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STUDY THE EFFECT OF SOIL PROPERTIES AND PLANT GROWTH AND ITS CONTENT OF SOME NITROGEN FORMS

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ABSTRACT: *The agricultural area of the Arab Republic of Egypt is very small when compared this area with the total area of the Arab Republic of Egypt soils . So that, in this study the worker's team referred to renewals reclamation soils nitrogen content which resulted from the lake drying (i.e. Idkou lake) this soil namely; Hallomorphic soil. The location used in this study was Bohaira Governorate around lake Idkou varied in their content of total soluble salts "Hallomorphic soil". The studied location was represented by different five sites. Each site was sampled at two soil locations. Soil samples were subjected to chemical and mechanical analysis. Nitrogen forms were determined. Pots experiment was carried out in the Experimental Farm, Faculty of Agriculture, Shbin El-Kom, Menoufiya University to study the effect of the studied soil properties on plant growth and it's content of nitrogen. The obtained results showed that, a highly significant correlation coefficients between clay contents and both soil OM and CEC in hallomorphic soil. Also, highly positive relationships between $CaCO_3$ contents (%) and pH values. However, a highly significant negative correlation coefficients between sand content and both soil OM and CEC in soil under invstigation. The content of NH_4-N in the soil samples under study ranged from 18.65 to 2.80 mg/100g soil. The content of NO_2-N in the soil samples under study ranged from 1.30 to 0.50 mg/100g soil. The soil content of total-N as mg/100 g was varied widely, where it's ranged from 113.97 to 65.10 mg/100g soil. The mean values of nitrogen uptake (mg/pot) ranged from 30.11 to 52.57 for shoots and from 3.58 to 16.33 for roots.*

Key words: *Hallomorphis soil, Nitrogen forms, Multiple regression, Soil properties and Plant growth.*

INTRODUCTION

The research on plant-soil interaction is focused on the processes that take place in the rhizosphere and the soil environment surrounding the root. Many of these processes can control plant growth، microbial infections, and nutrient uptake. (Roberto *et al*., 2007). The agricultural area of the Arab Republic of Egypt is very small when compared this area with the total area. So that, the worker's team referred to renewals reclamation soils nitrogen content which resulted from the lake drying (i.e. Idkou lake) this soil namely; Hallomorphic soil. The total nitrogen of the earth is about 167 x10^{15} ton (Barker and Pilbeam, 2007). Stevenson (1982) reported that, about 98% of the nitrogen of the earth is in the lithosphere (rocks, soil, coal, sediments, core, sea bottom). About 2% of the nitrogen is in the atmosphere, with the portions in the hydrosphere and biosphere being insignificant relative to that in the lithosphere and atmosphere. Most of the nitrogen of the earth, including the nitrogen in the rocks and in the atmosphere, is not available for plant nutrition. The nitrogen in soils, lakes, streams, sea bottoms, and living organisms is only about 0.02% of the total nitrogen of the earth. Mineralization of soil organic matter is generally of the order of less than 50 kg N ha^{-1} $year^{-1}$ for low organic matter content soils to greater than 200 kg N ha^{-1} $year^{-1}$, depending on climatic conditions, organic matter content and tillage practices. To keep steady state conditions, this N release has to be compensated by inputs of organic N and/or immobilization (Hofman, 2004). Soil N availability and microbial processing rates would track with the changes in soil moisture that occur between the moist growing season months and the hot, dry summer months (Parker and Schimel, 2011). Total soil nitrogen is primarily related to moisture content and secondly to stand age, whereas total litter nitrogen is controlled by carbon content and pH (Kennedy and Pitman, 2004). The amount of organic N in the extractant can range from less than 5% to more than 50% of total N depending on the intensity of the extraction (Ros *et al*., 2009). The extraction intensity determines how much organic N is released from the soil. It primarily depends on salt type, the molarity of the solution, the soil-to-solution ratio, and the duration and temperature of the extraction (Ros *et al*., 2011). The salinity effect on bacterial activity with respect to nitrogen fixation is one of the hypothesis for explaining its salt sensitivity (Katerji *et al*., 2001). Hoorn *et al*., (2001) found that, The soil nitrogen content decreased with increasing soil or water salinity. The main reason to that a salinity effect on the mineral nitrogen production by biological activity in the soil through nitrogen fixation and transformation of organic nitrogen.

Pietri and Brookes (2008) studied that, nitrogen mineralization along a pH gradient of a silty loam UK soil. They found that, the soil NH_4-N concentration was maximal at the lowest pH (pH 3.7), declining exponentially until pH 5.5.. However, unexpectedly, soil NO_3^--N concentration was also maximal at pH 3.7 and was significantly negatively correlated with increasing pH thereafter. Bertrand *et al*. (2007) found that, positive correlations between the amounts of NO^-_3 immobilized and soil pH changes by the release of hydroxyl ions by the soil microbial biomass which served to balance the charge in response to anion uptake (NO^-_3). In many ecosystems, the importance of plant uptake of soil organic N in the field remains unclear (Nasholm *et al*. 2009). It has been generally suggested that direct uptake of organic N is significant for plants in soils where inorganic N availability is very limited (Schimel and Bennett 2004) or where soil concentration of amino acids is very high (Jones *et al*. 2005). The relationship between soil N availability and plant N uptake, however, will depend on various factors, including soil interactions, plant-microbial competition, and mycorrhizal association (Persson *et al*. 2003 and Schimel and Benetnett 2004). Therefore, the aims of this study were; 1) study the soil forms and content of N which located in the different sites, 2) study the relation between some soil properties and it's content, forms and transformation of N, 3) study the effect of studied soil properties on plant growth and it's uptake of nitrogen and 4) Concluded the relation between availability and uptake of nitrogen. The aims of this study were; 1) Study the soil forms and content of N which located in the different sites, 2) Study the relation between some soil properties and it's content, forms and transformation of N, 3) Study the effect of studied soil properties on plant growth and it's uptake of nitrogen and 4) Concluded the relation between availability and uptake of nitrogen.

MATERIALS AND METHODS

This study was carrird out on the soils of Bohaira Governorate around Idkou lake varied in their content of total soluble salts "Hallomorphic soil". The studied location was represented by different five sites as shown in Table (1). Two surface soil samples (0-20 cm) were taken from each selected site. Each soil sample was air dried, gently crushed and seived through a 2 mm seive. Fine soil (< 2 mm) were subjected to some chemical and mechanical analysis and these samples content of different N-forms was determined according to the methods described by Cottenie *et al*., (1982) and Page *et al*., (1982) and the obtained data presented in Tables (2 and 3). Also, the relationships between the soil content of different N-forms and some physical or chemical properties of these soils were calculated.

The content of total nitrogen was determined in all soil samples digestion by a mixture of conc. at 1:3 ratio perchloric acid ($HClO_4$) and sulphuric (H_2SO_4) acid using method of Page *et al*., (1982). Ammonium (NH_4-N) was extracted from soil samples and determined using Nessler method as proposed by Jackson (1973). Nitrite (NO_2-N) was extracted from soil samples and determined using sulfanilic acid-alpha naphthylamine method as proposed by Chapman and Partt (1961). Nitrate (NO_3-N) was extracted from soil samples and determined using phenoldisulphonic acid method as proposed by Chapman and Partt (1961). Finally, organic nitrogen (ON) value was calculated by subtracting total inorganic nitrogen from total soil nitrogen.

Table (1): The choice soil sites and rank under study

No.	Location rank	Locations
1	HGI	Halqe El-Gamal Village, Idkou area.
2	IGI	Idkou El-Gidida Village, Idkou area.
3	KBI	Kom Bellage Village, Idkou area.
4	HI	El-Hallawany Village, Idkou area.
5	IAR	Idkou agriculture reclamation area.

Table (2): Particle size distribution of the studied soil samples

Location	Site No.	Sand (%)		Silt (%)	Clay (%)	Texture grade
		Fine	Coarse			
HGI	1	12.80	27.60	20.00	39.60	Clay loam
	2	16.66	33.34	10.00	40.00	Sandy clay
IGI	3	7.46	42.54	20.00	30.00	Sandy clay loam
	4	14.56	25.44	22.00	38.00	Clay loam
KBI	5	3.11	6.89	34.00	56.00	Clay
	6	2.17	3.69	35.42	58.72	Clay
HI	7	20.26	13.00	32.54	34.20	Clay loam
	8	7.74	9.21	20.47	62.58	Clay
IAR	9	16.42	18.62	34.56	30.40	Clay loam
	10	11.69	26.25	25.78	36.28	Clay loam

Table (3): Chemical analysis of the studied soil samples

Chemical properties		HGI		IGI		KBI		HI		IAR	
		1	2	3	4	5	6	7	8	9	10
Ca^{2+}	meq/l.	2.00	2.00	6.00	2.60	1.00	1.00	7.00	10.0	13.0	19.0
Mg^{2+}		6.00	3.00	5.00	4.50	3.00	2.00	5.00	8.00	14.0	10.0
Na^{+}		15.30	16.70	23.80	27.40	5.22	5.14	36.48	27.16	110.92	128.70
K^{+}		0.70	0.62	0.58	0.84	0.88	1.30	0.43	1.05	0.79	1.28
CO_3^{2-}		-	-	-	-	-	-	-	-	-	-
HCO_3^{-}		10.00	7.00	12.00	8.00	3.60	4.00	12.00	9.00	18.00	16.00
Cl-		12.80	14.40	13.60	20.40	5.20	4.40	31.20	22.87	109.20	126.40
SO_4^{2-}		2.10	1.40	11.40	7.95	1.08	0.16	8.86	15.93	17.24	18.65
SAR		10.81	10.56	10.15	14.55	3.69	4.19	14.90	9.05	30.18	33.80
pH		8.14	8.11	8.14	8.21	8.06	8.03	8.12	7.98	8.07	8.12
EC (dSm^{-1})		2.58	2.27	3.74	3.76	1.00	0.87	5.22	4.77	14.56	16.19
$CaCO_3$ (%)		2.28	2.14	2.24	2.91	1.37	0.94	2.23	1.12	1.69	2.09
OM (%)		1.77	1.53	1.38	1.77	2.91	2.81	1.52	2.85	2.18	1.81

CEC	31.31	28.75	26.90	31.31	43.27	42.2	30.64	42.61	32.19	33.29

Pots experiment was carried out in the Experimental Farm, Faculty of Agriculture, Shbin El-Kom, Menoufiya University to study the effect of the studied soil properties on plant growth and it's content of some nitrogen. Plastic pots with one kg capacity (30 pots) has mean diameter and depth equal 12 cm were used in this study. The used pots were divided into five main groups (6 pots/ main group represent the the studied five sites) The pots of each main group were divided into two subgroups represented the first and second soil samples taken from each site. The used pots were arranged in completely randomized block design with three replicates. Each pot was sown by 5 seeds of corn (*Zea maize*) at 2 cm depth and irrigated by tap water at 60% of water holding capacity (WHC) for each soil under study. After ten days from planting, the plants of each pot were thinned to two plants. These pots were irrigated every three days to kept the moisture content at 60% WHC. The plants were harvested after 45 days from planting. The harvested plant samples were separated into shoots and roots, air-dried, oven dried at 70 °C to 48 hours, weighted and kept for determination of it's content of nitrogen forms. The obtained weights for either of shoots or roots were statically analysis according to Snedecor and Cochran (1967). The relationships between plant content of nitrogen and some soil physical and chemical properties were estimated.

RESULTS AND DISCUSSION

The relationships between some chemical and physical properties of the studied soil samples:

Table (4) showed the correlation coefficients of relationships between some physical and chemical properties of the studied hallomorphic soil samples in different locations. These data illustrated that there were a highly significant correlation coefficients between clay contents and both soil OM and CEC. The value of this coefficient was 0.873** between clay and OM. Similar relationships were obtained by El-Meleegy (2007) and Hammad (2009). On the other hand, results in Table (4) showed that, the correlation coefficient between clay contents and soil CEC was 0.923**. These results were in agreement with Dontsova and Bigham (2005) and El-Gamal (2008).

Results in Table (4) indicated that there were highly positive relationships (0.958**) between $CaCO_3$ contents (%) and pH values of the studied soil samples. With regard to the relationships between soil OM contents and soil CEC, data in Table (4) showed that these relationships were highl positive. The found correlation coefficient between OM and CEC was 0.974**. This means that soil organic matter play an important role on soil CEC by increasing soil surface charges. Also, there are a highly significant positive correlation coefficient between sand content and $CaCO_3$ content which was 0.826**.

On the other hand, results in Table (4) showed a significant positive correlation coefficient between sand content and pH value which was 0.728**. The obtained results are in agreement with the findings of Hammad (2009) and Tantawy and Hammad (2010). Also, the data illustrate a highly negative significant correlation coefficients between clay contents and both soil pH and $CaCO_3$ content in the studied soil samples. The findings show that, $CaCO_3$ in the studied soil samples were presented in the sand fraction size, so its have lower active. On the other hand, the value of this coefficient was -0..734** between clay and soil pH. The correlation coefficient between clay contents and $CaCO_3$ content was -0.765**. These results were in agreement with those obtained El-Daweg (1993).

The correlation coefficient recorded in Table (4) illustrated that there was a highly significant negative correlation coefficient between pH values and both soil OM and CEC in the studied soils. The value of this coefficient was -0.796** between pH and OM. These findings resulted from organic acids and other compounds resulted from organic matter decomposition (Li *et al.*, 2007). On the other hand, the correlation coefficient between soil pH and soil CEC was -0.769**. These results were in agreement with those obtained by Khan *et al* (1992) and Kingery *et al* (1994).

Table (4): Correlations coefficients between some physical and chemical properties of the studied soil samples

Soil properties		Silt	Clay	Sand	pH	OM	CEC
Clay	Pearson correlation	0.158					
	P	0.331					
	N	10					
Sand	Pearson correlation	-0.658*	-0.848**				
	P	0.019	0.001				
	N	10	10				
pH	Pearson correlation	-0.312	-0.734**	0.728**			
	P	0.190	0.008	0.009			
	N	10	10	10			
OM	Pearson correlation	0.497	0.873**	-0.933**	-0.796**		
	P	0.072	0.000	0.000	0.003		
	N	10	10	10	10		
CEC	Pearson correlation	0.478	0.923**	-0.961**	-0.769**	0.974**	
	P	0.081	0.000	0.000	0.005	0.000	
	N	10	10	10	10	10	
$CaCO_3$	Pearson correlation	-0.451	-0.765**	0.826**	0.958**	-0.858**	-0.832**
	P	0.096	0.005	0.002	0.000	0.001	0.001
	N	10	10	10	10	10	10

* . correlation is significant at the 0.05 level (1-tailed) **. correlation is significant at the 0.01 level (1-tailed)

The correlation coefficients listed in Table (4) illustrated a highly significant negative correlation coefficients between sand content and both soil OM (-0.933**) and CEC (-0.961**) in the soils under invstigation. These results were in agreement with the findings of Khan *et al.*, (1992). With regard to the relationships between soil OM contents and $CaCO_3$ content, the obtained results showed a highly negative relationship between OM and $CaCO_3$ (-0.858**). There were a highly negative relationships between CEC and $CaCO_3$ content (-0.832**) of all soil samples in various location. These results were in agreement with the findings of Sweed (2012) and Tantawy *et al.*,2012), Also, Caravaca *et al.*, (1999) concluded that, the correlation coefficients between the cation exchange capacity (CEC) and the total organic carbon (TOC) content of the clay and fine silt size fractions were highly significant (r=0.82*** and r= 0.97***, respectively).

Soil content of different nitrogen forms

a. Ammonium nitrogen (NH_4^+-N)

Regarding to the soil content of ammonium-N (NH_4^+-N) (mg/100 g soil), the data recorded in Table (5) show that, the content of NH_4^+-N in the soil samples under study ranged from 18.65 to 2.80 mg/100g soil with an average of 10.00 mg/100g soil. These data also show that, NH_4^+-N represent the main fraction of soil inorganic-N. Based on the mean values of the soil content of NH_4^+-N, as mg/100g soil, the studied soil locations were taken the following order: KBI > HI > IAR > HGI > IGI. The variation of soil content of NH_4^+-N may be attributed to soil aeration, soil moisture degree, ammonification rate, soil pH and the content of fine fraction. These results were in agreement with those obtained by Horron *et al.*, (2001) and El-Mleegy, 2007.

Table (5): The studied soil samples content (mg/100g) of different nitrogen forms

Site No.	Location	N_T	NH_4^+	NO_3^-	NO_2^-	N_{in}	N_O
1	HGI	76.44	2.80	4.90	0.80	8.50	67.94
2		74.36	7.50	3.60	1.30	12.40	61.96
3	IGI	65.10	3.60	2.30	0.70	6.60	58.50
4		71.85	6.20	1.20	0.90	8.30	63.55
5	KBI	110.45	17.28	2.50	0.50	20.28	90.17
6		113.97	18.65	0.60	0.80	20.05	93.92
7	HI	83.89	10.09	3.30	1.00	14.39	69.50
8		101.39	14.98	0.70	1.10	16.78	84.61
9	IAR	86.10	8.60	2.60	0.70	11.90	74.20
10		81.65	10.30	0.50	1.20	12.00	69.65

b. Nitrite nitogen (NO_2^--N)

Regarding to the soil content of nitrite-N (NO_2^--N) (mg/100 g soil), the data recording in Table (5) show that, the content of NO_2^--N in the soil samples under study ranged from 1.30 to 0.50 mg/100g soil and the mean was 0.90 mg/100g soil. Based on the mean values of the soil content of NO_2^--N, as mg/100g soil, the studied soil locations were taken the following order: HGI > HI > IAR > IGI > KBI. These results were in agreement with those obtained by Granli and Bockman (1994).

c. Nitrate nitrogen (NO_3-N)

Regarding to the soil content of nitrate-N (NO_3^--N) (mg/100 g soil), the data recording in Table (5) show that, the content of NO_3^--N in the soil samples under study ranged from 4.90 to 0.50 mg/100g soil and the mean was 2.33 mg/100g soil. Based on the mean values of the soil content of NO_3^--N, as mg/100g soil, the studied soil locations taken the following order: HGI > HI > IGI > KBI = IAR. The obtained results are in agreement with Horron *et al.*, (2001) and El-Mleegy (2007). The high content of the previous inorganic-N forms was attributed to the high content of soil fine fraction in alluvial soil samples and the high biological activity which decomposed the soil organic matter through the processes of nitrification and ammonification or during the process of atmospheric nitrogen (Abou Hussien, 1999 a, b and c). The obtained results are in agreement with Parker and Schimel (2011), who concluded that, the production of NO_3^- from NH_4^+ by nitrifying bacteria could be an important process in soils contributing to higher soil NO_3^-. The content of both NH_4 and NO_3 in the different soil sites deficient was related to the content of organic matter (El-Mleegy, 2007).

d. Organic-N (No)

Regarding to the soil content of organic-N (mg/100 g soil), the data recording in Table (5) show that, the content of organic-N in the soil samples under study ranged from 93.92 to 58.50 mg/100g soil with an average of 73.40 mg/100g soil. Based on the mean values of the soil content of organic-N, as mg/100g soil, the studied soil types were taken the following order: KBI > HI > IAR > HGI > IGI. The obtained results are in agreement with those obtained by Shaban (2005) and El-Mleegy (2007) in some soils of Egypt which characterized by different physical and chemical properties. Also, climate change will lead to changes in soil moisture and temperature, thereby affecting organic matter mineralization and the cycling of nitrogen (Guntiñas *et al.*, 2012).

e. Total-N (N_T)

Regarding to the soil content of total-N (mg/100 g soil), the data recording in Table (5) show that, the soil content of total-N as mg/100 g was varied widely, where it's ranged from from 113.97 mg/100 g soil in site No. 6 which taken from (KBI) to 65.10 mg/100 g soil in site No. 3 which taken from (IGI) and the mean was 86.52 mg/100g soil. Based on the mean content of total-N as mg/100 g, the studied soil locations can be arranged as the following order: KBI > HI > IAR > HGI > IGI. The high content of total-N in the different sites of soil samples was resulted from the high content of organic matter and soil fine fraction in this site compared with other sites. The obtained results are in agreement with those obtained by Shaban (2005) and El-Mleegy (2007). Concerning the comparison of nitrogen forms in the studied soils, the nitrogen forms can be arranged as the following order: NO > NH_4^+ > NO_3^- > NO_2^-.

Relationships between soil properties and its content of different N forms

a. Relationships between the studied soil properties and the content of ammonium nitrogen (NH_4^+)

Data in Table (6) showed that, the relationships between NH_4^+ and clay, OM and CEC were highly significant and positive, where the correlation coefficient were 0.810**, 0.861** and 0.907** respectively. We can concluded that increasing soil clay contents, soil organic matter (OM) and soil CEC, were associated by increase in the content of NH_4^+ form. This may attributed to the increase in the negative charges which found on both clay surface and active groups of organic matter.

The correlation coefficient for the relation between NH_4 content and soil pH was -0.762**. Also, the correlation coefficient of the relation between soil $CaCO_3$ and NH_4-N was -0.836**. These results illustrated that increasing soil pH and or the soil content of $CaCO_3$ the NH_4-N content were negative. These may be due to the volatilization of NH_4-N under high soil pH and $CaCO_3$ content. The obtained results are in agreement with those obtained by Kemmitt *et al.* (2005), Eltilib *et al.* (2005) and Pietri and Brookes (2008).

Table (6): Relationships between soil properties and it's content of different N forms

Soil properties	NH_4^+	NO_3^-	NO_2^-	Nin	NO
Sand	-0.926** 0.000	0.443 0.200	0.353 0.317	-0.905** 0.000	-0.985** 0.000
Silt	0.573 0.083	-0.255 0.476	-0.579 0.079	0.547 0.102	0.640* 0.046
Clay	0.810** 0.004	-0.401 0.251	-0.055 0.879	0.801** 0.005	0.840** 0.002
Fine	0.926** 0.000	-0.443 0.200	-0.353 0.317	0.905** 0.000	0.985** 0.000
pH	-0.762* 0.010	0.317 0.372	0.034 0.925	-0.773** 0.009	-0.792** 0.006
OM	0.861** 0.001	-0.452 0.190	-0.342 0.333	0.829** 0.003	0.954** 0.000
CEC	0.907** 0.000	-0.486 0.154	-0.249 0.488	0.875** 0.001	0.960** 0.000

$CaCO_3$	-0.836** 0.003	0.359 0.309	0.200 0.579	-0.836** 0.003	-0.888** 0.001

* Fine fraction and sand are highly correlated with other soil properties variables
* Fine fraction and sand has been removed from the equation

b. Relationships between the studied soil properties and the content of nitrite (NO_2-N) and nitrate (NO_3-N)

With regarding to the impact of the physical and chemical properties of the studied soil samples on the soil content of both NO_2-N and NO_3-N forms, the obtained data show that, these relations varied between positive or negative (Table, 6). This can explained on the basis of the absence of a direct effect of studied soil properties on both NO_2-N or NO_3-N. The examined soil properties have a greater effects on nitrification and for denitrification processes. The obtained results are in agreement with those obtained by Abou Hussien (1999 a, b and c), Bertrand *et al*. (2007), Pietri and Brookes (2008) and El-Meleegy (2007).

c. Relationships between studied soil properties and its content of organic nitrogen form (No-N)

Concerning to the behavior of organic nitrogen (No) and the influence of the physical and chemical properties of the soil samples under examination, the correlation coefficients set at Table (6) showed variation in these effect. The clay contents had a positive highly significance (0.840*). The obtained results are in agreement with those obtained by Tisdal *et al.*, (1990) and El-Meleegy (2007). The effects of both soil organic matter and CEC have a highly positive correlation with NO-N form, where found the correlation coefficient between OM and NO-N content was 0.954** and was 0.960** between CEC and NO-N. This means that with increasing soil organic matter and CEC, the NO-N content were increased. These results were in agreement with those obtained by Barker and Pilbeam (2007) and Sahrawat (2006). The soil properties which had a negative relation with organic nitrogen were soil pH and the content of $CaCO_3$. The correlation coefficients between NO-N and soil pH and $CaCO_3$ were -0.792** and -0.888**, respectively. This can be interpreted by the influence of soil carbonate on the soil OM decomposition and consequently NO-N form. These results were in agreement with, Shaban (2005), Basak (2005), Sahrawat (2006) and Ros *et al.*, (2011).

Evaluation of some nitrogen forms in studied soil samples

In order to evaluate the different forms of nitrogen in the soil samples under study, multiple regression equations by the SPSS and Mini Tab statistical computer programs were applied. Applying multiple regression equations can be predict the values of various nitrogrn forms under different physical and chemical conditions of the studied soil samples in any location.

a. Regression equations of NH_4-N

Regarding to regression equations of NH_4 multiple regression equations for NH_4 for the studied soil samples, the following equation can predict the value of ammonium form:

$$NH_4 = - 83 + 0.248\ silt + 0.34\ clay + 9.3\ pH - 6.3\ OM + 0.45\ CEC - 3.45\ CaCO_3 + 0.164\ EC \quad (R^2 = 90.4\%)$$

b. Regression equations of NO_2-N

Concerning the nitrite form (NO_2-N) values, the multiple regression equation was:

$$NO_2 = 11.5 + 0.0163\ silt + 0.0878\ clay - 1.29\ pH - 0.440\ OM - 0.119\ CEC + 0.223\ CaCO_3 + 0.0572 \quad (R^2 = 91.7\%)$$

c. Regression equations of NO_3-N

Concerning the nitrate form (NO_3-N) values, the multiple regression equation was:

$$NO_3 = 229 - 0.094\ silt - 0.383\ clay - 28.0\ pH - 0.50\ OM + 0.54\ CEC + 1.74\ CaCO_3 - 0.325\ EC \quad (R^2 = 57.5\%)$$

d. Regression equations of NO- N

Concerning the organic nitrogen form (NO-N) values, the multiple regression equation was:

NO = - 238 + 0.548 silt + 0.590 clay + 35.2 pH + 4.10 OM - 0.23 CEC - 7.63 $CaCO_3$ + 0.111 EC (R^2 = 99.2%)

Farrell *et al*., (2011) studied the seasonal variation in soluble soil carbon and nitrogen across a grassland productivity gradient obtained similar results. Also, Holst *et al*., (2012) analyzed statically of soluble inorganic and organic nitrogen in two Australian soils and obtained fitting results. Bechtold and Naiman (2006) found that positive correlations of fine texture and net N mineralization could result from stimulation of N mineralization by other related to soil texture. Pietri and Brookes (2008) concluded that soil NO_3-N concentration was maximal at pH 3.7 and was significantly negatively correlated with increasing pH thereafter. It was clearly that in this work for most soil locations.

Greenhouse Experiment

Dry matter yield of corn plant as affected by the studied soil properties

Data in Table (7) show the obtained dry weight (DW) for shoots and roots of corn plant. These data showed that, the DW values (g/pot) were varied widely. Shoots DW ranged from 3.67 g to 0.00 g with an average values 2.24 g/pot. Also, the values of roots DW varied widely and roots weight ranged from 1.25 g to 0.00 g with an average 0.71 g/pot. Based on the mean values of shoots, roots and whole plant dry weight, soil locations take the following order: IGI > KBI > HI > HGI > IAR. The wide variations in the dry weights of plant grown in salt affected soils were found by Koreish *et al*. (2001) and Losada *et al*. (2006).

Plant content of nitrogen

Results concerning the effect of different soil samples represent the salt affected soils under study on N concentration (%) and uptake (mg/pot) by either shoots or roots of corn plant are shown in Table (8). Nitrogen concentration (%) ranged from 0.93 to 2.33 % for shoots with an average of 1.45% and from 0.65 to 1.63 % for roots with an average of 0.91%. Based on the mean values of nitrogen concentration (%), the studied soil locations take the following order:

KBI > HI > IGI > IAR > HGI for shoots and
HI > IGI = HGI > KBI > IAR for roots.

The mean values of nitrogen uptake (mg/pot) ranged from 17.52 to 52.57 for shoots with an average of 35.46 mg/pot and from 3.58 to 16.33 for roots with an average of 7.22 mg/pot. Based on the mean values of nitrogen uptake (mg/pot) the studied soil locations take the following order:

Table (7): Dry matter yield (g/pot) of corn plant grown on the studied soils

Site No.	Location	Dry matter yield (g/pot)		
		Shoots	Roots	Whole plants
1	HGI	2.39	0.69	3.08
2		1.88	0.48	2.36
3	IGI	3.05	0.62	3.67
4		3.67	1.25	4.92
5	KBI	2.48	0.87	3.35
6		2.56	0.91	3.47
7	HI	2.80	0.64	3.44
8		1.65	1.00	2.65

9	IAR	0.00	0.00	0.00
10		1.94	0.60	2.54

KBI > IGI > HI > HGI > IAR for shoots,
HI > IGI > KBI > HGI > IAR for roots and
KBI > IGI > HI > HGI > IAR for whole plant.

Table (8): Corn nitrogen content as a percent (%) and it's uptake (mg/pot)

Location	Site No.	Shoots		Roots		Whole plants
		(%)	uptake mg/pot	(%)	uptake mg/pot	uptake mg/pot
HGI	1	1.26	30.11	1.21	8.25	38.36
	2	0.93	17.52	0.75	3.58	21.1
IGI	3	1.54	46.97	1.03	6.37	53.34
	4	1.21	44.53	0.93	11.67	56.2
KBI	5	1.87	46.29	0.84	7.31	53.6
	6	2.05	52.57	0.65	5.95	58.52
HI	7	1.45	40.51	1.03	6.57	47.08
	8	1.87	30.80	1.63	16.33	47.13
IAR	9	0	0	0	0	0
	10	2.33	45.27	1.03	6.16	51.43

These variations in values of nitrogen uptake may be attributed to the variations among in these soil properties and it's content of different nitrogen forms (Jones *et al.* 2005 and Absalan *et al.*, 2011).

To predict the N-uptake by corn plant, the correlation between N-uptake and the soil nitrogen forms content for shoots and roots were calculated for the studied soils and each of correlation coefficient and correlation equations were obtained as follow:

N-uptake by shoot = 93.0 - 0.436 NT- 14.3 NH_4 + 23.5 NO_3^- - 6.8 NO_2 (R^2= 85.8%)

N-uptake by root = 12.9 - 0.080 NT - 1.40 NH_4 + 2.13 NO_3^- + 1.95 NO_2 (R^2 = 26.3%)

Karaivazoglou *et al.* (2007) concluded that, the soil content of NH_4-N significantly reduced ($P \leq 0.05$) plant height, the number of leaves per plant and the fresh weight of leaves. A similar negative effect of NH_4-N on dry-matter accumulation of tobacco seedlings was reported by Zou *et al.* (2005). Uptake inhibition of NH_4 by plants was due to carbohydrate limitation or NH_4^+ toxicity (Claussen and Lenz, 1995). In addition, Walch-Liu *et al.* (2001) found that, the root growth of plant was not affected by the N form, while shoot growth was strongly inhibited by NH_4. This result are agree with obtained by Gelfand and Yakir (2008) and Camberato (2009). They stated that there is an antagonistic relationship between N-uptake and denitrification in which results from soil moisture increased or low aeration.

REFERENCES

Abou Hussien, E. A. (1999 a). Status and distribution of some micronutrients in the soils representing different physiographic units in the desertic zone of Minufiya Governorate (El-Sadat City). VI[16]. National Conference for Environmental Studies and Research "Egyptian Desert Environmental Development". 7-9 November (1999). Pp 369-393.

Abou Hussien, E. A. (1999 b). Soybean and corn response to different sulphur sources. Mansoura Univ., J. of Agric. Sci. 24 (11): 7007-7021.

Abou Hussien, E. A. (1999 c). Effect of different cultivation periods of banana plants on: 2-The chemical composition of the soil humic substances. Minufiya J. Agric. Res., 24 (2): 701-714.

Absalan, A. A., M. Armin, M. R. Asghripour and S. K. Yazdi (2011). Effects of Different Forms of Nitrogen Application on Yield esponse of Corn under Saline Conditions. Advances in Environmental Biology, 5(4): 719-724.

Barker, V. A. and D. J. Pilbeam (2007). Hand Book of Plant Nutrition. Taylor & Francis Group. Library of Congress Cataloging Publication. CRC. New York. U.S.A. Pp. 30-90.

Basak, R. K. (2005). "Fertilizers". Kalyani Publishers, Ludhiana-New Delhi-Noida (U. P.), Hyderabad-Chennai-Calcutta-Cuttack.

Bechtold, J.S. and R.J. Naiman (2006). Soil texture and nitrogen mineralization potential across a riparian toposequence in a semi-arid savanna Soil. Biology & Biochemistry 38: 1325–1333.

Bertrand, I., D. Olivier and M. Bruno (2007). Carbon and nitrogen mineralization in acidic, limed and calcareous agricultural soils: Apparent and actual effects. Soil Biology & Biochemistry 39: 276–288.

Camberato, J. J. (2009). NITROGEN IN SOIL AND FERTILIZERS. Australian Journal of Botany 53 (7): 639–650.

Caravaca, F., A. Lax and J. Albaladejo (1999). Organic matter, nutrient contents and cation exchange capacity in fine fractions from semiarid calcareous soils. Geoderma 93: 161–176.

Chapman, H. D. and P. F. Pratt (1961). Methods of Analysis for Soils, Plants and Waters. Univ. of California, Dvi. Agric. Sc.

Claussen, W. and F. Lenz (1995). Effect of ammonium and nitrate on net photosynthesis, flower formation, growth and yield eggplants (Solanum melongena L.). Plant Soil 171: 267–274.

Cottenie, A., M. Verloo, L. Kiekens, G. Velghe and R. Camerlynik (1982). Chemical analysis of plant on soils lab. Of an Analytical and Agroch., State University of Ghent, Belgium.

Dontsova, K.M. and J.M. Bigham (2005). Anionic Polysaccharide adsorption by Clay Minerals. Soil Science Society American Journal 69: 1026-1035.

El-Daweg, G. (1993). Evaluation the changes in physical and chemical properties of a newly reclaimed soils through twenty years of cultivation". Assuit J. of Sci . 24(4): 155 – 168 .

El-Gamal, B. A. (2008). Response of wheat plants grown on low cation exchange capacity soils to fertilization with potassium. M. Sc. Thesis. Faculty of Agric., Menufiya Univ., Shebin El-Kom, Egypt.

El-Mleegy, H. A. (2007). Effect of soil chemical and physical properties on nitrogen forms and distribution in soils Minufiya Governorate. M. Sc. Thesis. Faculty of Agric., Menufiya Univ., Shebin El-Kom, Egypt.

Eltilib, A.M., A.E. Elamin, M.M. El-Gaziri and Y.E. El mahi (2005). Combined effects of nitrogen fertilization and soil CaCO3 contents on corn performance in El-Marj soil, Libya. Journal of Plant Nutrition 28: 1619-1632.

Farrell, M., P. W. Hill, J. Farrar, R. D. Bardgett and D.L. Jones (2011). seasonal variation in soluble soil carbon and nitrogen across a grassland productivity gradient. Soil Biology & Biochemistry 43: 835-844.

Gelfand, I. and D. Yakir (2008). Influence of nitrite accumulation in association with seasonal patterns and mineralization of soil nitrogen in a semi-arid pine forest. Soil Biology & Biochemistry 40: 415–424.

Granli, T. and O.C. Bockman (1994). Nitrogen oxide from agriculture. Norw. J. Agric. Sci. 12:7–127.

Guntiñas, M.E., M.C. Leirós, C. Trasar-Cepeda and F. Gil-Sotres (2012). Effects of moisture and temperature on net soil nitrogen mineralization: A laboratory study. European Journal of Soil Biology. 48: 73-80.

Hammad, M. M. H. (2009). Effect of saline irrigation water on calcareous soil and its productivity. Ph. D. Sc. Thesis. Faculty of Agric., Menufiya Univ., Shebin El-Kom, Egypt.

Hofman, G. (2004). Soil and Plant Nitrogen. International Fertilizer Industry Association. Paris. Pp. 1-48.

Holst, J., R. Brackina, N. Robinsona, P. Lakshmananb and S. Schmidta (2012). Soluble inorganic and organic nitrogen in two Australian soils under sugarcane cultivation. Agriculture, Ecosystems and Environment 155: 16– 26.

Horron, J.W., N. Katerji, A. Hamdy and M. Mastrorilli (2001). Effect of salinity on yield and nitrogen uptake of four grain legumes and on biological nitrogen contribution from the soil. Agricultural Water Management 51: 87–98.

Jackson, M. L. (1973). Soil chemical Analysis. Prentice-hell of India private limited New Delhi, India.

Jones, D. L., D. Shannon, T. Junvee and J. F. Farrar (2005). Plant capture of free amino acids is maximized under high soil amino acid concentrations. Soil Biol. Biochem. 37: 179-181.

Karaivazoglou, N. A., N.C. Tsotsolis and C.D. Tsadilas (2007). Influence of liming and form of nitrogen fertilizer on nutrient uptake, growth, yield, and quality of Virginia (flue-cured) tobacco. Field Crops Research 100: 52–60.

Katerji, N., J.W. Van Hoorn, A. Hamdy and M. Mastrorelli (2001). Salt tolerance of crops according to three classifications methods and examination of some hypothesis about salt tolerance. Agric. Wat. Manage. 47: 1–8.

Kemmitt, S., D. Wright and D. Jones (2005). Soil acidification used as a management strategy to reduce nitrate losses from agricultural land. Soil Biology & Biochemistry 37: 867–875.

Kennedy, F. and R. Pitman (2004). Factors affecting the nitrogen status of soils and ground flora in Beech woodlands. Forest Ecology and Management 198: 1–14.

Khan, H. R., S. M. Faz, M. N. Islam, T. Adachi and I. U. Ahmed (1992). Physical chemical characteristics of a saline soil under rice as influenced by gypsum and Zn. Current Agric., 16 (1-2): 14 refs.

Kingery, W. L. C., W. Wood, D. P. Delaney, J. C. Williams and G. L. Mullins (1994). Impact of long-term land application of boriler litter on environmentally related soil properties. J. Environ. Qual. 23: 139 – 147.

Koreish, E.A., H.M.Ramadan and M.E. El-Fayoumy (2001). Response of faba been and wheat to bio and mineral fertilization in newly-reclaimed soils. J. Adv. Agric. Res., Fac. Agric. Saba Basha, 6 (4): 903-921.

Li X, Rengel Z., E. Mapfumo, Bhupinderpal-Singh (2007). Increase in pH stimulates mineralization of native organic carbon and nitrogen in naturally salt-affected sandy soils. Plant and Soil 290: 269-282.

Losada, M.R.M., E.F. Nunez and A.R. Rodriguez (2006). Posture tree and soil evolution in silvopastoral systems of Atlantia Europe. Forest Ecology and Management, 232 (1/3): 135-145.

Nasholm, T., A. Ekblad and U. Ganetag (2009). Uptake of organic nitrogen by plants. New Phytol. 182: 31–48.

Page, A.L., R.H. Miller and D.R. Keeney (1982). Methods of soil analysis part 2. Madison Wisconsin, U.S.A.

Parker, S. S. and J. P. Schimel (2011). Soil nitrogen availability and transformations differ between the summer and the growing season in a California grassland. Applied Soil Ecology 48: 185–192.

Persson, J., P. H Gberg, A. Ekblad, M. H. Gberg، A. Nordgren and T. N. Sholm (2003). Nitrogen acquisition from inorganic and organic sources by boreal forest plants in the field. Oecologia. 137: 252-257.

Pietri, J.C.A. and P.C. Brookes (2008). Nitrogen mineralization along a pH gradient of a silty loam UK soil. Soil Biology & Biochemistry 40: 797–802.

Roberto, P., Z. Varanini and P. Nannipieri (2007). *The Rhizosphere Biochemistry and Organic Substances at the Soil-Plant*

Interface. Second edition, Taylor and Francis group, CRC Press. Boca Raton London New York.

Ros, G.H., E. Hoffland, C. Van Kessel and E.J.M. Temminghoff (2009). Extractable and dissolved organic nitrogen – a quantitative assessment. Soil Biology & Biochemistry, 41: 1029–1039.

Ros, G. H., E. J. M. Temminghoff and E. Hoffland (2011). Nitrogen mineralization: a review and meta-analysis of the predictive value of soil tests. European Journal of Soil Science, 62, 162–173.

Sahrawat, K. L. (2006). Organic Matter and Mineralizable Nitrogen Relationships in Wetland Rice Soils. Communications in Soil Science and Plant Analysis, 37: 787-796.

Schimel, J. A. and J. Bennett (2004). Nitrogen mineralization: challenges of a changing paradigm. Ecology 85: 591–602.

Shaban, Kh. A. (2005). Effect of different irrigation water resources on properties and productivity of salt affected soils. Ph. D. Thesis, Fac. of Agric. Minufiya Univ., Egypt.

Snedecor, G. W. and W. G. Cochran (1967). Statistical Methods. The Iowa State University Press, Ames, Iowa.

Stevenson, F.J. (1982). Organic forms of soil nitrogen, In: F.J. Stevenson, ed. *Nitrogen in Agricultural Soils*. Madison, Wis.: American Society of Agronomy, pp. 67–122.

Sweed, A. A. A. I. (2012). Interaction of humic and organic acids with carbonate minerals and calcareous soils. Ph. D. Thesis, Fac. of Agric. Minufiya Univ., Egypt.

Tantawy, Manal, FA, E.A. Abuo Hussien, M.A. Ahmed and A. A. A. Sweed (2012). Relative changes of chemical properties of calcareous soils treated by organic acids under different salinity levels of irrigation water. J. Soil Sci. and Agric Eng. Mansoura Univ., 3 (10): 1017-1037.

Tantawy, Manal, F.A. and M. M. H. Hammad (2010). Effect of leaching water salinity and sodicity on salinity and ionic composition distribution of calcareous soils. The Sixth International Conference of Sustainable Agricultural Development, 27-29 December, Fayoum Univ., Egypt, 355-368.

Tisdale, S. L., W. L. Belson and J. L. Havlin (1990). Soil fertility and fertilizers 4th-ed., Macmillan Publishing Company, New York, USA.

Walch-Liu, P., G. Neumann and C. Engels (2001). Response of shoot and root growth to supply of different nitrogen forms is not related to carbohydrate and nitrogen status of tobacco plants. J. Plant Nutr. Soil Sci. 164: 97–103.

Zou, C., X. Wang, Z. Wang and F. Zhang (2005). Potassium and nitrogen pattern and growth of flue-cured tobacco seedlins influenced by nitrogen form and calcium carbonate in hydroponic culture. J. Plant Nutr. 28: 2145–2157.

دراسة تأثير خواص الأرض على نمو النبات ومحتواه من بعض صور النيتروجين

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مساحة الأرض الزراعية صغيرة جدا عند مقارنتها بالمساحة الكلية لجمهورية مصر العربية. ولذلك، أشار فريق العمل في هذه الدراسة إلى المحتوى الأزوتي لأراضي الاستصلاح الجديدة والتي تنشأ نتيجة تجفيف البحيرات (مثل بحيرة إدكو)، تسمى هذه الأراضي بالأراضي المتأثرة بالأملاح "الأراضي المتدهورة". الموقع المستخدم في هذه الدراسة أراضي بمحافظة البحيرة حول بحيرة إدكو والتي تختلف في محتواها من الأملاح الكلية الذائبة، حيث تم اختيار خمس مواقع مختلفة. كل موقع أخذ منه عينتين، عينات الأرض المأخوذة تم تقدير بعض خواصها الكيميائية والفيزيائية، وكذلك صور النيتروجين تم تقديرها. تم تنفيذ تجربة أصص بمزرعة كلية الزراعة بشبين الكوم – جامعة المنوفية لدراسة تأثير خواص الأراضي المدروسة على نمو النبات ومحتواه من النيتروجين. النتائج المتحصل عليها أوضحت أن هناك علاقة موجبة عالية المعنوية بين محتوى الطين وكل من المادة العضوية والسعة التبادلية الكاتيونية للأراضي المتدهورة. أيضا، وجدت علاقة موجبة عالية المعنوية محتوى الأرض من كربونات الكالسيوم والـ pH. كما وجدت علاقة سالبة عالية المعنوية بين محتوى الأرض من الرمل وكل من المادة العضوية والسعة التبادلية الكاتيونية للأراضي المدروسة. محتوى الأرض من الأمونيوم تراوح بين ١٨.٦٥ إلى ٢.٨٠ ملجم/١٠٠جم أرض. تراوحت قيم محتوى النيتريت في الأراضي المدروسة من ١.٣٠ إلى ٠.٥٠ ملجم/١٠٠جم أرض. تراوحت قيم محتوى النيتروجين الكلي في الأراضي المدروسة من ١١٣.٩٧إلى ٦٥.١٠ ملجم/١٠٠جم أرض. تراوحت قيم الأزوت الممتص (ملجم/أصيص) في الأراضي المدروسة من ٣٠.١١ إلى ٥٢.٥٧ ملجم/أصيص للسيقان و من ٣.٥٨ إلى ١٦.٣٣ ملجم/أصيص للجذور.