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EFFECT OF ORGANIC AND NANO NITROGEN FERTILIZATION ON SOIL PROPERTIES, CROP PRODUCTION AND NUTRIENTS UPTAKE BY CORN PLANT IN SANDY SOILS

***Shawer, S.S. and ** I.M. Abdalla**

**Soil and Water Dept. Faculty of Agric., Al-Azhar Univ. Cairo, Egypt.*
***Soil, Water and Environmental Research Institute - Agriculture Research Center-Giza- Egypt.*

ABSTRACT

A field experiment carried out at the experimental area of the El-smallia station search, Egypt, during summer season of 2018 of three compost fertilization rates (0, 10 and 20 ton/fed) were added before planting. Meanwhile, nano- nitrogen fertilizers added levels (0, 3, 45 and 60 kg N /fed) as well as 100 kg N/fed mineral nitrogen fertilizers; on grain yield (kg/plot), ear weight (kg/plot), grain yield (kg/fed), length (cm), grain yield (Ardab /fed) of plant either nutrients content and uptake by corn plant *(zea mays L.)* grown in sandy soil.

The obtained results showed that application of the compost fertilization rates and nano- nitrogen fertilizers added levels added alone or in combination with each other led to significantly increase grain yield (kg/plot), ear weight (kg/plot), grain yield (kg/fed), length (cm), grain yield (Ardab /fed) of plant. In addition, the phosphorus, and potassium concentration (%) and uptake (kg/fed) by grain in corn plant, significantly increase with increasing compost rates a combined with nano nitrogen fertilizers**,** the highest values was recorded the treatments of 20 ton/fed with100 kg N/fed. It was noticed that, the highest values of N-uptake (kg/fed) at 20 ton compost with 60 kg nitrogen level. This may be attributed to the positive effects of compost manure and nano nitrogen fertilizers on available nutrient in soil have demonstrated the importance of optimum mineral supply,

independent of nutrition. On the other hand, addition of compost fertilization rates to soil in combination with nano- nitrogen fertilizers caused a high increase of the available nitrogen, phosphorus and potassium due to increase of soil fertility compared with control treatment as well as improve soil properties. Generally, from these results it can be concluded that the application compost fertilization rates and nano- nitrogen fertilizers level improved all growth component, some nutrients concentration (%) and uptake in grain of corn plant.

Key words: Nano fertilizers, nutrients uptake, organic manure, plant, soil properties.

INTRODUCTION

Composts as a 'slow-release fertilizer' whereas chemical fertilizers release their nutrients faster and compost contains elements play an important role to growing plants **(Sinha and Rajiv, 2003)**. Organic matter improves soil structure, increases the water holding capacity and promotes biological transformations such as N-mineralization **(Hassink, *et al.*, 1997**). Information on the availability of phosphorus and potassium following compost addition to soil may help to a better management of P and K fertilization of the crop in respect to plant growth and environment protection **(Scherer 2004).**

Increased N bioavailability was reported after the application of composted manure to alfalfa and the increased nutrients availability from soil was associated with the improvement of soil properties **(Malhi 2012)**. **Nguyen and Shindo (2011)** reported that the increased of N concentration in soil after different levels of compost application. **Irshad *et al.* (2002)** reported that increasing composted manure application profoundly increased the nutrients uptake by maize plants. **Aziz, *et al.*, (2010)** who reported that, the application of organic manures caused increase improved of phosphorus and potassium contents in shoot of maize plants. This improved growth was mainly due to increased soil nutrient availability and uptake by maize plants.

The term "nanomaterial" is based on the prefix "nano," which originates from the Greek word meaning "dwarf." More precisely, the word nano means 10^{-9} or one billionth of a meter. The word nanomaterial is generally used for materials with a size ranging between 1 and 100 nm (**Rai and Ingle 2012). Heba, *et al.*, (2018)** the

application of Nano chitosan-NPK fertilizers could be used to improve the chemical composition of wheat grains.

Nano fertilizer has a positive significant effect on soil mineral nitrogen, due to available by plant **(Junxi, *et al*., 2013**). **Rajonee *et al.*, (2016)** reported that the application of nano fertilizer caused accumulation of N in plants. Post effect of nano fertilizer application in soil showed better pH, moisture, EC and available nitrogen under nano fertilizer treatment than the conventional fertilizer. **Manikandan and Subramanian (2016)** stated that, the growth, yield, quality and nutrient uptake were consistently higher for nanozeourea treatment than conventional urea. **Van, *et al.* (2013)** showed that the foliar application of chitosan nanoparticles (as nano fertilizer) to coffee seedlings in the green house enhanced significantly the uptake of nitrogen content from 20 to 35%, phosphorous content from 50 to 100%, potassium content from 30 to 40%, calcium (3.77%) and magnesium (18.75%) compared to the control. **Ahmed *et al.*, (2012)** reported that the nano fertilizer, the most important field of agriculture has been to the attention of the soil scientists as well as the environmentalists due to its capability to increase yield, improve soil fertility. **Singh and Chauhan (2009)** who found that potassium is as effective as chemical fertilizer with continued application of compost (organic fertilizer); it tends to be released of nutrients in soil as well as available to plant. The main goals of this study were investigate the effect of organic and nano nitrogen fertilization under spring irrigation system on yield, nutrients content and uptake by corn plants *(zea mays L.)*.

MATERIALS AND METHODS

A field experiment carried out in the experiment area of the El-smallia station search, Egypt, to study the effect of compost fertilization rate and levels nano nitrogen fertilizer under spring irrigation system on grain yield (kg/plot), ear weight (kg/plot), grain yield (kg/fed), length (cm), grain yield (Ardab /fed) of plant either nutrients content and uptake by corn *(zea mays L.)* plants three way cross 329 grown in sandy soil. The experiment using a randomized complete Plock design with three replications, the experimental unit area was 10.5 m^2 (3x3.5m), 12 rows in each plot and 20 cm apart;

during season of 2018 to study the effect of three compost fertilization rates (0, 10 and 20 kg /fed were added before planting.

In this concern, nano- nitrogen fertilizers added levels (0, 3, 45 and 60 kg N /fed were added on the three doses after 20, 40 and 60 days of planting, as well as 100 kg N/fed mineral nitrogen fertilizers were added on the three doses; phosphorus fertilizers was added 30 kg/fed P_2O_5 as ordinary super phosphate, potassium fertilizers was added 24 kg/fed K_2O as potassium sulphate; other fertilized according to the general recommendations by Ministry of Agriculture. Plant samples were taken at harvesting time (120 days after planting), Then, dry weight was calculated as well as some characteristic growth, the sample of plant was dried at 70^0C. The determine concentration of N, P and K in grain of corn as well as uptake of nutrient in grain. Also, some physical and chemical properties of the used soil, as well as content of soil fertility such as N, P and K in soil were determined. **Table (1)** showed some physical and chemical properties of investigated soil and **Table (2)** showed some chemical of the used compost.

Table (1) some physical and chemical properties of investigated soil.

Parameters	value
Some physical properties	
Sand%	85.45
Silt%	8.55
Clay%	6.00
Textural class	sandy
Field capacity %	11.00
Permanent wilting point %	5.40
Available water%	5.60
Some chemical properties	
pH	7.90
EC (1:2.5) dS/m	1.30
OM%	0.21

Table (2): Some chemical properties of the used compost.

pH	EC dS/m	OC %	MO%	C/N ratio	Total macronutrients %				
					N	P	K	Ca	Mg
7.66	2.98	25.32	43.55	17.58:1	1.44	0.78	0.86	0.95	0.52

The soil sample was routinely analyzed according to (**Klute, 1986)** and (**Page *et al.*, 1982**) the results are presented in Table 1. Plant analysis; total nitrogen was determined using Kjeldahl method, phosphorus was determined colorimetrically, potassium by flame photometer **Page *et al*., (1982)**. Statistical analysis: finally all obtained data were subjected to analysis of variance and treatment means were compared by L. S. D. test at the 5% level of probability in the experimented season according to **Gomez and Gomez (1984)**.

RESULTS AND DISCUSSION

A- Dry matter yields:

Data presented in **Table (3)** show that the grain yields (kg/fed), Ear (kg/plot) and length (cm), of corn plant were significantly affected by application of compost manure rates and nano nitrogen fertilizers levels; Hence, the data show that the grain yields, Ear and length of corn plant increased with increasing compost rates, these results may be due to composts manure as a slow release fertilizer these nutrients play an important role to growing plants. On the other hand, the application of nano fertilizer, grain yields, Ear and length of corn plant increased with increasing nitrogen level as nano fertilizer application this may be due to nano fertilizer caused accumulation of N in plants as well as available nitrogen under nano fertilizer treatment.

The data obtained from the interaction effect between compost manure rates and nano nitrogen fertilizers levels on grain yields of corn plant, the highest values of grain yields were 2022.17 (kg/fed) at 20 ton compost with 100 kg nitrogen level, compared the lowest values were 1143.79 (kg/fed) with the control treatment. The positive effects of compost manure and nano nitrogen fertilizers on grain yields have demonstrated the importance of optimum mineral supply, independent of nutrition. These results are in accordance with those reported by **Manikandan1and Subramanian (2016)** revealed that, the growth, yield, quality and nutrient uptake were consistently higher

for nanozeourea treatment than conventional urea. Also, **Heba*, et al.*, (2018)** reported that the nano fertilizers significantly increased the element content, especially potassium and phosphorus contents in the wheat grains. Further nano fertilizers improve the quality of wheat grains.

Table (3) Effect of compost and nano nitrogen fertilization on characteristic growth, by corn plant.

Treatments		Grain yield (Kg/fed)	Grain yield (Kg/plot)	Ear (kg/plot)	length (cm)	yield (Ardab /fed)
Compost (ton/fed) A	Nitrogen (Kg/fed) B					
Control		1143.79	3.81	5.20	97.33	8.17
0	30	1594.71	5.32	7.25	116.00	11.39
	45	1685.63	5.62	7.66	124.67	12.04
	60	1894.59	6.32	8.61	133.00	13.53
	100*	1922.45	6.41	8.74	143.00	13.73
	Mean	1648.23	5.50	7.49	122.80	11.77
10	0	1605.71	5.35	7.30	116.67	11.47
	30	1720.09	5.73	7.82	128.00	12.29
	45	1838.13	6.13	8.36	136.00	13.13
	60	1933.45	6.44	8.79	141.67	13.81
	100*	2011.90	6.71	9.15	143.33	14.37
	Mean	1821.86	6.07	8.28	133.13	13.01
20	0	1756.01	5.85	7.98	123.33	12.54
	30	1792.67	5.98	8.15	136.33	12.80
	45	1873.33	6.24	8.52	146.00	13.38
	60	1995.04	6.65	9.07	151.00	14.25
	100*	2022.17	6.74	9.19	152.33	14.44
	Mean	1887.84	6.29	8.58	141.80	13.48
Mean of nitrogen	0	1501.84	5.00	6.83	112.44	10.73
	30	1702.49	5.68	7.74	126.78	12.16
	45	1799.03	6.00	8.18	135.56	12.85
	60	1941.03	6.47	8.82	141.89	13.86
	100*	1985.51	6.62	9.03	146.22	14.18
	Mean	1785.98	5.95	8.12	132.58	12.76
LSD at 5%						
A		33.82	0.114	0.154	3.15	0.243
B		19.53	0.066	0.089	1.82	0.140
C		58.58	0.197	0.154	5.46	0.420

*100 was added mineral N fertilizers. 30, 45 and 60 were added as Nano fertilizers

B- Some macronutrients concentrations (%) of plant:

In this concern, the nitrogen, phosphorus and potassium (%) of corn plant, data illustrated in **figs 2, 3 and 4** show that the NPK (%)of corn plant were significantly affected by application of compost manure rates and nano nitrogen fertilizers levels; on the other hand, the data revealed that the NPK (%) in grain by corn plant increase with increasing compost rates, these results may be due to composts manure as a slow release fertilizer these nutrients such as nitrogen, phosphorus and potassium available in soil play an important role to growing plants. meanwhile, the application of nano fertilizer on NPK (%) of corn plant increased with increasing nitrogen level as nano fertilizer application, this may be due to nano fertilizer caused accumulation of nutrients in plants as well as available nitrogen under nano fertilizer treatment .

The interaction effect between compost manure rates and nano nitrogen fertilizers levels on N (%) in grain by corn plant, showed the highest values recoded at 20 ton compost with 60 kg nitrogen level compared the lowest values recoded with the control treatment; while PK-(%) the highest values was observed at 20 ton compost with 100 kg nitrogen level; this may be due to the positive effects of compost manure and nano nitrogen fertilizers on available nutrient in soil have demonstrated the importance of optimum mineral supply, independent of nutrition. These results are in a partial agreement with those obtained by **Van *et al.* (2013)** showed that the foliar application of chitosan nanoparticles (as nano fertilizer) to coffee seedlings in the green house enhanced significantly the content of nitrogen, phosphorous and potassium compared to the control. Also, **Heba, *et al.*, (2018)** reported that the nano fertilizers significantly increased the element content, especially potassium and phosphorus contents in the wheat grains.

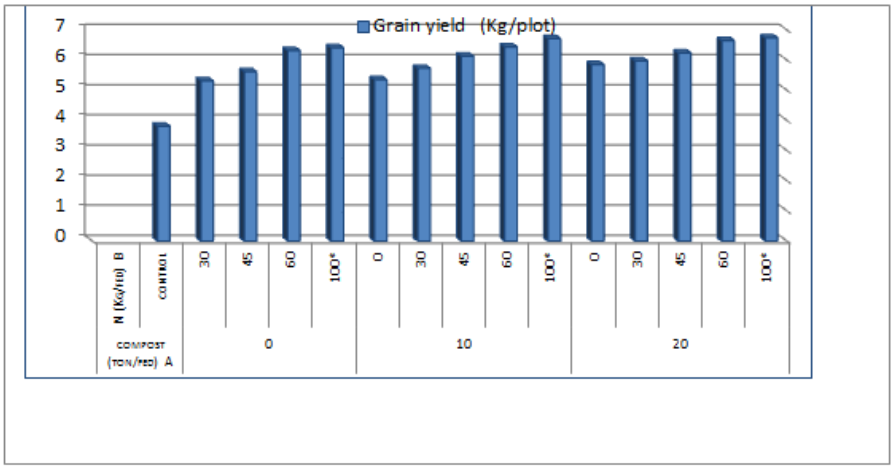

Fig (1) Effect of compost and nano nitrogen fertilization on grain yield (Kg/plot) of corn plant.

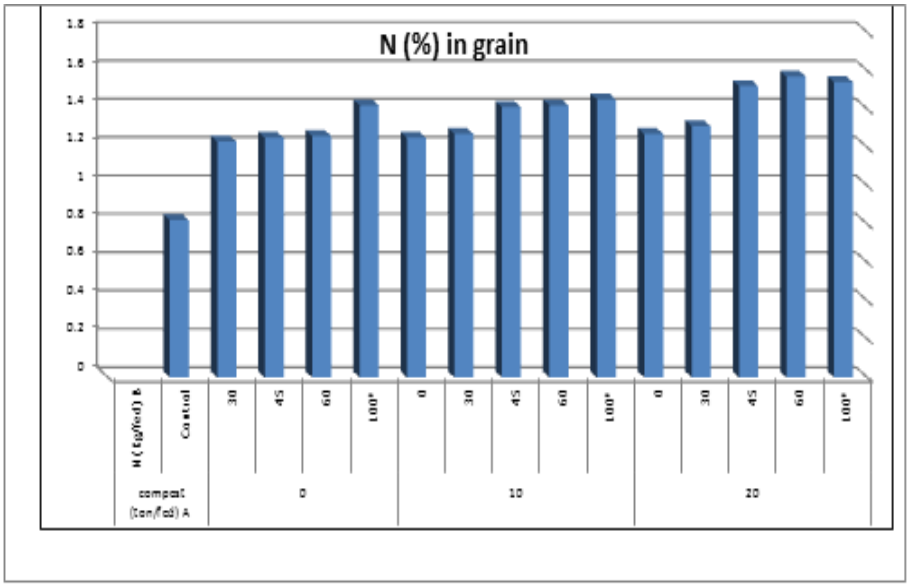

Fig (2) Effect of compost and nano nitrogen fertilization on nitrogen (%) in grain of corn plant.

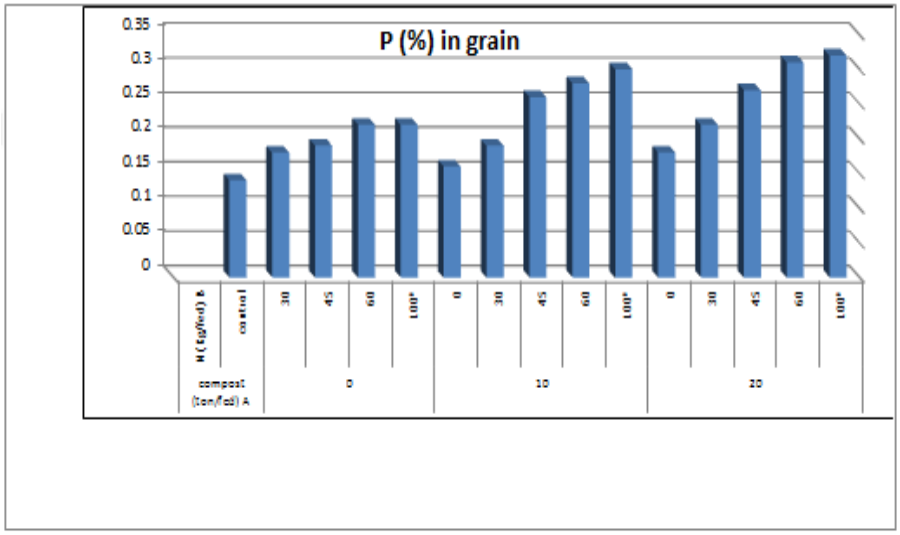

Fig (3) Effect of compost and nano nitrogen fertilization on phosphorus (%) in grain of corn plant.

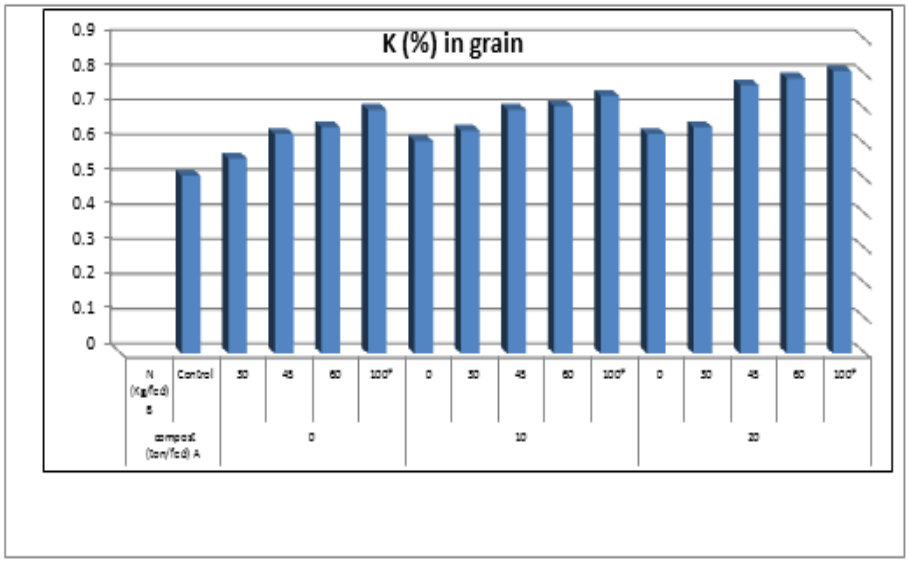

Fig (4) Effect of compost and nano nitrogen fertilization on potasium (%) in grain of corn plant.

C- Some macronutrients uptake by plant:

Nitrogen, phosphorus and potassium uptake (kg/fed) by corn plant as well as protein (%), data presented in **Table (4)** show that the NPK uptake by corn plant were significantly affected by application of compost manure rates and nano nitrogen fertilizers levels; It is interesting to say that, the data revealed that the NPK uptake in grain by corn plant increase with increasing compost rates, these results may be due to compost manure as a slow release fertilizer these nutrients such as nitrogen, phosphorus and potassium available in soil play an important role to growing plants. meanwhile, the application of nano fertilizer NPK uptake by corn plant increased with increasing nitrogen level as nano fertilizer application this may be due to nano fertilizer caused accumulation of nutrients in plants as well as available nitrogen under nano fertilizer treatment .

The data obtained from the interaction effect between compost manure rates and nano nitrogen fertilizers levels on N uptake in grain by corn plant, the highest values were 31.26 N-uptake (kg/fed) at 20 ton compost with 60 kg nitrogen level compared the lowest values were 9.42 N-uptake (kg/fed) with the control treatment; while PK-uptake the highest values was observed at 20 ton compost with 100 kg nitrogen level; the protein as affected by treatments the values increase from 4.69 to 8.76 (%); the positive effects of compost manure and nano nitrogen fertilizers on available nutrient in soil have demonstrated the importance of optimum mineral supply, independent of nutrition. These results are in harmony with those obtained by **Sharif *et al.*, (2013**)) who reported that available nitrogen of soil was improved when composts added to soil. **Heba*, et al.*, (2018)** reported that the nano fertilizers significantly increased the element content, especially potassium and phosphorus contents in the wheat grains.

Table (4) Effect of compost and nano nitrogen fertilization on some nutrients uptake and protein (%) of corn plant.

Treatments		N-uptake in grain (kg/fed)	P-uptake in grain (kg/fed)	K-uptake in grain (kg/fed)	Protein (%)
Compost (ton/fed) A	Nitrogen (Kg/fed) B				
Control		9.42	1.60	5.87	4.69
0	30	19.56	2.87	8.88	6.99
	45	21.13	3.20	10.56	7.14
	60	23.93	4.17	12.38	7.20
	100*	27.23	4.23	13.46	8.08
	Mean	20.25	3.21	10.23	6.82
10	0	20.12	2.57	9.74	7.14
	30	21.79	3.27	11.01	7.22
	45	25.86	4.78	12.81	8.02
	60	27.45	5.41	13.73	8.09
	100*	29.24	6.04	14.82	8.28
	Mean	24.89	4.41	12.42	7.75
20	0	22.36	3.16	11.00	7.26
	30	23.48	3.94	11.71	7.47
	45	28.41	5.06	14.42	8.65
	60	31.26	6.18	15.83	8.93
	100*	31.07	6.47	16.38	8.76
	Mean	27.32	4.96	13.87	8.21
Mean of nitrogen	0	17.30	2.44	8.87	6.36
	30	21.61	3.36	10.53	7.23
	45	25.13	4.35	12.60	7.94
	60	27.55	5.25	13.98	8.07
	100*	29.18	5.58	14.89	8.37
	Mean	24.15	4.20	12.17	7.59
LSD at 5%					
A		0.573	0.573	0.327	0.108
B		0.331	0.331	0.189	0.062
C		0.993	0.993	0.566	0.186

*100 was added mineral N fertilizers. 30, 45 and 60 were added as Nano fertilizers

D- Some chemical and Fertility content in soil studies:

The effect of compost manure rates and nano nitrogen fertilizers levels; on soil electrical conductivity is shown in **Table (5)**. At the end of experiments, the final electrical conductivity (EC) was found to be influenced by the applied compost manure rates and nano nitrogen fertilizers levels; the results revealed that all the treatments were

decrease the EC of the soil as compared with control treatment. It was noticed that, the compost as organic fertilizer was more effective in reducing the EC of soil; EC in soil was reduced from 1.30 dS/m to 0.73 dS/m. The decrease in EC of soil was resulted from the addition of organic matter and leaching of excessive ions by improving soil properties as reported by **Abou El-Defan, *et al.* (2005)** found that EC and ESP values significantly decreased with the application of farmyard manure.

The effect of compost manure rates and nano nitrogen fertilizers levels on soil pH and organic matter (%) is presented in **Table (5).** It was clear that at the end of experiments, soil reaction pH was influenced by the treatments. The results revealed that all the treatments reduced the pH of the soil as compared with control treatment. It was also noticed that, the effect of treatments was more effective in reducing the soil pH compared control treatment. Soil pH was reduced from 7.90 to 7.70; in contrast organic matter was increased from 0.20 to 0.55 %. This may be due to the addition of organic matter and leaching of excessive cation such as sodium which lead to improving soil properties. However, nano nitrogen fertilizers and organic matter had soluble anion such as sulfur and organic acid in soil due to reduce soil pH as well as improved physical and chemicals properties. Similarly, **Nguyen and Shindo (2011)** reported that the increased of nutrients concentration in soil after different levels of compost application.

With regard the effect of compost manure rates and nano nitrogen fertilizers levels; on some available nutrients (NPK) content (ppm) in the soil is presented in **Tables (5)**. It was found that at the end of experiments, N, P and K in the soil were influenced by the applied treatments. in general the results revealed that all the treatments increased the concentration of N, P and K in the soil as compared with control treatment. It was observed that, the combined effect of compost manure rates and nano nitrogen fertilizers were more effective of N, P and K in the soil compared with application of treatments. Nitrogen increased from 15.30 to 24.60 ppm, while phosphorus increased from 1.40 to 1.85 ppm; potassium increased from 30.50 to 39.40 ppm in the soil after harvesting time of corn plant. This may be indicated that the compost manure added to soil alone are in combination with nano nitrogen fertilizers levels caused a very increase of available nitrogen, phosphorus and potassium compared

with control treatment, as well as increase of soil. These results are in agreement with those obtained by **Negm *et al.* (2003)** who indicated that, application of compost improved soil properties as well as increasing macronutrients availability in the soil.

Table (5) Effect of compost and nano nitrogen fertilization on on some chemical properties of soil after harvesting of corn plant treatment.

Treatments		some chemical properties in soil					
Compost (ton/fed) A	Nitrogen (Kg/fed) B	N (ppm)	P (ppm)	K (ppm)	EC (dsm^{-1})	pH	O.M %
Control		15.30	1.40	30.50	1.30	7.90	0.21
0	30	16.20	1.50	32.55	0.97	7.90	0.23
	45	16.50	1.55	32.60	0.96	7.85	0.23
	60	16.80	1.56	32.80	0.96	7.84	0.22
	100*	16.85	1.56	33.20	0.90	7.84	0.23
	Mean	16.33	1.51	32.33	1.02	7.87	0.22
10	0	18.30	1.60	35.00	0.80	7.76	0.35
	30	19.20	1.62	35.30	0.87	7.75	0.34
	45	19.50	1.65	35.40	0.87	7.74	0.35
	60	19.60	1.65	35.60	0.85	7.74	0.36
	100*	19.80	1.70	35.70	0.84	7.73	0.36
	Mean	19.28	1.64	35.40	0.85	7.74	0.35
20	0	22.50	1.75	37.00	0.75	7.72	0.53
	30	23.40	1.75	38.20	0.75	7.72	0.55
	45	23.80	1.80	38.70	0.73	7.71	0.56
	60	24.50	1.82	39.00	0.70	7.70	0.55
	100*	24.60	1.85	39.10	0.70	7.70	0.56
	Mean	23.76	1.79	38.40	0.73	7.71	0.55

*100 was added mineral N fertilizers. 30, 45 and 60 were added as Nano fertilizers

Conclusion:

Results obtained in the present work confirmed that the application of compost fertilization rates and nano- nitrogen fertilizers levels added alone or in combination to produce some positive effects in corn plants *(zea mays L.).* In particular, significant improving characteristic of plant growth, some nutrients content and uptake by plant, as well as improve soil properties.

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تأثير التسميد العضوى والنيتروجينى النانو على خواص التربه وانتاجية المحصول وامتصاص العناصر المغذية لنبات الذره الشاميه فى الاراضى الرمليه

سالم سالم شاور* ابراهيم محمد عبدالله**

*قسم الاراضى والمياة - كلية الزراعة - جامعة الازهر- القاهرة- مصر

**معهد بحوث الاراضى والمياه والبيئه- مركز البحوث الزراعيه-الجيزه-مصر

أجريت تجربة حقليه خلال موسم 2018 فى تربه رمليه بمحطة بحوث الاسماعليه ، مصر، لدراسة تأثير معدلات التسميد العضوى 0، 10 ، 20 طن/ فدان، ومستويات من التسميد النيتروجينى النانو 30، 45، 60 وايضاً100كجم / فدان نيتروجين معدنى تحت نظام الرى بالرش ، على النمو وامتصاص بعض العناصر الغذائيه لنبات الذره الشاميه.

واشارت النتائج المتحصل عليها الى أن اضافة معدلات من السماد العضوى (الكمبوست) ومستويات التسميد النيتروجينى النانو ، ادت الى زيادة معنويه فى وزن محصول الحبوب للفدان ووزن الكوز وارتفاع النبات لنبات الذره ، كما تجدر الاشاره ايضاً الى زياده المحتوى والكميه الممتصة من النيتروجين والفوسفور والبوتاسيوم فى حبوب نبات الذره. بالاضافه الى ماسبق فان اعلى القيم التى تم الحصول عليها كانت عند 20طن/فدان من السماد العضوى(الكمبوست) مع السماد النيتروجينى 100كجم/فدان، ومن الملاحظ بالنسبه للكميه الممتصه من النيتروجين تم الحصول عليها عند 20طن/فدان من السماد العضوى(الكمبوست) مع السماد النيتروجينى 60كجم/فدان. ويرجع السبب فى ذلك الى الدور الايجابى الذى يقوم به السماد العضوى مقترناً بالسماد النيتروجينى النانو على تيسروامتصاص العناصر الغذائيه لنبات الذره. بوجه عام ادى استخدام السماد العضوى مع السماد النيتروجينى النانو الى زيادة المحتوى الخصوبى والمحصول وامتصاص العناصر الغذائيه الغذائيه لنبات الذره الشاميه.