns	ns
With compost					
Urea soil application	0	8.05	8.03	3.55	3.49
	10	8.01	8.00	2.69	2.38
	20	7.97	7.92	2.41	2.22
	40	7.93	7.89	2.18	2.07
Mean				2.71	2.54
Urea Foliar application	0	8.06	8.05	4.03	3.89
	1.25 %	8.04	8.03	3.85	3.55
	2.5 %	8.01	8.00	3.61	3.24
	5 %	7.98	7.97	3.35	3.10
Mean				3.71	3.45
LSD5% N Rate		--	--	0.43	0.48
LSD5% Methods		--	--	0.31	0.34
N Rate*Methods		--	--	ns	Ns

Soil pH:

Soil pH is one the more important parameter which reflects the overall change in soil chemical properties. Data presented in Table (5) show that the pH values were generally around 7.89-8.02. Application of compost with urea ether foliar or soil application reduces pH values in both seasons. Also the soil pH tends to slightly decrease with increasing the rates of urea.

This may be due to urea hydrolysis raises pH values by removing hydrogen ions (H) from the soil solution and forming the HCO_3 acid according to the following equation.

$$CO(NH_2)_2 + H^+ + 2H_2O \rightarrow 2NH_4 + HCO_3$$

The formation of the acid in root zoon will lead to decrease pH soil. Also Shaban et al., [51] stated that the effect of urea on reducing soil. pH is probably because of its hydrolyzes upon application of irrigation water and hence ammonia releases as shown by the following equation.

$$CO(NH_2)_2 + H_2O \rightarrow 2NH_3 + CO_2$$

Carbon dioxide that dissolved in H_2O forming the carbonic acid, with cause the decrease of soil pH.

The lowest pH values (7.89, 7.93) recorded with soil application urea with compost at rate 40 Kg/acre for first and second season, respectively. These results may be due to improving soil chemical, biological and fertility properties. These finding are agreement with those reported by [52, 42].

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