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IMPACT OF HUMIC ACID AND MINERAL NITROGEN FERTILIZATION ON SOIL CHEMICAL PROPERTIES AND YIELD AND QUALITY OF SUGAR BEET UNDER SALINE SOIL.

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ABSTRACT

Two field experiments were conducted at Gelbana district Sahl–El Tina plain (North Sinai) laying between longitudes 32 ^{o} 20 and 32^{o} 33 east and latitudes 30 ^{0} 57 and 31^{0} 04 North during two successive seasons 2011/2012 and 2012/2013 to study the effect of soil application of inorganic nitrogen fertilization at rates of 50, 75 and 100 kg N fed $^{-1}$ and organic humic acid fertilizer at rates of (0- 10 kg fed^{-1}) and its impact on some chemical soil properties, growth, chemical composition, yield and quality of some sugar beet varieties (Mirador, Panther and Athospoly). A split -split plot design with three replicates was used in the two seasons.

The highest values of available K content in soil in both seasons and available N content in the 1st season were recorded by Panther variety.

Panther variety occurred a significant superiority over the other varieties in vegetative traits i.e. diameter, weight, dry matter %, of root, photosynthetic pigments i.e. chlorophyll a, b and carotenoides and proline as will as root and sugar yields in the two season. All quality parameters (total soluble solids %, sucrose% and juice purity %) were insignificantly affected by the tested varieties in the two seasons.

Soil application of humic acid exhibited significant increase in available K-content in the soil in both seasons and available N in the 2nd season as will as N, P and K- percentages in sugar beet root in both seasons. Also application of humic acid significantly increased proline concentration in leaves beet by (15.73 and 13.97%), sucrose% by (0.41 and 0.61%), as will as root yield by (22.80 and 28.38 %) and sugar yield by (26.56 and 32.44%) in the 1st and 2nd seasons compare with untreated one.

Increasing mineral N-rate significantly increased root and sugar yields/fed in both seasons. Also application of 100 kg N fed $^{-1}$ recorded the highest values of root yield (29.91 and 27.27 ton fed $^{-1}$) and sugar yield (5.53 and 4.71 ton fed $^{-1}$) in the 1st and 2nd seasons.

The interaction between mineral nitrogen fertilizer rates and humic acid (NXH) had a significant effect on root and sugar yields, sucrose%, and proline concentration in both seasons as will as on available K in the soil in the 1st season. However, the interaction between sugar beet varieties and nitrogen fertilizer (VxN) and between sugar beet varieties and humic acid (VxH) had a significant effect on root length, LA, chlorophyll a and carotenoides, proline concentration and root and sugar yields in both season. Meantime, the interactions effects between the three variables under study (sugar beet varieties, humic acid and mineral nitrogen fertilizer rates) insignificantly effected on all traits under studies.

Keywords: Sugar beet varieties - nitrogen fertilizer - humic acid - salinity - chemical soil properties - growth traits – yields and quality.

INTRODUCTION

Inorganic and organic fertilizers applied together are of importance to agricultural sustainability mostly for their significant effect on soil productivity as well as on chemical soil properties. Numerous studies reported that combinations of organic with inorganic fertilizers are more beneficial for soil properties and crop production than either fertilizer applied alone, (Ayoola 2006).

Soil salinity is adversely affecting physiological and metabolic processes, finally diminishing growth and yield (Ashraf and Harris 2004). Excessive salts injure plants by disturbing the uptake of water into roots and interfering with the uptake of competitive nutrients (David 2007). The inhibitory effect of salinity on plant growth and yield has been ascribed to osmotic effect on water availability, ion toxicity, nutritional imbalance, and reduction in enzymatic and photosynthetic efficiency and other physiological disorders (Khan *et al.* 1995). Mundree *et al*. (2009) reported that, a decline in photosynthesis due to salinity stress could be due to lower stomata conductance, depression in carbon uptake and metabolism, inhibition of photochemical capacity, or a combination of all these factors.

All sugar beet genotypes (*Beta vulgaris,* L.) cultivated in Egypt are imported from foreign countries, so, it is preferable to evaluate them under Egyptian conditions especially under newly reclaimed soils to select the best suited ones. (Hozayn 2013) evaluated some sugar beet cultivars grown under newly reclaimed soil, he found significant differences among tested cultivars in all studied traits. Heliospoly variety recorded the highest root yield, sugar recovery and maximum sugar yield. Conversely Monte Rosa variety comes out as a poorest cultivar with minimum root yield and lowest sugar yield.

Sugar beet (*Beta vulgaris, L.*) ; is one of the main sources for sugar production in Egypt; has the ability to grow in the new reclaimed soils that usually suffer from salinity and poor quality of irrigation water. It resists againest soil salinity and water stress (Hills *et al*. 1990). Sugar beet is reputed to be a deep rooting crop and relatively insensitive to water stress (Salter and Goode 1967). Recently, the use of salt tolerant crops has been recognized as a successful method to overcome salinity problem (Meiri and Plaut 1985). (Roades and Loveday 1990) indicated that sugar yield of sugar beet was not affected by salinity up to an electrical conductivity value (EC) of 7 dSm^{-1}. (Dadkhah 2011) found that, at the highest level of salinity (350 mM) sugar beet, cv 7233- P_{29} showed a significantly higher leaf area and total dry matter than Madison Cultivar. High levels of salinity had up to 91.5% inhibition in photosynthetic rates.

Humic substances are renowned for their ability to: Chelate soil nutrients, improve nutrient uptake, especially phosphorous, sulfur and nitrogen, reduce the need for nitrogen fertilization, remove toxins from soils, stimulate soil biological activity, solubilize minerals, improve soil structure, act as a storehouse of N, P, S and Zn and improve water-holding capacity for better drought resistance and reduction in water use. (Russo and Berlyn 1990) Found that usage of humic acid in addition to enhancement in maize's performance, gave better results by reducing the usage of chemical fertilizers also they reported that, humic acid might show anti-stress effects under abiotic stress conditions such as salinity. (Hussein and Hassan 2011) found that soil application of humus increased the N-uptake of corn, significant effect of interaction between salt and soil humus application. (Hanafy *et al.*

2013), reported that, humic acid increased chemical constitutes related to salt tolerance either inorganic, N, P and K, or organic constitutes e.g. proline, total sugars, chlorophyll a, b, total chlorophyll and total carotenoids. (Somayeh *et al.* 2012) studied the response of sugar beet genotypes to humic acid; they revealed significant differences between genotypes in terms of leaf chlorophyll content under stress condition.

Nitrogen is a vital importance to plant physiology. It plays a critical role in the process of photosynthesis, is essential in plants' manufacturing of proteins and in virtually every other aspect of plant physiology. Plants that are deficient in nitrogen grow poorly and develop yellowing leaves. Many workers studied the influence of N-fertilizer on sugar beet plant (Hellal *et al.* 2009) showed that, increasing N- level up to 80 kg/fed significantly increased root yield of sugar beet. (Shalaby *et al.* 2011) stated that application of (120 kg N/fed) surpassed the other nitrogen fertilizer levels (80 and 100 N/fed) in growth traits of sugar beet and recorded the highest root and sugar yields 37.26 and 5.33 (ton fed^{-1}). (Amin *et al.* 2013) revealed that application of nitrogen fertilizer at the rate of 100 kg/fed recorded the highest values in root length and diameter dry matter per plant, root, top and sugar yields.

The aim of this study is to find out the relative influence of different nitrogen rates and humic acid on some chemical soil properties growth traits, chemical composition, yield and quality of some sugar beet varieties under extremely saline soil conditions (Gilbana district Sahl–El Tina, North Sinai, Egypt)

MATERIALS AND METHODS

Sahl El-Tina location situate in the North Western part of Sinai Peninsula, laying between longitudes 32 ^{o} 20 and 32^{o} 33 east and latitudes 30^{0} 57 and 31^{0} 04 North, the texture varies between sandy loam to clay and soils are extremely saline (Reda 2000).

During two winter seasons of, 2011/2012 and 2012/20113, a field experiment was carried out at Gelbana district Sahl-El Tina ((North Sinai Governorate,) to study the effect of different nitrogen rates combined with or without humic acid on some chemical soil properties, growth traits, yield and quality of some sugar beet varieties under saline soil conditions. Sugar beet was sown on 25th and 28th of October during 2011/2012 and 2012/2013 seasons. The experiment was designed in a split -split plot design with three replications. The main plots were assigned to three sugar beet varieties (Mirador, Panther and Athospoly), while humic acid fertilizer (0 and 10 kg fed^{-1} mixed with 100 kg sandy soil) were randomly distributed in sub – plots. The sub- sub -plots were occupied with three nitrogen fertilizer levels (50 ; 75 and 100 kg N fed^{-1}) in the form of urea (46% N) in three equal doses, the 1st one was added after thinning and the other two doses were applied two weeks interval. Plot area was 21 m^2 7m long and 50 cm apart consisted of 6 rows. Potassium sulfate (48% K_2O) was added two times with the first and second doses of N- fertilizer at a rate of 48 kg K_2O fed^{-1}. Calcium super phosphate 15.5% was applied at 200 kg P_2O_5 fed^{-1} during land preparation. Humic acid fertilizer was added once after thinning.

surface soil sample (0 -30 cm) were collected and prepared for some physical and chemical analysis was taken before sowing and after harvest as using the methods described by (Page *et al.* 1982) and (Cottonie *et al.* 1982). The obtained data are presented in Tables (1 and 2).

Table (1) Some physical and chemical properties of the soil before planting (mean of tow seasons).

Sand (%)		**Silt (%)**	**Clay (%)**	**Texture**		**O.M (%)**		**$CaCO_3$ (%)**
75.12		8.35	16.53	Sandy loam		0.55		4.69
pH (1:2.5) (Soil :water suspension)	EC (dS/m)	Soluble Cations (mmolc L^{-1})				Soluble Anions (mmolc L^{-1})		
		Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	HCO^{-}_3	Cl^{-}	SO^{-2}_4
8.10	12.75	12.78	21.63	92.34	0.75	8.14	85.20	34.16
Available macronutrients (mg kg^{-1})			**Available micronutrients (mg kg^{-1})**					
N	P	K	Fe			Mn	Zn	
33	3.25	175	2.88			1.49	0.71	

Studied traits:

After 105 days from planting random samples were taken from each plot to determine:

1**-** Leaf area/ plant (cm^2) was measured using the area meter, model: 3000A.

2**-** Photosynthetic pigments (mg/g f.w.) i.e. chlorophyll a, b and carotenoides according to Wettstein (1957).

3- Proline content was estimated by the ninhydrin method as cited by Bates *et al.* (1973).

At harvest, random samples of sugar beet plant were taken from each plot to determine:

1- Root length and diameter (cm), as well as, root weight (kg/plant.).

2- Dry mater of sugar beet root (dry weight %).

3-Nitrogen concentration (%) was determined in roots using micro- kjeldahl method A.O.A.C., (1986). Phosphorus was determined calorimetrically according to Chapman and Pratt (1961). A flame photometric was used to estimate Potassium as a reported by Brown and Lilliand (1964).

4- Sucrose % was determine using Sacharimeter apparatus according to the method described by Le – Docte (1927), also total soluble solids (TSS %) by using Hand Refractometer, while Juice purity % was determined as a ratio between sucrose % and TSS %.

5**-**Yield traits: To determined root yield (ton fad^{-1}) six rows of each plot, were harvested, topped and weighted to determine root yield, sugar yield was also calculated by multiplying root yield(ton fad^{-1}) by Sucrose %.

Data of the two seasons were statistically analyzed according to Snedecor and Cochran (1980**),** and treatments means were compared using L.S.D test at 5% of probability.

RESULTS AND DISCUSSION

Chemicals Soil properties:

Available N, P and K content in the soil:

Data presented in Table (2) indicated that potassium content (mg kg^{-1}) in soil significantly affected by sugar beet varieties in both season. While, available N significantly affected by sugar beet varieties in the 1^{st} seasons only. Meantime, the available phosphorus (mg kg^{-1}) was insignificant in both seasons. The highest values of available K content in soil (١٩٠ and 19٨ mg kg^{-1}) in the 1^{st} and 2^{nd} seasons and available N content (1^{st} season's 40.70 mg kg^{-1}) in the 1^{st} seasons were recorded by Panther variety. In the same Table, it could be notice that the response of available K content in the soil to humic acid was significant in both seasons and available N (mg kg^{-1}) in the 2^{nd} season, there was no evidence for significant differences in available P (mg kg^{-1}) in the soil due to application of humic acid in both seasons. Also data in Table (2) show that the available N and K (mg kg^{-1}) were increased by application of humic acid compared with untreated plants in the two seasons. This may be due to humic substances improve soil structure, act as a storehouse of N and K, and improve solubilize minerals (Türkmen *et. al.* 2005) These results are in agreement with those obtained with Mesut *et al.* (2010) who reported that humic acid released the fix K. Hussein and Hassan (2011) they indicated that humic acids are important soil components; improve nutrient availability and have impact on chemical, biological, and physical properties of soils. Singh *et al* (2005) who reported that the application of organic and inorganic sources of N either alone or in combination led to increase available N and P in soil; this might be due to higher supply of N (urea).

Also data presented in Table (2) show that the effect of nitrogen rates on available N and P (mg kg^{-1}) in the soil was insignificant in both seasons. Meantime available K (mg kg^{-1}) was significantly affected by different nitrogen rates in the two seasons. .K content was increased by increasing N fertilizer rates. All the interactions between the studied treatments insignificantly effected on available NPK (mg kg^{-1}) in both seasons except, the interactions between sugar beet varieties x humic acid and nitrogen rates x humic acid for available K in the 1^{st} season.

Performance of sugar beet varieties:

1-Growth traits:

Statistical analyses of data in Table (3) indicated significant differences in length diameter, weight, dry matter %, of root as well as leave area per plant among sugar beet varieties in both seasons. Panther variety recoded the highest values of all the previous mentioned traits in the two seasons. While Mirador variety was ranked the second, except root length in the 1^{st} season Mirador variety surpassed the other two varieties in this trait and leaf area per plant in the 2^{nd} season. Athospoly variety recorded the highest value of it. However, insignificants differences were found between Mirador and Athospoly varieties in the 1^{st} season and between Mirador and Panther varieties in the 2^{nd} seasons for leaf area.

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The variations among the tested sugar beet varieties in these traits might be due to the gene make-up action, which plays an important role in plant structure and morphology. In this respect, Hozayn (2013) reported that there are high significant differences among cultivars in root weight of sugar beet. Varieties differences in root parameters were also recorded by Ahmed *et al.* (2012).

2-Photosynthetic Pigments and Proline Concentrations:

Results in Table (3) showed that the tested varieties differed significantly in their concentration of photosynthetic pigments (chlorophyll a, b) and proline in the two seasons, and carotenoides in the 1^{st} season. Panther variety surpassed the other two varieties in respect to chlorophyll a, b, carotenoides and prolin concentration in both seasons, while the Mirador variety recorded the lowest values of this traits. Meantime, insignificants differences were found between Mirador and Athospoly varieties for proline concentration in the two seasons.

Table (3) Some growth traits, photosynthetic pigments (mg/g f.w.) and proline concentration (u moles/g f.w.) as affected by performance of sugar beet varieties (2011/2012 and 2012/2013 seasons)

varieties	2011/2012								
	Growth traits					Photosynthetic pigments (mg/g f.w)			Proline (u moles/ g f.w.)
	RL (cm)	RD (cm)	RW (kg/p)	RDM%	LA (cm^2)	Chl. a	Chl. b	Carot.	
Mirador	25.66	12.63	1.097	23.86	145.82	1.29	1.13	0.80	2.09
Panther	23.38	13.87	1.171	27.77	169.72	1.64	1.45	0.95	3.72
Athospoly	19.24	11.17	0.937	22.96	145.85	1.38	1.14	0.87	2.22
LSD at 5%	1.60	0.95	0.100	1.17	1.41	0.11	0.16	0.02	0.27
2012/2013									
Mirador	21.68	12.18	0.997	22.14	131.84	1.17	1.03	0.65	1.95
Panther	23.53	13.15	1.076	23.31	134.23	1.46	1.35	0.77	3.45
Athospoly	17.43	11.44	0.886	21.12	158.91	1.43	1.10	0.80	1.95
LSD at 5%	2.28	0.71	0.060	0.16	6.75	0.06	0.05	N.S	0.27

RL= Root length RW= Root weight RDM=Root dry matter LA=leaf area Ch. a= chlorophyll a Ch. b= chlorophyll b
Carot. = carotenoides

The variations among the tested sugar beet varieties in these traits might be due to gene make-up effect and their response to the environmental conditions, this results are in harmony with Dadkhah (2011) who reported that there were significant differences in total chlorophyll contents in leaf between (7233-P_{29} and Madison) cultivars under saline conditions.

3-Yields and quality:

Data in Table (4) indicated that the studied varieties differed significantly in root and sugar yields. While, all quality parameters evaluated (total soluble solids% (TSS %), sucrose %, and juice purity) were insignificant among the three tested varieties in the two seasons. Panther variety exhibited a general superiority over the other varieties in respect to root and sugar yields in both seasons, while, the Athospoly variety recorded the lowest values of this traits. Insignificants differences were found between Mirador and Athospoly varieties for root and sugar yields in the two season **Abd El-Aal *et al*. (2010)** revealed that significant variation in yield productivity among sugar beet varieties.

Table (4) Root and sugar yields and quality traits as affected by performance of sugar beet varieties (2011/2012 and 2012/2013 seasons).

Varieties	2011/2012				
	Yields (ton fed^{-1})		Quality traits		
	Root yield	Sugar yield	TSS %	Sucrose%	Purity %
Mirador	22.72	4.03	21.40	17.35	81.07
Panther	26.34	4.60	21.15	17.25	81.74
Athospoly	22.46	3.99	22.61	17.38	76.97
LSD at 5%	1.70	0.48	NS	NS	NS
	2012/2013				
Mirador	21.25	3.61	21.19	16.88	79.66
Panther	26.13	4.37	21.14	16.51	78.14
Athospoly	21.07	3.72	21.83	17.19	78.73
LSD at 5%	3.18	0.15	NS	NS	NS

Effect of humic acid:

1-Growth traits:

Results given in Table (5) indicated that soil application of humic acid significantly increased root length by (11.72 % and 12.95 %), root diameter by (7.01% and 7.27%), root weight by (18.51 and 16.47%) and root dry matter by (2.90 and 3.63%) as will as leaf area per plant by (11.66 and 9.69%) in the 1st and 2nd seasons, respectively compare with untreated plants. This may be due to promoted growth and nutrient uptake of plants by addition of humic substances which affect membrane permeability Zientara (1983). A similar trend was found by Mehdi *et al.,* (2013) showed that total dry matter (TDM) of sugar beet affected by the level of humic acid and the maximum value (14.45 ton ha-1) was obtained from humic application and the lowest value (11.54 ton ha-1) was observed when humic acid was not applied. Türkmen *et al.* (2005) reported that HA application positively affected the parameters of plant grown in salinity condition.

2-Photosynthetic Pigments and Proline Concentrations:

Applications of humic acid had a significant effect on the photosynthetic pigments (chlorophyll a, b and carotenoides) and free proline accumulation in both seasons, Table (5). The photosynthetic pigments and free proline were found higher with humic acid applications compared with untreated one. This increment amounted to about (19.84 and 21.31%) for chlorophyll a, (26.36 and 27.45%) for chlorophyll b, (17.50 and 13.04%) for carotenoides and (15.73 and 13.97%) for proline in the 1st and 2nd seasons, respectively. Higher leaf chlorophyll associated to humic substances could be related to increased cell membrane permeability by these substances, thus promoting greater efficiency in the absorption of nutrients, such as nitrogen, which has a direct relation with leaf chlorophyll concentration Tahir *et al*. (2011). These results are in agreement with those reported by Turkmen *et al.*

(2005) who recorded that, humic substances (HS) have positive effects on plant physiology. Also Hanafy *et al.* (2013) found that, application of HA enhanced leaf chlorophyll of cotton plants and recorded the highest values of proline.

Table (5) Some growth traits, photosynthetic pigments (mg/g f.w.) and proline concentration (u moles/g f.w.) as affected by humic acid (2011/2012 and 2012/2013 seasons).

Humic acid	2011/2012								
	Growth traits					Photosynthetic pigments (mg/g f.w)			Proline (u moles/g f.w.)
	RL (cm)	RD (cm)	RW (kg/p)	RDM%	LA (cm^2)	Chl. a	Chl. b	Carot.	
Without (H1)	21.50	12.13	0.978	24.51	145.33	1.31	1.10	0.80	2.48
With 10 kg fed^{-1} (H2)	24.02	12.98	1.159	25.22	162.27	1.57	1.39	0.94	2.87
LSD at 5%	0.42	0.67	0.060	0.62	3.19	0.08	0.12	0.01	0.16
2012/2013									
Without (H1)	19.61	11.83	0.911	21.79	135.12	1.22	1.02	0.69	2.29
With 10 kg fed^{-1} (H2)	22.15	12.69	1.061	22.58	148.21	1.48	1.30	0.78	2.61
LSD at 5%	0.39	0.12	0.060	0.07	1.43	0.03	0.02	0.10	0.08

RL= Root length RW= Root weight RDM=Root dry matter LA=leaf area Ch. a= chlorophyll a Ch. b= chlorophyll b Carot.= carotenoides

3-Yields and quality:

Data in Table (6) cleared that a significant effect of humic acid was found for root and sugar yields and sucrose% in both season, also total soluble solid in the 2nd season only. Meantime purity % insignificantly affected by the application of humic acid in both seasons. Application of humic acid was significantly increased effected on root yield by (22.80 % and 28.38 %), sugar yield by (26.56and 32.44%) and sucrose % by (0.41 and 0.61%), respectively in the 1st and 2nd seasons compared with untreated one.

Table (6) Root and sugar yields and quality traits as affected by humic acid (2011/2012 and 2012/2013 seasons).

Humic acid	2011/2012				
	Yields (ton fed^{-1})		Quality traits		
	Root yield	Sugar yield	TSS %	Sucrose %	Purity %
Without (H1)	21.40	3.69	21.55	17.12	79.73
With 10 kg fed^{-1} (H2)	26.28	4.67	21.89	17.53	80.12
LSD at 5%	0.90	0.24	NS	0.39	NS
	2012/2013				
Without (H1)	19.98	3.35	21.03	16.55	78.69
With 10 kg fed^{-1} (H2)	25.65	4.44	21.74	17.16	79.00
LSD at 5%	1.42	0.27	0.40	0.28	NS

These results may be due to that humic substances enhance the uptake of some nutrients, reduce the uptake of toxic elements, and improve the plant resistance to salinity. This was reflected in the growth traits and occurred positive effete on the final production. In this respect, Mehdi *et al*. (2013) reported that, root yield of sugar beet was strongly affected by humic acid, also humic acid increase root yield by 25.86% and sugar yield by 27 % compared with untreated plant.

Effect of nitrogen fertilizer rates:

1-Growth traits:

Data collected in the Table (7) revealed that increasing nitrogen rates from 50 up to 75 and 100 kg N fed^{-1} occurred a significant increase in length, diameter, weight, dry matter %, of root as well as leaf area per plant in the two seasons. Application of 100 kg N fed^{-1} gave the highest values of root length (26.41 and 24.56 cm), root diameter (13.70 and 13.40 cm), root weight (1.304 and 1.173 kg/plant), root dry matter %, (26.68 and 24.01%), finally leave area per plant (173.80 and 159.22 cm^2), in the 1st and 2nd seasons, respectively. This may be due to nitrogen affects growth and in turn on yield through its effect on cell division, expansion, and elongation resulting to large leaves and enhanced yield Onyango (2002). These results are in agreement with those reported by Mohamed *et al.* (2012) they cleared that, application of 100 kg N fed^{-1} gave the highest values of root weight 1135 and 1179 g/plant also root length and diameter increased significantly when N- level raised from 75 up to 100 kg N fed^{-1} in both seasons. Moreover, Mehran and Samad (2013) reported that, root fresh and dry weights were significantly increased with increasing N- fertilizer rate up to 100 kg N fed^{-1}.

Table (7) Some growth traits, photosynthetic pigments (mg/g f.w) and proline concentration (u moles/g f.w.) as affected by nitrogen rates (2011/2012 and 2012/2013 seasons).

N rates (kg fed^{-1})	Growth traits					Photosynthetic pigments (mg/g f.w)			Proline (u moles/g f.w.)
	RL (cm)	RD (cm)	RW (kg/p)	RDM%	LA (cm^2)	Chl. a	Chl. b	Carot.	
2011/2012									
50	19.54	11.58	0.847	23.26	128.95	1.22	1.04	0.73	2.00
75	22.33	12.39	1.054	24.65	158.64	1.47	1.23	0.91	2.79
100	26.41	13.70	1.304	26.68	173.80	1.61	1.45	0.98	3.24
LSD at 5%	0.28	0.32	0.053	0.36	2.57	0.01	0.06	0.01	0.17
2012/2013									
50	17.79	11.23	0.803	20.48	116.57	1.14	0.96	0.62	1.87
75	20.28	12.13	0.981	22.06	149.19	1.37	1.13	0.77	2.64
100	24.56	13.40	1.173	24.01	159.22	1.55	1.38	0.83	2.84
LSD at 5%	0.34	0.26	0.052	0.40	2.07	0.01	0.02	0.03	0.17

2-Photosynthetic Pigments and Proline Concentrations:

Data presented in Table (7) showed that, increasing nitrogen levels from 50 up to 75 and 100 kg N fed^{-1} significantly increased chlorophyll a, chlorophyll, b and carotenoid as will as proline concentration in beet leaves in both seasons. This may be due to that nitrogen is considered on of the essential compound in chlorophyll synthesis and that hence the process of photosynthesis and carbon dioxide assimilation and increase presence of amino acid could be synthesized. Jasso-Chaverria *et al*. (2005). In this respect, Mostafa and Darwish (2001) found that chlorophyll a, b and carotenoides of sugar beet leaves significantly increased by increasing nitrogen fertilizers.

3-Yields and quality:

Results in Table (8) indicated that inorganic nitrogen fertilizer significantly increased root and sugar yields, total soluble solids (TSS) and sucrose percentages in both seasons. Application of 100 kg N fed $^{-1}$ gave the highest values of root yield (29.91 and 27.27 ton fed $^{-1}$) and sugar yield (5.53 and 4.71 ton fed $^{-1}$) as will as total soluble solids (22.50 and 22.17 %) and sucrose(18.40 and 17.30%) in the 1st and 2nd seasons, respectively. Insignificant differences were found between 75 and 100 kg N fed^{-1} in total soluble solids in the 1st season and sucrose % and purity % in the 2nd season. The increase in root and sugar yield with increasing N- fertilizer may be attributed to increased size and number of leaves consequently, photosynthetic activities, which reflected on greater root and sugar production per unit area Malnou, *et al.* (2008). Similar findings were observed by Mohamed *et al.* (2012) they reported that, under saline conditions application of 100 kg N fed^{-1} significantly increased root yield and gave the highest values compared with 75 kg N fed $^{-1}$ EL-Sarag and Sameh (2013) in North Sinai indicated that the highest root and sugar yields were obtained by using the highest N- rates 211 kg N h^{-1} maximum sucrose% was achieved by 141 kg N h^{-1} .

Table (8): Root and sugar yields and quality traits as affected by nitrogen rates (2011/2012 and 2012/2013 seasons).

N rates (kg fed^{-1})	2011/2012				
	Yields (ton fed^{-1})		Quality traits		
	Root yield	Sugar yield	TSS %	Sucrose %	Purity %
50	18.30	2.96	20.66	16.04	77.78
75	23.31	4.13	22.00	17.54	79.93
100	29.91	5.53	22.50	18.40	82.06
LSD at 5%	1.09	0.28	0.62	0.34	2.28
2012/2013					
50	18.74	2.95	20.30	15.65	77.23
75	22.44	3.83	21.69	17.01	78.45
100	27.27	4.71	22.17	17.30	78.00
LSD at 5%	1.33	0.30	0.43	0.31	2.07

Macronutrients N, P and K (%) content in root:

Data in Table (9) reveal that the evaluated varieties differed significantly in their macro nutrient contents in both seasons; Panther variety recoded the highest values of N, P and K contents in the two seasons. Significant increase of N, P and K contents in root of sugar beet were noticed due to application of humic acid than those of untreated plants in both seasons. This may be due to the increasing in available N and K (mg kg^{-1}) in the soil by application of humic acid compare with untreated plants in the two seasons as recorded in Table (2). Also attributed to plants absorbed more elements due to better-developed root systems by addition of humic substances David *et al*. (1994).

9

Concerning the effect of nitrogen fertilizer levels, data presented in Table (9) show that Macronutrients content increased significantly and gradually with increasing nitrogen levels. The great induction occurred at high nitrogen levels (100 kg N/fed). This was expected as high N- rate

enhanced vegetative growth and consequently absorption of other nutrients to meet the growth demand. These results are in accordance with those obtained by Mehran and Samad (2013) they indicated the contents of N and K in the root of sugar beet were significantly increased by increasing N- fertilizer up to 214 kg N ha^{-1} over two seasons.

All interaction effects had insignificant effect in N, P and K contents in root of sugar beet in both seasons except, the interaction between sugar beet varieties and nitrogen fertilizer (VxN) and between inorganic and organic nitrogen fertilization(NXH) for N content in both seasons and P content in the 1^{st} season.

The interaction effect between sugar beet varieties and humic acid (VxH) Table (10) had a significant effect on root length and LA, chlorophyll a and carotenoides, root and sugar yields finally on proline concentration in the tow season and root diameter and chlorophyll b in the 2^{nd} season only. The highest values of all the previous traits were obtained by10 kg /fed humic acid and Panther variety. The interaction effect between sugar beet varieties and nitrogen fertilizer (VxN) Table (11) had a significant effect on length, weight, dry matter% of root and LA, chlorophyll a, b and carotenoides, root and sugar yields finally on proline concentration in both season, and root diameter in the 2^{nd} season only,. The highest values of all the previous traits were obtained by100 kg N/fed and Panther variety.

The interaction effect between inorganic and organic nitrogen fertilization (NXH) Table (12) showed a significant effect on root and sugar yields and sucrose % as will as on proline concentration in both season. The highest values of all the previous traits were obtained by100 kg N/fed and 10 kg /fed humic acid.

All the investigated traits insignificantly affected by the interaction between the three factors i.e. inorganic and organic nitrogen fertilization and sugar beet varieties in both seasons.

Table (10): Interaction effect between sugar beet varieties and humic acid fertilizer on sugar beet plant (2011/2012 and 2012/2013seasons).

2011/2012

interaction	Growth traits		photosynthetic pigments (r f.w)		Yields (ton fed^{-1})		Proline (u moles/g f.w.)
	RL(cm)	LA(cm)^2	Chl.a	Carot.	RY	SY	
V1H1	24.63	137.70	1.18	0.77	20.07	3.53	2.01
V1H2	26.70	153.94	1.39	0.82	25.38	4.53	2.18
V2H1	21.43	157.96	1.43	0.86	23.19	3.96	3.34
V2H2	25.33	181.49	1.86	1.04	29.48	5.25	4.09
V3H1	18.45	140.32	1.31	0.77	20.94	3.74	2.10
V3H2	20.04	151.37	1.45	0.97	23.98	4.24	2.35
LSD at 5%	0.73	5.51	0.15	0.02	1.57	0.42	0.27

2012/2013

	RL(cm)	RD(cm)	LA(cm)^2	Chl. a	Chl. b	Carot.	RY	SY	Proline (u moles/g f.w.)
V1H1	19.53	11.63	131.49	1.09	0.94	0.61	18.54	3.13	1.84
V1H2	23.82	12.73	132.20	1.25	1.12	0.70	23.60	4.09	2.05
V2H1	22.82	12.86	129.15	1.32	1.16	0.76	21.43	3.47	3.21
V2H2	24.24	13.45	139.32	1.60	1.53	0.77	30.83	5.27	3.69
V3H1	16.48	10.99	144.71	1.26	0.95	0.71	19.96	3.46	1.82
V3H2	18.38	11.89	173.11	1.60	1.25	0.89	22.53	3.98	2.08
LSD at 5%	0.67	0.21	2.48	0.05	0.03	0.02	2.47	0.46	0.14

V= sugar beet varieties H= humic acid RL= Root length RD= Root diameter LA=leaf area RY=root yield RS= sugar yield Ch. a= chlorophyll a Ch. b= chlorophyll b Carot. = carotenoides

Table (11): Interaction effect between sugar beet varieties and nitrogen fertilizer on sugar beet plant (2011/2012 and 2012/2013 seasons).

2011/2012

interaction	Growth traits				Photosynthetic pigments (mg/g f.w.)			Yields (ton fed^{-1})		Proline (u moles/g f.w)
	RL (cm)	RW (kg/pant)	RDM %	LA(cm)^2	Chl.a	Chl.b	Carot.	RY	SY	
V1N1	20.56	0.862	23.02	12	1.16	1.01	0.71	16.24	2.63	1.63
V1N2	21.73	1.097	23.85	145.22	1.32	1.10	0.80	23.73	4.21	2.17
V1N3	27.83	1.333	24.72	170.34	1.38	1.29	0.88	28.21	5.26	2.48
V2N1	22.22	0.883	2	142.62	1.35	1.17	0.77	22.01	3.61	2.71
V2N2	26.35	1.230	27.42	182.37	1.67	1.42	1.02	26.37	4.63	3.92
V2N3	28.42	1.400	30.56	184.19	1.91	1.78	1.06	30.63	5.57	4.51
V3N1	15.84	0.797	21.44	122..35	1.16	0.94	0.70	16.66	2.66	1.66
V3N2	18.90	0.837	22.68	148.32	1.43	1.18	0.93	19.84	3.55	2.27
V3N3	22.99	1.178	24.75	166.87	1.55	1.29	0.99	30.90	5.75	2.74
LSD at 5%	0.48	0.092	0.62	4.44	0.02	0.11	0.02	1.88	0.48	**0.29**

2012/2013

	RL (cm)	RD (cm)	RW (kg/plant)	RDM %	LA(cm)^2	Chl.a	Chl.b	Carot.	RY	SY	Proline (u moles/g f.w)
V1N1	18.92	11.10	0.812	21.39	10	1.05	0.93	0.60	1		1.59
V1N2	19.25	12.39	1.042	21.91	140.73	1.21	1.01	0.66	22.09	3.75	2.09
V1N3	26.86	13.05	1.137	23.10	149.77	1.26	1.16	0.70	24.72	4.50	2.16
V2N1	20.20	12.12	0.857	20..35	132.13	1.20	1.08	0.62	22.06	3.49	2.59
V2N2	24.48	12.84	1.112	23.39	170.38	1.48	1.30	0.80	26.39	4.44	3.65
V2N3	25.91	14.49	1.258	26.18	174.21	1.70	1.66	0.91	29.94	5.19	4.11
V3N1	14.26	10.48	0.742	19.73	112.56	1.17	0.88	0.64	17.76	2.78	1.43
V3N2	17.11	11.17	0.790	20.87	136.46	1.42	1.08	0.85	18.84	3.29	2.17
V3N3	20.91	12.67	1.125	22.77	153.69	1.70	1.33	0.89	27.14	4.99	2.24
LSD at 5%	0.58	0.44	0.091	0.69	3.59	0.02	0.03	0.05	2.30	0.52	0.30

V= sugar beet varieties N= nitrogen rates RL= Root length RD= Root diameter RW= Root weight RDM =Root dry matter LA=leaf area RY=root yield RS= sugar yield Ch. a= chlorophyll a Ch. b= chlorophyll b Carot. = careteniodes

Table(12):Interaction effect between humic acid and mineral nitrogen fertilizer on sugar beet plant (2011/2012 and 2012/2013 seasons).

Interaction	2011/2012			
	Root yield (ton fed^{-1})	**Sugar yield (ton fed^{-1})**	**Sucrose %**	**Proline (u moles/g f.w)**
H1N1	15.61	2.48	15.78	1.78
H1N2	20.73	3.61	17.28	2.60
H1N3	27.87	5.13	18.31	3.06
H2N1	21.00	3.45	16.30	2.22
H2N2	25.90	4.65	17.80	2.98
H2N3	31.95	5..93	18.49	3.42
LSD at 5%	**5.11**	**0.56**	**1.24**	**0.34**
2012/2013				
H1N1	15.75	2.41	15.28	1.71
H1N2	19.46	3.24	16.65	2.44
H1N3	24.73	4.39	17.73	2.71
H2N1	21.73	3.50	16.03	2.03
H2N2	25.43	4.42	17.36	2.83
H2N3	29.81	5.40	18.10	2.96
LSD at 5%	**4.93**	**0.94**	**0.61**	**0.98**

N= nitrogen rates H= humic acid

It could be concluded that under the studied conditions, using soil application with 100 kg N fed^{-1} and 10 kg fed^{-1} humic acid could be improve soil chemical properties, which in turn produced highest root and sugar yields/ fed.

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تــاثير حمــض الـهيوميــك و التســميد النيتروجينــى المعــدني علــى خــواص التربــة الكيميائية و محصول وجودة بنجر السكر تحت ظروف الاراض الملحيه

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أجريـت تجربتـان حقليتـان بمنطقـة جلبانـة بسـهل الطينـة بمحافظـة شـمال سـيناء، خـلال موسـمي٢٠١٢/٢٠١١و٢٠١٣/٢٠١٢ لدراسـة تـاثير المعاملـة الارضـة بالتسـميد النيتروجينـي الغيـر عضـوي بمعدلات ٥٠ و٧٥ و١٠٠ كجم نيتروجين للفدان و بحمض ا لهيوميك كتسميد نيتروجينـي عضـوي بمعدلات صفر و ١٠كج/ فدان وتـاثير د لـك علـي بعض خصـائص التربـة الكيمائيـة ونمـو والتركيب الكيميائ وجودة ومحصـول بعض اصـناف بنجر السـكر(ميـرادور و بـانثر و اثوثبـولي). استخدم تصميم قطع منشقة مرتين مع ثلاث مكررات في كلا موسمي الزراعة.

-اظهرت النتائج ان اعلي القيم لكلا من محتوي التربة من البوتاسيوم المتاح في كلا الموسمين و من النيتروجين المتاح في الموسم الاول سجلت مع الصنف بانثر .

- تفوق الصنف بانثر معنويا علي الاصناف الاخري فـي الصـفات الخضـرية (قطـر والـوزن الطـازج والوزن الجاف للجدر)، صبغات البناء الضوئي (كلورفيل أ ، ب و الكاروتينويدات) ، البرولين وايضا محصـول الجـذور والسكر في كلا الموسمين. معظم صفات الجودة (النسبة المئويـة للمـواد الصلبة الذائبة الكلية والسكروز والنقاوة) لم تتاثر معنويا بالاصناف المختبرة في كلا الموسمين.

- الاضافة الارضية لحمض الهيوميك (١٠كجم/الفدان) ادت الي زيادة معنوية في محتوي التربـة من البوتاسوم المتاح في كلا الموسمين والنيتروجين المتاح في الموسم الثاني وايضا في النسبة المئوية للنيتروجين والفوسفور والبوتاسيوم في الجدور في كلا الموسمين وكدلك الـي زيـادة معنويـة بنسـبة (١٥.٧٣ و ١٣.٩٧ %) للبـرولين و (٠.٤١ و٠.٦١ %) للسـكروز و (٢٢.٨٠ و ٢٨.٣٨ %) لمحصول الجذور و (٢٦.٥٦ و ٣٢.٤٤ %) لمحصـول السـكر فـي الموسم الاول والثاني علي التوالي مقارنا بعدم الاضافة.

- ادي استخدام التسـميد النيتروجينـي المعدني الـي الـي زيـادة معنويـة فـي حاصـل الجـدور والسـكر /الفدان كما ان اضافة ١٠٠ كجم نيتروجين للفدان سجل اعلـي محصـول للجـدور (٢٩.٩١ و ٢٧.٢٧ طـن /فـدان) و محصـول سـكر(٥.٥٣ و ٤.٧١ طـن /فـدان) فـي كـلا الموسـمين علـي الترتيب.

-كـان للتفاعـل بـين التسميد بـالنيتروجين المعدني و حمض الهيوميك تـاثير معنـوي علـي محصـول الجدور والسكر و النسبة المئوية للسكروز وايضا تركيز البرولين في كلا الموسمين و محتوي التربـة مـن البوتاسـوم فـي الموسـم الاول. وايضـا التفاعل بـين الاصـناف و التسـميد النيتروجينـي المعدني والتفاعل بين الاصناف و حمض الهيوميك كان معنويا علي طول الجدر، متوسط مسـاحة الورقة/النبات و كلورفيل أ و الكاروتينويدات و البرولين وايضـا محصـول الجـدور والسكر فـي كلا الموسمين في حين ان التفاعل بين الثلاثة عناصر تحت الدراسة كان غير معنويا لكل الصفات المدروسة في كلا الموسمين.

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Table (2). Available macronutrients as affected by varieties, humic acid and mineral N fertilizer (2011- 2012 and 2012-2013 seasons).

Varieties	Mineral N rates (kg fed^{-1})	Season 2011/ 2012									Season 2012/ 2013								
		N ($mgkg^{-1}$)			P ($mgkg^{-1}$)			K ($mgkg^{-1}$)			N ($mgkg^{-1}$)			P ($mgkg^{-1}$)			K ($mgkg^{-1}$)		
		Humic acid (kg fed^{-1})									Humic acid (kg fed^{-1})								
		with	Without	mean	With	without	mean	With	Without	mean	with	without	mean	With	without	mean	With	without	mean
Mirador	50	39.48	36.75	38.12	3.85	3.41	3.63	189	179	184	39.78	36.94	38.36	3.89	3.51	3.70	193	182	188
	75	40.16	37.82	38.99	3.90	3.47	3.69	192	182	187	41.50	38.22	39.86	3.91	3.56	3.74	198	186	192
	100	40.76	38.22	39.49	3.93	3.52	3.73	196	185	190	41.88	38.46	40.17	3.97	3.59	3.78	204	189	197
Mean		40.13	37.60	38.87	3.89	3.47	3.68	192	182	187	41.05	37.87	39.46	3.92	3.55	3.74	198	186	192
Panther	50	40.18	38.66	39.42	3.87	3.45	3.66	192	182	187	40.91	39.44	40.18	3.90	3.54	3.72	198	188	193
	75	42.36	39.52	40.94	3.95	3.48	3.72	196	184	190	42.10	40.28	41.19	3.93	3.58	3.76	203	193	198
	100	43.10	40.35	41.73	3.99	3.55	3.77	198	189	194	42.66	40.81	41.74	3.95	3.61	3.78	207	197	202
Mean		41.88	39.51	40.70	3.94	3.49	3.72	195	185	190	41.89	40.18	41.04	3.93	3.58	3.76	203	193	198
Athospoly	50	38.41	38.11	38.26	3.84	3.47	3.66	186	184	185	40.73	39.66	40.20	3.87	3.58	3.73	195	185	190
	75	40.16	38.74	39.45	3.93	3.49	3.71	195	185	190	42.00	40.71	41.36	3.89	3.62	3.76	199	189	194
	100	41.84	39.00	40.42	3.95	3.53	3.74	197	187	192	42.34	41.22	41.78	4.02	3.64	3.83	203	193	198
Mean		40.14	38.62	39.38	3.91	3.50	3.71	193	185	189	41.69	40.53	41.11	3.93	3.61	3.77	199	189	194
Mean of N	50	39.36	37.84	38.60	3.85	3.44	3.65	189	182	186	40.47	38.68	39.58	3.89	3.54	3.72	195	185	190
	75	40.89	38.69	39.79	3.93	3.48	3.71	194	184	189	41.87	39.74	40.81	3.91	3.59	3.75	200	189	195
	100	41.90	39.19	40.55	3.96	3.53	3.75	197	187	192	42.29	40.16	41.23	3.98	3.61	3.80	205	193	199
Mean of H		40.72	38.58	39.64	3.91	3.49	3.70	193	184	189	41.54	39.53	40.54	3.93	3.58	3.75	200	189	195
LSD at 5%																			
Varity (V)		1.33			NS			1.17			NS			NS			1.10		
humic acid (H)		NS			NS			3.31			5.10			NS			1.36		
Inorganic (N)		NS			NS			1.46			NS			NS			1.81		
VX H		NS			NS			0.85			NS			NS			NS		
V X N		NS			NS			NS			NS			NS			NS		
N X H		NS			NS			0.63			NS			NS			NS		
V X H XN		NS			NS			NS			NS			NS			NS		

Table (9) Effect of sugar beet verities, humic acid and mineral nitrogen fertilizer on concentration (%)of macronutrients of sugar beet root (2011/2012 and 2012/2013 seasons).

Varieties	Mineral N rates (kg fed^{-1})	Season 2011/ 2012									Season 2012/ 2013								
		N (%)			P (%)			K (%)			N (%)			P (%)			K (%)		
		Humic acid (kg fed^{-1})									Humic acid (kg fed^{-1})								
		with	without	mean	with	without	mean	without	without	mean	with	without	mean	with	without	mean	with	without	mean
Mirador	50	0.98	0.91	0.95	0.29	0.29	0.29	2.31	2.27	2.29	1.03	0.97	1.00	0.33	0.30	0.32	2.35	2.30	2.33
	75	1.07	1.02	1.04	0.32	0.24	0.28	2.37	2.30	2.34	1.09	1.01	1.05	0.38	0.35	0.37	2.42	2.34	2.38
	100	1.18	1.07	1.13	0.34	0.29	0.32	2.44	2.37	2.41	1.22	1.05	1.14	0.44	0.38	0.41	2.47	2.42	2.44
Mean		1.08	1.00	1.04	0.32	0.27	0.30	2.37	2.31	2.34	1.11	1.01	1.06	0.38	0.35	0.37	2.41	2.35	2.38
Panther	50	1.10	1.05	1.08	0.33	0.28	0.30	2.43	2.37	2.40	1.13	1.03	1.08	0.38	0.34	0.36	2.47	2.39	2.43
	75	1.15	1.11	1.13	0.39	0.32	0.36	2.53	2.45	2.49	1.19	1.09	1.14	0.45	0.36	0.41	2.58	2.48	2.53
	100	1.26	1.12	1.19	0.43	0.39	0.41	2.57	2.51	2.54	1.30	1.16	1.23	0.45	0.39	0.42	2.62	2.55	2.59
Mean		1.17	1.09	1.13	0.38	0.33	0.36	2.51	2.44	2.48	1.20	1.09	1.15	0.43	0.36	0.40	2.56	2.48	2.52
Athospoly	50	1.02	0.92	0.97	0.25	0.21	0.23	2.18	2.15	2.17	1.05	0.97	1.01	0.28	0.22	0.25	2.23	2.19	2.21
	75	1.09	0.95	1.02	0.28	0.23	0.26	2.33	2.26	2.30	1.10	1.00	1.05	0.34	0.29	0.31	2.37	2.29	2.33
	100	1.13	1.03	1.08	0.40	0.27	0.34	2.41	2.33	2.37	1.18	1.03	1.10	0.38	0.32	0.35	2.45	2.36	2.40
Mean		1.08	0.97	1.02	0.31	0.24	0.27	2.31	2.25	2.28	1.11	1.00	1.05	0.33	0.28	0.30	2.35	2.28	2.31
Mean of N	50	1.03	0.96	1.00	0.29	0.26	0.27	2.31	2.26	2.29	1.07	0.99	1.03	0.33	0.29	0.31	2.35	2.30	2.32
	75	1.10	1.03	1.06	0.33	0.27	0.30	2.41	2.34	2.37	1.13	1.03	1.08	0.39	0.33	0.36	2.45	2.37	2.41
	100	1.19	1.07	1.13	0.39	0.32	0.36	2.47	2.40	2.44	1.23	1.08	1.16	0.42	0.36	0.39	2.51	2.44	2.48
Mean of H		1.11	1.02	1.07	0.34	0.28	0.31	2.40	2.33	2.37	1.14	1.03	1.09	0.38	0.33	0.35	2.44	2.37	2.40
LSD at 5%																			
Varity (V)		0.03			0.01			0.05			0.02			0.03			0.04		
humic acid (H)		0.02			0.01			0.02			0.01			0.01			0.02		
Inorganic (N)		0.02			0.01			0.02			0.01			0.02			0.02		
VX H		NS			NS			NS			NS			NS			NS		
V X N		0.03			0.02			0.04			0.02			NS			NS		
N X H		0.03			0.02			NS			0.02			NS			NS		
V X H XN		NS			NS			NS			NS			NS			NS		

1336 1337 1338 1339 1340 1341 1342 1343 1344 1345 1346 1347 1348 1349 1340 1341 1342 1343 1344 1345 1346 1347 1348 1349 1350

1351 1352 1353

1336 1337 1338 1339 1340 1341 1342 1343 1344 1345 1346 1347 1348 1349 1340 1341 1342 1343 1344 1345 1346 1347 1348 1349 1350

1351 1352 1353