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Response of Groundnut (*Arachis hypogaea* L.) Plants to Foliar Feeding with Some Organic Manure Extracts under Different Levels of NPK Fertilizers

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Abstract: Two field trails were carried out during two successive summer seasons in the experimental farm of Ismaellia Agriculture research station to study the effect of foliar feeding with organic manure extracts (Chicken, Biogas and Pigeon) and NPK rates (low rate 30:30:25 and high rate 60:60:50 kg/fed. respectively) on groundnut yield and its components as well as some chemical and biochemical constituents (macro and micro nutrients, oil and protein content of seeds). The results could be summarized as follows: -Increasing NPK rate from half the recommended rate (30:30:25) to the recommended rate (60:60:50) significantly increased all the studied parameters i.e wt. of 100 seeds (g), wt. of pods (kg/fed.), yield of straw and seeds (Kg/Fed), Shelling %, uptake of macro (N, P and K) and micronutrients (Fe, Mn and Zn) by straw and seeds as well as oil and protein content in the seeds of groundnut. -Foliar feedin.g with organic manure extracts (Chicken, Biogas and Pigeon) significantly increased all the mentioned parameters as compared with control treatment (sprayed with tap water). Pigeon manure extract showed the highest values of yield and its components, macronutrients (N, P and k), oil and protein content in seeds, followed by Chicken and Biogas manures in decreasing order. On the other hand, Biogas manure gave the highest values of micronutrient (Fe, Mn and Zn) uptake by straw and seeds followed by Pigeon and chicken manures in decreasing order. -The interactions between NPK rates and foliar feeding with the organic manure extracts showed significant effects on all the studied parameters. The highest values of yield and its components, as well as uptake of macronutrients (N, P and K) by straw and seeds and the content of oil and protein of the seeds were obtained when the higher (recommended) rate of NPK was used and the plants were sprayed with Pigeon manure extract, while the highest values of micronutrients (Fe, Mn and Zn) uptake by straw and seeds were found when the lower (half the recommended rate) NPK rate was used and the plants sprayed with Biogas manure extract. All the studied parameters of groundnut plants had the same trend during the two growing seasons.

Key words: Foliar feeding · groundnut · macro and micronutrients · organic manure · oil and protein %

INTRODUCTION

Groundnut (*Arachis hypogaea L.*) is an important summer oil seed crop and food grain legume, it contains about 50% oil, 25-30% protein, 20% carbohydrate and 5% fiber and ash which make a substantial contribution to human nutrition [1]. Most of the cultivated area in poor sandy soil using high rates of NPK chemical fertilizers aiming to maximize seed yield for human feeding and straw yield to use it in animal feeding.

Recently this crop has been given great attention from Government as well as from the scientific institutes due to its suitability for growth in the new reclaimed sandy areas in Egypt, which located in Ismaellia, Sharkia, Minia and Giza Governorates as well as south Tahrir province, Al-Tahady Sector (Beheira Governorate). These sandy-textured soils were long believed to be too droughty for economic groundnut production. Now under recent irrigation system (sprinkler irrigation), these soils are proving to be most economically feasible soils for groundnut.

Nitrogen, phosphorus and potassium fertilizers are essential nutrients for crop growth and high yield with good quality. In this respect, Nasr- Alla *et al.*, [2] reported that increasing the rate of PK as single or in combination application increased number of branches / plant, yield of pods / plant and per feddan of groundnut. In addition, El-Far and Ramadan [3] indicated that application of

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46.6 kg P_2O_5 / Fed. and 36 kg k_2O/Fed. gave the highest effect on yield and its attributes. Recently, El-Habbasha *et al.,* [4] reported that increasing phosphorus levels increased each of leaves and stem weight/plant, number of pods and seeds /plant, weight of pods and seeds/plant, 100 seed weight, seed and oil yields, oil%, seed protein content as well as N, P and K contents.

Foliar feeding is often the most effective and economical way to correct plant nutrient deficiencies. During the last decades, foliar feeding of nutrients has become an established procedure in crop production to increase yield and improve the quality of crop products [5]. This procedure can also improve nutrient utilization and lower environmental pollution through reducing the amounts of fertilizers added to soil [6]. On the other hand, foliar feeding of a nutrient may actually promote root absorption of the same nutrient or other nutrients through improving root growth and increasing nutrients uptake [7]. The concept of foliar feeding implies that nutrient applied to leaves and other above ground plant parts are absorbed and taken up by plants. Accordingly, nutrients needed by plants can theoretically be fed through plant leaves. Moreover, several research workers revealed that foliar feeding is more efficient than soil fertilization. This fact is totally true in case of micronutrients under arid and semi-arid conditions [8,9].

Therefore, the objective of the present study was to improve the vegetative growth, yield and seed quality as well as nutrient status of groundnut plants grown on newly reclaimed sandy soil by use two NPK rates and foliar feeding with some organic manure extracts (Chicken, Biogas and Pigeon).

MATERIALS AND METHODS

Two field trails were carried out in the experimental farm of Ismaellia Agriculture Research Station, Egypt during two successive summer seasons, to study the effect of NPK fertilizers rates and foliar feeding with organic manure extracts on yield and yield components as well as chemical constituents of groundnut plants.

Some characteristics of the experimental soil and the used organic manures were determined according to Black [10] and Page [11] as shown in Tables 1, 2 and 3.

Seeds of groundnut C.V. Giza 5 were inoculated just before sowing with the specific rhizobium bacteria inoculants and were sown in hill 10 cm apart in ridges on second week of May in both seasons. The experimental design of split-plot with four replicates was used. Each experimental unit (plot) contains 5 rows (3.5 m in length and 60 cm a part), the plot area was 10.5 m^2.

Table 1: Particle size distribution and some chemical properties of the soil at the experimental site

		Soluble cations (meq/L)				Soluble anions meq/L			
PA 1:2.5	EC Dsm^{-1}	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO^{-3}	HCO_3^{-}	Cl^{-}	SO_4^{--}
7.8	1.62	4.56	2.60	3.07	0.36	-	6.60	12.83	1.16
Coarse sand %		Fine sand %		Silt %	Clay %	O.M %	$CaCo_3$ %	Soil texture	
80.0		16.0		2.0	2.0	0.23	1.50	Sandy soil	
						Available micronutrients ppm			
Available N mg/kg		Available P mg/kg		Available k mg/kg		Fe	Mn	Zn	Cu
12.0		4.8		34.6		4.1	1.6	0.63	0.26

Table 2: Chemical composition of the used organic manures

									Available micronutrients µg/g			
Organic manures	EC Dsm^{-1}	O.M %	PH 1:5	Total C %	Total N %	C/N ratio	Total P %	Total K %	Fe	Mn	Zn	Cu
Chicken	8.50	62.7	6.42	30.03	3.03	9.10	0.75	0.89	190.5	44.0	84.0	6.70
Biogas	8.15	47.7	7.31	27.21	1.80	15.12	0.64	0.74	285.6	60.1	111.2	8.15
Pigeon	7.65	69.8	6.12	33.6	4.31	7.80	0.97	0.98	240.3	50.8	92.60	7.65

Table 3: Chemical composition of the organic manure extracts with a ratio of (1:12)

			Macronutrients %			Micronutrients ppm			
Manure extracts 1:12	PH 1:12	EC dsm^{-1}1:12	N	P	K	Fe	Mn	Zn	Cu
Chicken	7.11	3.47	1.43	0.48	0.41	17.1	7.6	6.8	1.6
Biogas	8.18	2.75	0.83	0.36	0.34	23.7	15.3	13.9	2.4
Pigeon	8.34	3.51	2.84	0.71	0.57	18.6	8.5	7.9	1.9

Nitrogen fertilizer was added at two rates 30 and 60 kg/Fed (half recommended and recommended rates respectively) as ammonium sulfate (20.6% N) in three equal portions, the first at sowing, the second after 30 days and the third after 50 days from plantation date. Phosphorus fertilizer, as calcium super phosphate (15.5% P_2O_5) was added at two rates of 30 and 60 kg/Fed during the seed bed preparation. Potassium sulphate (48% K_2O) at rates of 25 and 50 kg/Fed. were applied at swing. The normal cultural practices for groundnut were applied as recommended in the district. Sprinkler irrigation was applied as plant needed. Groundnut was manually harvested on September 13th and 15th in the first and second season respectively. Gypsum at rate of 750 kg/Fed. was added during the seed bed preparation.

The experimental treatments can be described as follows:

Main plot:

- Lower rate of soil NPK (half the recommended rates 30:30:25)
- Higher rate of soil NPK (the recommended rate of 60:60:50)

Subplots:

- Control treatment (foliar spraying with tap water).
- Foliar application with Chicken manure extract at rate of 600 L/Fed.
- Foliar application with Biogas manure extract at rate of 600 L/Fed.
- Foliar application with Pigeon manure extract at rate of 600 L/Fed.

All the foliar application was applied in 3 equal doses at 25, 50 and 75 days from plantation.

At harvest the yield and yield components were recorded. All plants from each plot were harvested to determine seeds and straw as kg /Fed. Shelling % was recorded as seed weight/pod weight %. N, P, K, Fe, Mn and Zn in straw and seeds were determined according to Chapman and Pratt [12]. Crude protein % was calculated by multiplying N% by 6.25. Seed oil content was determined according to A.O.A.C. [13].

All data were statistically analyzed according to Snedecor and Cochran [14]. The least significant differences (LSD at 5%) were used to compare means.

RESULTS AND DISCUSSION

Yield and yield components

a-Effect of NPK rates: Data presented in Table (4) show that increasing soil NPK rate from the lower rate (30:30:25) to the higher one of (60:60:50) significantly increased wt. of 100 seeds, wt. of pods (kg/Fed), yield of straw and seeds (kg/Fed) and shelling percentage. The results are true for the two growing seasons 2006 and 2007. These

Table 4: Effect of NPK rates and foliar application with some organic manure extracts on yield and its components of groundnut plants

		Season 2006					Season 2007				
NPK rates	Foliar application of organic manures	Wt. of 100 Seed (g)	Wt. of pods Kg/Fed	Yield kg/Fed. Straw	Seeds	Shelling %	Wt. of 100 seeds(g)	Wt. of pods kg/Fed.	Yield kg /Fed Straw	Seeds	Shelling %
Lower rate of NPK (30:30:25)	Control	65.26	945.69	1181.96	588.17	59.63	64.47	959.95	1285.11	591.42	62.20
	Chicken	76.33	1085.81	1398.59	676.04	60.09	72.85	1118.00	1420.48	692.97	62.26
	Biogas	70.33	1002.44	1294.06	625.45	61.76	67.69	1011.51	1309.99	606.81	61.79
	Pigeon	80.24	1142.50	1522.02	717.64	61.96	80.13	1262.46	1560.57	736.63	62.95
Mean		73.04	1044.11	1349.16	652.08	60.86	71.29	1087.98	1394.04	656.96	62.23
Higher rate of NPK (60:60:50)	Control	65.26	945.69	1181.96	588.17	59.63	64.47	959.95	1285.11	591.42	62.20
	Chicken	80.21	1119.77	1456.13	713.72	61.76	80.55	1170.50	1479.87	747.58	63.72
	Biogas	71.69	1010.06	1442.87	662.71	63.90	74.22	1055.50	1457.88	692.99	65.67
	Pigeon	88.45	1257.87	1850.78	820.95	65.88	82.25	1389.45	1858.75	827.95	65.25
Mean		76.40	1083.35	1482.94	696.39	62.79	75.37	1143.83	1520.46	714.99	64.21
Mean of foliar application	Control	65.26	945.69	1181.96	588.17	59.63	64.47	959.95	1285.11	591.42	62.020
	Chicken	78.27	1102.79	1427.36	694.88	60.93	76.70	1144.25	1450.18	720.28	62.99
	Biogas	71.01	1006.25	1368.47	643.58	62.83	70.96	1033.56	1383.94	649.90	63.73
	Pigeon	84.35	1200.19	1686.40	769.30	63.92	81.19	1325.96	1709.66	782.29	64.10
L.S.D at 5%											
NPK rates		3.01	34.11	130.0	41.13	1.81	3.24	54.06	124.12	51.72	1.9
Foliar application		4.16	38.30	100.11	30.28	0.76	4.90	60.22	199.20	40.66	0.60
NPK×Foliar application		4.90	39.12	102.80	33.23	0.81	5.12	63.11	200.60	41.82	0.63

increasing in the previous parameters may be due to the increase of phosphorus rate which is known to help developing a more extensive root system and thus enabling plants to extract water and nutrients, from more depth. This in turn could enhance the plants to produce more assimilates which was reflected in higher biomass [15]. Furthermore, the increases in yield due to phosphorus fertilizer may be attributed to the activation of metabolic processes, where its role in building phospholipids and nucleic acid is known [16]. Moreover, phosphorus is an important nutrient for all the crops in general and legumes in particular, it is a key constituent of ATP and plays significant role in energy transformation in plant and also in various roles in seed formation [17]. Phosphorus application increases groundnut yield and yield contributing characters. Dry matter can also be increased with increasing P levels up to a certain limit [18].

Such favorable effects on yield and yield components could be attributed to the stimulation effect of NPK on number and weight of nodules and nitrogen activity which in turn reflected positively on groundnut yield attributes [19].

The highly increases of yield and its components by using the higher level of NPK may be due to the abundant nutrients in the soil solution which facilitate nutrients absorption through plant roots. Also this effect may be due to N fertilizer which is essential element and important determinant of plant growth and development. In this concern Patra *et al.* [20] stated that addition of N fertilizer generally increases root-shoot ratio and pod yield of groundnut.

The obtained results are in full agreement with those obtained by Nasr-Alla *et al.* [2], El-Far and Ramadan [3], Laxminarayana [21] and Hossain *et al.* [22], who reported that increasing the rate of NPK as single or in combination application gave the highest effect on yield and its attributes of groundnut. They added that application of NP fertilizers significantly increased number of mature pods/plants, weight of 100 seeds and pod yield and plants receiving 60:60 kg NP had the higher better morphological characters that eventually resulted in greater pod yield. Further increase in nitrogen and phosphorus rate (beyond N_{60} P_{60}) tended to depress N and P uptake, number of pods per plant, 100 seed weight and pod yield.

b. Effect of Foliar application with organic manure extracts: Foliar application with organic manure extracts had significant effect on yield and its components of groundnut plants (Table 4). All the used organic manure extracts (Chicken, Biogas and Pigeon) significantly increased wt. of 100 grains, wt. of pods (kg/Fed.), yield of straw and seeds (kg/Fed.) and shelling percentage as compared with control treatment (sprayed with tap water). These increases in yield and its components as results of foliar spraying the organic manure extracts (Chicken, Biogas and Pigeon) may be attributed to their content of micronutrients which might enhance the activity of photosynthesis and protein synthesis in the leaves, which in turn encourage photosynthetic process apparatus [23,24]. The elemental composition of the organic manure extracts especially their content of N, P, K, Fe, Mn, Zn and Cu may account for such finding. This favorable effect of foliar spraying with the organic manure extracts may be due to elemental Zn which may promote earlier flowering and improve fruit quality, this effect may be due to stimulation of phosphorus uptake [25]. Also, Zn may help in the production of indole acetic acid which resulted in an increase in leaves area and more sugar production and could be play a vital role activity in the function of enzymes for the biological processes in plant, which lead to increase in yield components [26,27].

Data presented in Table 4 show that Pigeon manure extract was the most pronounced effect on groundnut and its components, where it resulted in the highest values of the mentioned parameters, followed by Chicken manure extract and Biogas manure extract in decreasing order. These results are true for the two growing seasons 2006 and 2007. The elemental composition of the organic manure extracts especially their content of N, P and K as well as micronutrients may account for such finding. The higher effect of Pigeon manure extract than the other two organic extracts (Chicken and Biogas) may be due its higher content of O.M.%, N%, P% and K% (Tables 2 and 3). Nasef [28] came to the same results and stated that the positive effect of Pigeon manure extract on wheat yield and its components surpassed the organic manure extracts of Biogas and Chicken. Moreover, the positive responses of groundnut yield to foliar nutrition with Zn, Mn, Fe and Cu each alone or in combination were reported by Darwish *et al.* [29] and Ali and Mowafy [30].

In addition the increase in growth characters, yield and its attributes by foliar fertilization may be due to that the sprayed solution of nutrients is readily absorbed by the leaves and not lost through fixation, decomposition or leaching [31]. It is worthy to mention that the efficiency of foliar nutrition under field conditions does not only depend on the concentrations and combination of nutrients, but also on carriers of the nutrient as well as the soil chemical properties [32].

Table 5: Effect of NPK rates and foliar application with some organic manure extracts on uptake of macronutrients (kg/Fed) by straw and seeds, oil and protein % in seeds of groundnut plants

		Season 2006								Season 2007							
	Foliar application of organic	Straw kg/Fed.			Seeds kg/Fed.					Straw kg/Fed.			Seeds kg/Fed.				
NPK Rates	manures	N	P	K	N	P	K	Oil%	Protein%	N	P	K	N	P	K	Oil%	Protein%
Lower rate of	Control	16.73	1.60	12.45	27.33	2.32	20.86	33.33	28.64	19.55	1.62	12.59	28.32	2.38	21.12	34.31	29.23
NPK (30:30:25)	Chicken	20.82	1.88	13.94	30.36	2.57	27.58	38.00	30.21	22.64	1.89	14.12	33.18	2.95	27.80	38.33	30.37
	Biogas	20.50	1.75	12.54	29.30	2.49	25.34	34.33	29.30	21.11	1.82	13.42	30.42	2.56	26.29	35.33	29.60
	Pigeon	24.01	2.50	14.40	36.17	3.58	34.82	44.67	31.90	25.51	2.53	14.60	38.06	3.58	29.36	45.33	32.91
Mean		20.53	1.90	13.33	30.79	2.74	27.15	37.58	30.01	22.20	1.79	13.68	32.50	2.87	26.14	38.33	30.53
Higher rate of	Control	16.73	1.06	12.45	27.33	2.32	20.86	33.33	28.64	19.55	1.62	12.59	28.32	2.38	21.12	34.33	29.23
NPK (60:60:50)	Chicken	22.84	2.50	14.43	35.38	3.38	33.47	42.33	30.98	24.12	14.50	14.31	37.45	3.48	36.69	42.00	32.39
	Biogas	22.06	2.08	13.30	33.45	3.37	29.95	38.33	29.99	21.89	2.26	14.09	35.94	3.17	33.02	38.00	30.47
	Pigeon	24.99	2.79	15.01	39.50	4.17	36.85	46.80	32.08	26.55	2.91	15.14	41.39	3.76	37.18	46.33	33.89
Mean		21.66	2.24	13.80	33.92	3.31	30.28	40.20	30.42	23.03	2.32	14.03	35.78	3.20	32.00	40.17	31.50
Mean of foliar	Control	16.73	1.60	12.45	27.33	2.31	20.86	33.33	28.64	19.55	1.62	12.59	28.32	2.38	21.12	34.33	29.23
application	Chicken	21.85	2.19	14.19	32.87	2.98	30.53	40.17	30.59	23.38	2.20	14.22	35.32	3.22	32.25	40.17	31.38
	Biogas	21.28	1.92	12.92	31.38	2.93	27.65	36.33	29.64	21.50	2.04	13.76	33.18	2.87	29.66	36.67	30.04
	Pigeon	24.50	2.65	14.71	37.84	3.88	35.84	45.74	31.99	26.03	2.72	14.87	39.73	3.67	33.27	45.83	33.40
L.S.D at 5%																	
NPK rates		0.81	0.30	0.39	3.10	0.50	4.00	2.11	0.33	0.80	0.24	0.25	0.95	0.27	3.75	1.40	0.46
Foliar application		0.70	0.12	0.13	1.32	0.18	3.10	1.81	0.60	0.97	0.11	0.28	0.89	0.26	1.25	1.70	0.51
NPK×Foliar application		0.78	0.13	0.14	1.60	0.20	3.80	2.22	0.71	1.11	0.19	0.38	0.99	0.31	2.30	1.83	0.62

c. Effect of interaction between NPK rates and foliar application: The interaction effects between the different rates of NPK fertilizers and foliar application with organic manure extracts seemed to be significant for yield and yield components of groundnut plants grown for the two successive seasons 2006 and 2007 (Table 4). The highest values of the yield and its components of groundnut were obtained by using foliar application with Pigeon manure extract under the highest rate of NPK fertilizers (60:60:50), while the lowest ones were attained by spraying the plants with Biogas manure extract under the lowest rate of NPK fertilizers (30:30:25). These results mean that the interaction of NPK and foliar spray with Pigeon manure extract was reflected in a good utilization of nutrients and water which gave a good growth and biological yield. In this connection Gobarah *et al.* [15] stated that the highest yield of seed, oil and protein (kg/Fed.) of groundnut plants were obtained by application the highest level of phosphorus with foliar spraying with zinc. The obtained results are in full agreement with those obtained by Ali and Mowafy [30] and Laxminarayana [21] who reported that application of the optimum PK or NPK rates in combination with organic manures recorded the highest pod yield, haulm yield and other yield attributes.

Chemical constituents of groundnut plant

a. Effect of NPK rates: Macronutrients uptake (N, P and K) by straw and seeds, oil % and protein % (Table 5) as well as uptake of micronutrients by straw and seeds (Table 6) of groundnut plants grown for two successive seasons significantly increased when the higher levels of NPK fertilizers (60:60:50) were used as compared with the lower ones (30:30:25). These results were similar in the two seasons of the experiment and the increases in the previous parameters by using the higher levels of NPK fertilizers may be due to the increases in nutrients absorption resulting by more available nutrients in the soil solution and this probably promoted the well developed root system in upper zone. Confirm these results Abo-El-Magd and Hoda [33] on onion, Abou-El-Nour and Abdel-Maguid [34] on corn and Hossain *et al.*, [22] on groundnut, who stated that higher values of nutrients content i.e. macro (N, P, K and Na) and micro (Fe, Mn, Zn and Cu) in onion bulbs were obtained by the higher level of NPK (80:50:60) as compared with the lower one (40:25:30). Moreover, they added that decreasing NPK applied to soil than the recommended rate resulted generally, in reducing macro and micronutrient concentration in corn plants. Also, application of NP

Table 6: Effect of NPK rates and foliar application with some organic manure extracts on uptake of micronutrients (kg/Fed) by straw and seeds of groundnut plants

		Season 2006						Season 2007					
	Foliar application of organic	Straw kg/Fed.			Seeds kg/Fed.			Straw kg/Fed.			Seeds kg/Fed.		
NPK rates	manures	Fe	Mn	Zn	Fe	Mn	Zn	Fe	Mn	Zn	Fe	Mn	Zn
Lower rate of	Control	83.50	34.46	30.76	72.13	21.36	24.53	83.85	36.16	31.69	77.12	22.33	26.30
NPK (30:30:25)	Chicken	91.86	38.18	33.60	81.28	25.77	32.71	92.17	41.00	34.60	80.91	26.02	32.81
	Biogas	110.39	44.29	41.08	87.53	33.64	39.48	122.52	45.62	41.90	87.92	34.08	41.59
	Pigeon	99.39	42.58	36.83	84.17	30.79	35.98	95.46	45.53	37.78	84.63	30.86	37.76
Mean		95.29	39.88	35.57	81.28	27.89	33.18	98.50	41.33	36.49	82.65	28.32	34.62
Higher rate of	Control	83.50	34.46	30.76	72.13	21.36	24.53	83.85	36.16	31.69	77.12	22.33	26.30
NPK (60:60:50)	Chicken	98.43	40.64	37.45	84.58	33.09	34.94	98.40	43.02	37.48	83.80	33.17	35.64
	Biogas	121.22	47.18	43.90	92.56	37.80	42.74	126.28	48.50	44.53	93.37	38.69	44.24
	Pigeon	100.14	44.51	38.92	87.50	36.17	38.48	100.81	44.07	38.32	85.66	34.70	40.11
Mean		100.82	41.70	37.76	84.19	32.11	35.17	102.34	41.69	38.01	84.99	32.22	36.57
Mean of foliar	Control	83.50	34.46	30.76	72.13	21.36	23.53	83.85	36.16	31.69	77.12	22.33	26.30
application	Chicken	95.15	39.41	30.76	82.93	29.43	33.83	95.29	42.01	36.04	82.36	29.60	34.23
	Biogas	115.81	45.74	42.49	90.05	35.72	41.11	124.40	47.06	43.22	90.64	36.39	42.92
	Pigeon	97.77	43.55	37.88	85.81	33.48	37.23	98.14	43.30	38.05	85.15	32.78	38.94
L.S.D at 5%													
NPK rates		4.10	1.70	2.01	2.71	3.12	1.92	3.06	0.30	1.34	2.11	2.01	1.35
Foliar application		4.60	2.10	2.21	2.40	3.0	2.20	3.40	1.40	1.62	1.99	1.60	1.80
NPK×Foliar application		5.21	3.11	2.90	3.10	2.90	2.46	3.90	2.01	1.82	2.18	1.98	2.10

fertilizers significantly increased N and P uptake by leaf, stem and seeds of groundnut plants. They revealed that plants receiving 60:60 kg NP had the higher uptake of N and P by groundnut and further increase in nitrogen and phosphorus rate (beyond N_{60} P_{60}) tended to depress N and P uptake. These findings are in harmony with those obtained by Gobarah *et al.,* [15] who indicated that increasing rate of phosphorus fertilizers from 30 to 60 kg P_2 O_5/Fed. increased significantly protein content, N, P and K%. Otherwise oil percentage did not reach to the level of significance by increasing the P rate.

All the studied parameters were true for the two growing seasons and had the same trend of the yield components of groundnut plants (Table 4).

b- Effect of foliar application with organic manure extracts: Data presented in Tables 5 and 6 show that foliar spraying with organic manure extracts (Chicken, Biogas and Pigeon) significantly increased the N, P, K, Fe, Mn and Zn uptake by straw and seeds as well as oil % and protein% in seeds of groundnut plants grown for two successive seasons as compared with control treatments (sprayed with tap water). In this connection, Gobarah *et al.,* [15] stated that spraying groundnut plants with Zn had significant effect on chemical constituents including protein content, N, P, K % as well as oil %. Foliar feeding of nutrients has become an established procedure to improve nutrient utilization and lower environmental pollution through reducing the amount of fertilizers added to soil [6]. On the other hand, foliar feeding of nutrients may actually promote root absorption of the same nutrient [35] or other nutrients through improving root growth and increasing nutrient uptake [7].

Regarding the chemical constituents of groundnut plants as affected by spraying the different organic manure extracts, data in Table (5) show that Pigeon manure extract was the most superior effect on the uptake of N, P and K by straw and seeds as well as seed protein and oil %, followed by Chicken manure extract which occupied the second order, whereas the foliar application of Biogas manure extract was the least effect on all the previous constituents (uptake of N, P, K, Protein % and Oil %).

These results were true for the two successive seasons. Such effects are expected since they reflect the chemical composition and elemental contents of the used

organic manure extracts (Tables 2 and 3). These results are full agree with those obtained by Nasef [28] on wheat plants and to some extent, with those of Faiyad *et al.*, [36], who cleared that organic matter acts as a sustained release source of N, P and K.

Considering the uptake of nutritive elements Fe, Mn and Zn, data in Table 6 indicate that the effect of Biogas manure extract was the most pronounced. This is likely to be a final product of its relatively higher contents of Fe, Mn and Zn (Tables 2 and 3). The Pigeon manure extract occupied the second order after Biogas manure, whereas the foliar application of Chicken manure extract was the least effect on the uptake of micronutrients (Fe, Mn and Zn) by straw and seeds of groundnut plants grown for two successive seasons. These results were proportional to the content of the used organic manure extract from these elements. Confirm the uptake of the micronutrients by groundnut as affected by the different organic manure extracts [28] on wheat plants.

Generally, the increases in the chemical constituents of groundnut plants by foliar feeding with organic manure extracts may be due to that sprayed solution of nutrients is readily absorbed by the leaves and not lost through fixation, decomposition or leaching [31].

c. Effect of the Interaction between NPK rate and foliar application: The interaction effect of soil application of NPK fertilizers and foliar application of organic manure extracts, seemed to be significant for all macro (N, P and K) and micro nutrients (Fe, Mn and Zn) uptake by straw and seeds as well as protein and oil% in seeds of groundnut plants grown for two successive seasons (Tables 5 and 6). The highest values of N, P and K uptake by straw and seeds as well as protein and oil% in seeds, were obtained when the higher NPK level (60:60:50) was used and the plants were sprayed with Pigeon organic manure extracts; while the lowest ones were found by using the lower NPK rate (30:30:25) and spraying the plants with Biogas organic manure extracts (Table 5).

Regarding the micronutrients (Fe, Mn and Zn) uptake, by straw and seeds, data in Table (6) show that the highest values were found when the higher NPK rate (60:60:50) was used and the plants were sprayed with Biogas manure extract, while the lowest values were attained by using the lower rate of NPK (30:30:25) and plants sprayed with Chicken manure extract. In this connection Laxminarayana [21] stated that integrated application of organic and inorganic manure showed higher uptake of N, P and K compared to sole application of organic manures due to increased nutrient availability. The available nutrient status of the soil significantly improved with the combined application of organic and inorganic manures as compared to the control plants.

The obtained results in this investigation may be due to the beneficial effect of NPK and organic manure extracts on metabolic processes and growth which in turn reflected positively on chemical content of groundnut seeds.

This mean that the uptake of the studied nutrients as well as protein and oil% in seeds of groundnut plants showed more increment by applying the higher rate of soil NPK fertilizers combined with foliar feeding with the organic manure extracts. This may be due to the positive effect of foliar feeding on plant root growth and hence, promoting nutrients uptake, in turn, this may be due to stimulating and enhancement of limiting nutrient. El-Fouly and El-Sayed [7] and Baier and Baierova, [37] observed similar results.

From the over all data in Tables 4, 5 and 6, it could be concluded that all the studied parameter had higher levels in the second season as compared with the first one. This may be due to the residual effect of the added mineral fertilizers (NPK) as well as the organic manure extracts. Badole *et al.* [38] stated that groundnut is one of the most effective crops in using residual fertilizers. The groundnut is deep rooted and its taproot can reach 6 feet deep. Therefore, a well fertilized crop preceding peanut will be more effective in providing nutrients to the groundnut than direct application of fertilizers.

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