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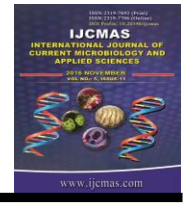

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Effect of Foliar Application with Humic Acid Substances under Nitrogen Fertilization Levels on Quality and Yields of Sugar Beet Plant

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A B S T R A C T

Two field experiments were carried out at the experimental station of Sakha Agricultural Research Station, Egypt during the two growing seasons of 2013/2014 and 2014/2015 to study the effect of foliar application with humic acid, fulvic acid and potassium humate at level 0.5%, and four soil application of nitrogen fertilization rates (36, 52, 73 and 90kgN/fed.)on yield and quality of sugar beet. Results showed that foliar application statistically improved sucrose, extractable sugar, purity, sugar lost to molasses, extractability percentages and yield (tons/ fed) in both seasons. Fulvic acid surpassed the other humic substances in the content of sucrose, extractable sugar, and purity percentages; also yield, and lowest juice impurities in both seasons. Decreasing nitrogen fertilization level from 90kg N/fed to 36kg N/fed significantly decreased all traits in both seasons, except K% and Na% in 2nd season. Applied N fertilization at level 72kg N/fed significantly maximized extractable sugar%, extractability, also root and sugar yields (tons/ fed) in both seasons. Application of 72Kg N/fed with fulvic acid helpful for suggesting good use of nitrogen fertilizer along with fulvic acid to increase sugar beet crop yield and improve its quality.

Introduction

Nitrogen is referred to a balance wheel of sugar beet nutrition because of the fact that the efficiency of other nutrients is based on it. Many investigations have been oriented to optimize using of nitrogen through a better understanding of crop requirements under varying conditions of soil and climate. This is because nitrogen has a pronounced effect on growth where Attallah and El Etreiby (2002) found that root fresh weight was increased with increasing N levels.

EL-Geddawy *et al.*, (2008) mentioned that nitrogen levels had a significant effect on purity % and reduced it; they also added that the drop in juice purity was due to the increase in amino compounds caused by the excessive N uptake. El-Sarag (2009) reported that increasing N levels increased root fresh weight. Ferweez *et al.*, (2011) indicated that adding N fertilizer at 100 or110 kg N fed^{-1} caused an increase in root length by 8.58 and 11.32% and root diameter by 7.78 and 11.84% compared to addition of 80 kg N fed. Shaban *et al*., (2014) and Ali (2015) revealed that N levels significantly increased root length and diameter, as well as root, and top fresh weight, in addition to yield of root, top, biological, gross sugar, white sugar and loss sugar, also K, Na and α-amino N%, whereas harvest index was decreased.

Demand for sugar beet is increasing, thus growers are required to use additional nutrient inputs, especially mineral N to increase yield. Higher N application may result in NO_2pollution of groundwater Shrestha and Ladha, (1998), and soil acidification Kennedy and Tchan, (1992). Also, high N% levels are increase identification resulting in higher emission of N_2O to the atmosphere, which has a harmful impact on global warming (Bronson *et al.*, 1997). These problems have renewed public interest in exploring alternate or supplementary nonpolluting sources of N for agriculture Ladha *et al*., (1997). Attention has therefore focused on substitute fertilizers, including organic sources such as humic acid substances.

Insignificant differences were observed on white sugar and its purity (%). Humic substances can be subdivided into three major fractions: (1) Human, (2) Humic acid (HAs), and (3) Fulvic acid (FAs). These sub divisions are arbitrarily based on the solubility of each fraction in water adjusted to different acid alkaline (pH levels) conditions. Humic compounds occupy a key position because of their multifarious roles in maintaining improving soil fertility and positively affecting physiological functions (both of soil biota as well as plants). Plenty of information is available on the beneficial effect of organic matter and especially humic compounds in the soil-plant system (Nardi *et al.,* 2002; Arancon *et al.,* 2006; Campitelli *et al.,* 2006; Steinberg *et al.,* 2008; Khaled and Fawy, 2011). Bowen and Rovira (1999) explained that rhizobacteria, specifically plant hormone producing rhizosphere bacteria, in conjunction with humic and fulvic acids will supply plant growth promoting hormones to stimulate root and general plant growth via improved water and nutrient utilization from the soil solution. Humic and fulvic acids, preparations were reported to increase the uptake of mineral elements Mackowiak *et al.,* (2001), to promote the root length Canellas *et al*., (2002), and to increase the fresh and dry weights of crop plants Chen *et al*., (2004a,b). Humicacid (HA) is one of the natural antioxidants. The absorption of humic substances into the plant tissue resulting in various biochemical effects through elevating the nutrient uptake and maintaining vitamins and amino acid level in plant tissues. Humic acid is used widely across the globe by agriculturists due to its several benefits i.e., stimulates the respiration rates, increases root, shoot growth, fresh and dry weight enhancement of plant root uptake of P, K, Fe, Cu, Zn and Ca, and plant enzymes and hormones. More ever, it suppresses diseases, heat stress and frost damage by promoting antioxidant activity (El-Bassiouny Hala *et al.*, 2014and Syedabadi and Armin 2014). Due to the positive effect of humic substances on the visible growth of plants, these chemicals have been widely used by the growers instead of other substances such as pesticides, etc. this, however, has led to growers using higher amounts of these substances. Fulvic acid has a much smaller molecular weight, and is more biologically active. In addition not only it doesn't surrounds mineral ions, but it can also help transport them through the cell membrane and release them inside the cell. This means that fulvic acid makes a great foliar spray, allowing trace elements such as copper, iron, manganese and zinc to be better absorbed through the leaves. Fulvic acid also stimulates the metabolisms of plants, which makes fulvic acid treatments a great way to quickly correct trace metal deficiencies while stimulating plant growth by Harley, 2015.

The main objective of this study was tominimize the environmental pollution which resulted from mineral fertilizers by using organic fertilization.

Materials and Methods

Two experiments were carried out in (2013-2014 and 2014-2015) seasons at Sakha Agricultural Research Station, KafrEL-Sheikh Governorate, Egypt to study the effect of foliar application by some humic acid substances under various levels of nitrogen fertilization on sugar beet quality and yields. Soil of the experimental area, was prepared for some physical and chemical analysis before sowing and after harvest for both studied seasons according to Chapman and Pratt (1961), and the description was given in Table (1).This study included sixteen treatments which were the combination of four humic acid substances (control, Humic acid, Fulvic acid and Potassium humate) as foliar application at level 8mg/L sprayed twice at 45 and 75 days after sowing and four soil applications of nitrogen fertilization rates of36, 54, 72 and 90 kgN/fed. Treatments were arranged in a split plot design with three replications. Spraying foliage by humic acid substances allocated in the main plots, whereas, the four nitrogen rates were randomly distributed in the sub plots. The plot area was $21m^2$ included six ridges of 50 cm apart and 7 meter in length. Sugar beet seeds (*Beta vulgaris*, L.) variety Sultan was sown in hills of 20 cm apart in the 1^{st} week of October in both seasons. Nitrogen fertilizer was added as urea (46% N) in two equal splits i.e. after thinning (45days after sowing) and 4 weeks later at the above mentioned rates. Potassium fertilizer at rate (48kg K_2O/fad.) was added as potassium sulfate of48%$K_2O$with the 1^{st} dose of nitrogen. However, phosphorus was applied as calcium superphosphate (15.5% P_2O_5), 30kg P_2O_5/ fed at seed bed preparation. Other agricultural practices were carried out as recommended for growing sugar beet.

At harvest, the three guarded central rows of each plot were harvested to estimate juice quality and root yield from random five plants:

Juice quality

All parameters were determined in Delta Sugar Company Limited Laboratories at El-Hamoul, Kafr El-Sheikh Governorate according to the method of McGinnus (1971).

-Impurities percentages (K%, Na% and α-amino-N %)

- Some technological traits, *i.e.* sucrose%, purity%, extractable sugar extractability%, alkalinity coefficient, SLM.

- Root yield (ton/fed.) and sugar yield (ton/fed.).

Where Sugar yield (ton/fed.,) = extractable sugar×root yield (ton/fed.).

The obtained data of the two seasons were computed and subjected to the proper statistical analysis of split plot design according to Snedecor and Cochran, (1980),and the treatments means were compared using the least significant difference (LSD) at 5 level of significance was used.

Results and Discussion

Juice impurities contents (K, Na and α-amino-N %):

Data illustrated in Table (2) indicated that foliar spraying application with humic substances significantly affected the content of K, Na and α-amino-N% in both seasons. This result may be ascribed to the possibility that humic substances may enhance the uptake of some nutrients. Another reason may be related to plants absorption of more elements due to better developed root system by addition of humic substances, David *et al.*, (1994). Foliar application with fulvic acid recorded the lowest values for K and Na%, while spraying K- humate gave the lowest α-amino-N% compared the other humic acid substances in both seasons.

The increment of N levels up to 90kgN/ fed significantly increased juice impurities contents (K and Na %) in the 1st season only and α-amino-N (%) in both seasons, Table (2).This was anticipated since high nitrogen levels enhance 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 that the contents of N and K in the root of sugar beet were significantly increased by increasing N- fertilizer levels over the two growing seasons.

The interaction effect between foliar application with humic substances and mineral nitrogen fertilizer rates had a significant effect on K, Na and α-amino-N %) in the 1st and 2nd seasons. The lowest interaction values were obtained by applying8mg of fulvic acid/ L and 72 kgN/ fed for K and Na%in the 1st season and α-amino-N (%) in the 2nd season. In this regard, Armstrong and Milford (1985) interpreted this behavior to the large amounts of N mineralization either from soils inherently rich in organic matter or from recently added manures.

Sucrose, extractable sugar and purity

Data presented in Table (3) revealed that the evaluated humic acid substances as foliar application differed significantly in their concentration of Sucrose, extractable sugar and purity in sugar beet roots grown over two seasons. Fulvic acid surpassed over humic acid and potassium humate, which recorded the highest sucrose, extractable sugar and purity in both seasons.

Data presented in Table (3) showed that soil application by inorganic N-fertilizer (ten/fed) significantly increased these traits in the 1st and 2nd seasons. Insignificant difference was obtained between N-fertilizer levels applied at 90 and 72kg N/ fed in their effect on sucrose, extractable sugar and purity in both seasons. So; nitrogen level at 72kg/ fed significantly maximized sucrose, extractable sugar and also juice purity percentages in both seasons. The positive effect of N- fertilizer on sucrose values might be attributed to the increased efficiency of nitrogen fertilization in building up metabolites translocations from leaves to developing roots thus increases sucrose accumulation in sugar beet roots Ramadan (2015).

The interaction effect between humic substances and mineral nitrogen rates (Table3) revealed a significant effect on sucrose, extractable sugar as well as purity in the two seasons The highest values of these traits were obtained by spraying foliage of sugar beet with fulvic acid and fertilized by nitrogen at 72kg/fed in both 2013/2014 and 2014/2015seasons.

Sugar lost in molasses, alkalinity coefficient and extractability

Humic acid substances as foliar application beside mineral nitrogen levels individually and, or in combination insignificantly affected on alkalinity coefficient percentage in the two growing seasons. In general, foliar application by humic substances decreased sugar lost in molasses%, while it increased extractability% in both seasons. This could be due to its effect in decreasing K and α-amino-N, and also increasing extractable sugar (Tables, 2 and 3). Regarding the effect of humic acid substances as foliar application on % sugar lost in molasses and extract ability, this is substantially evident from data of Table (4) and extractability %, where fulvic acid recorded the lowest sugar lost in molasses%, as the wells as highest extractability% compared to control in both seasons.

Data presented in Table (4) revealed that increasing nitrogen fertilizer levels up to 90 kg/fed significantly increased sugar lost in molasses, while it significantly decreased extractability %. Decreasing nitrogen fertilizer levels from 90 to 72 kg/ fed insignificantly affected both sugar lost in molasses and extractability% in the 1st and 2nd seasons. This result agrees with those reported by Shafika (2006). As for the interaction effect it is clear from data show in Table (4) that the interaction between humic acid substances and nitrogen fertilizer levels possessed a significant decrease on sugar lost in molasses and reversely a significant increase on extractability% (Fig.1) for the two seasons. Fulvic acid as a foliar application and nitrogen fertilizer level applied at 72kg/fed decreased sugar lost in molasses by 11.03% and 11.04%. Meanwhile, it increased extractability% by 2.17% and 1.74%, respectively in both seasons.

Table.1 Soil analysis before sowing and at harvest (the average of the two growing seasons).

Before Sowing									
Mechanical analysis					**SP %**	**EC (ds/m)**	**PH 1:2.5**		
Texture	**%Clay**	**% Silt**	**% Fine sand**	**% coarse sand**					
Salty clay	39.3	39.0	16.2	5.5	43.3	1.50	7.49		
Chemical analysis for paste soil									
Soluble cations (meq/ L)				**Soluble anions (meq/ L)**				**OM %**	**Available N (mg/ kg soil)**
K^+	**Na^+**	**Mg^{++}**	**Ca^{++}**	**$So_4^=$**	**Cl^-**	**Hco_3^-**	**$Co_3^=$**	1.1	0.13
0.45	1.10	1.40	3.00	2.16	1.00	2.79	-		
After harvesting									
Mechanical analysis					**SP %**	**EC (ds/m)**	**PH 1:2.5**		
Texture	**%Clay**	**% Silt**	**% Fine sand**	**% coarse sand**					
Silty clay	36.4	38.4	20.1	5.30	49.00	1.64	7.99		
Chemical analysis for paste soil									
Soluble cations (meq/ L)				**Soluble anions (meq/ L)**				**OM %**	**Available N (mg/ kg soil)**
K^+	**Na^+**	**Mg^{++}**	**Ca^{++}**	**$So_4^=$**	**Cl^-**	**Hco_3^-**	**$Co_3^=$**	1.32	0.25
0.63	1.40	1.64	3.86	3.04	1.39	3.10	-		

Table.2 Effect of humic acid substances on juice impurities percentage (K, Na and α-amino-N %) of sugar beet roots in (2013/ 2014 and 2014/ 2015) seasons

N-fertilization rates	2013/ 2014														
	Foliar application														
	Potassium (K)				Mean	Sodium (Na)				Mean	α-amino-N				Mean
	Control	Humic	Fulvic	Humate K		Control	Humic	Fulvic	Humate K		Control	Humic	Fulvic	Humate K	
90kgN/ fed	5.677	5.677	5.390	5.420	**5.564**	2.883	2.407	2.470	2.757	**2.629**	4.040	3.827	3.930	3.863	**3.915**
72kgN/ fed	5.270	5.100	5.047	5.377	**5.199**	2.543	2.176	2.053	2.550	**2.331**	3.847	3.547	3.707	3.370	**3.618**
54kgN/ fed	5.200	5.133	4.847	5.293	**5.118**	2.270	2.057	2.023	2.197	**2.137**	3.807	3.550	3.490	3.340	**3.547**
36kgN/ fed	5.097	5.017	4.843	5.203	4.**790**	2.163	2.087	1.957	2.177	**2.096**	3.780	3.270	3.353	3.240	**3.411**
Mean	**5.334**	**5.232**	**5.032**	**5.323**		**2.465**	**2.182**	**2.126**	**2.420**		**3.869**	**3.549**	**3.620**	**3.453**	
LSD at 5%															
A					**0.105**					**0.186**					**0.207**
B					**0.231**					**0.241**					**0.235**
AxB					**0.415**					**0.506**					**0.197**
	2014/ 2015														
90kgN/ fed	6.170	6.110	5.853	5.900	**6.008**	2.007	1.923	1.771	1.843	**1.886**	2.817	2.407	2.157	2.223	**2.401**
72kgN/ fed	6.060	5.943	5.780	5.970	**5.938**	1.963	1.900	1.732	1.767	**1.841**	2.683	2.337	2.083	2.217	**2.330**
54kgN/ fed	5.933	5.877	5.793	5.917	**5.880**	1.903	1.867	1.722	1.707	**1.800**	2.541	2.323	1.977	1.967	**2.202**
36kgN/ fed	5.933	5.923	5.757	5.890	**5.851**	1.847	1.803	1.703	1.733	**1.772**	2.392	1.741	1.211	1.963	**1.827**
Mean	**6.024**	**5.963**	**5.796**	**5.919**		**1.930**	**1.873**	**1.732**	**1.763**		**2.608**	**2.202**	**1.857**	**2.093**	
LSD at 5%															
A					**0.142**					**0.096**					**0.339**
B					**NS**					**NS**					**0.345**
AxB					**0.118**					**0.107**					**0.702**

Table.3 Effect of humic acid substances on sucrose, Ex. S. and α-amino-N % of sugar beet roots in (2013/ 2014 and 2014/ 2015) seasons

N-fertilization rates	Sucrose (S%)				Mean	Extractable sugar (Ex. S %)				Mean	Purity (P%)				Mean
	Control	Humic	Fulvic	Humate K		Control	Humic	Fulvic	Humate K		Control	Humic	Fulvic	Humate K	
2013/ 2014															
90kgN/ fed	20.94	20.94	21.42	20.94	**21.06**	17.62	17.75	18.24	17.73	**17.83**	90.71	91.24	91.51	91.16	**91.14**
72kgN/ fed	20.69	20.74	21.39	20.87	**20.92**	17.53	17.73	18.37	17.82	**17.86**	91.32	91.91	92.15	91.64	**91.75**
54kgN/ fed	19.85	20.95	20.85	20.77	**20.61**	16.75	17.96	17.92	17.79	**17.60**	91.25	92.04	92.27	91.92	**91.87**
36kgN/ fed	18.76	20.25	20.81	20.63	**20.11**	15.70	17.34	17.92	17.69	**17.16**	90.96	92.05	92.40	92.01	**92.03**
Mean	**20.04**	**20.72**	**21.12**	**20.80**		**16.88**	**17.73**	**18.12**	**17.76**		**91.06**	**91.81**	**92.08**	**91.68**	
LSD at 5% A					**0.61**					**1.12**					**0.51**
B					**0.33**					**0.45**					**0.55**
AxB					**1.04**					**0.86**					**0.73**
2014/ 2015															
90kgN/ fed	21.08	21.62	21.36	21.38	**21.36**	18.13	18.79	18.65	18.64	**18.55**	91.92	92.47	92.83	92.71	**92.48**
72kgN/ fed	21.08	21.59	21.39	21.35	**21.33**	18.19	18.81	18.72	18.61	**18.58**	92.11	92.63	92.96	92.71	**92.60**
54kgN/ fed	20.37	21.56	21.28	21.21	**21.11**	17.54	18.80	18.63	18.55	**18.38**	92.09	92.70	92.99	92.91	**92.67**
36kgN/ fed	20.54	21.49	21.03	21.17	**21.06**	17.75	18.87	18.58	18.51	**18.43**	92.29	93.07	93.48	92.90	**92.94**
Mean	**20.77**	**21.57**	**21.27**	**21.28**		**17.90**	**18.82**	**18.65**	**18.58**		**92.10**	**92.72**	**93.06**	**92.81**	
LSD at 5% A					**0.43**					**0.35**					**0.46**
B					**0.21**					**0.11**					**0.39**
AxB					**0.65**					**0.58**					**0.56**

Foliar application

Table.4 Effect of humic acid substances on SLM, AC and Ex% of sugar beet in (2013/ 2014 and 2014/ 2015) seasons

2013/ 2014															
	Foliar application														
N-fertilization rates	Sugar lost to molasses (SLM%)				Mean	Alkalinity Coefficient (AC%)				Mean	Extractability (Ex%)				Mean
	Control	Humic	Fulvic	Humate K		Control	Humic	Fulvic	Humate K		Control	Humic	Fulvic	Humate K	
90kgN/ fed	2.721	2.589	2.583	2.611	**2.626**	2.141	2.112	2.000	2.117	**2.093**	84.14	84.77	85.14	84.67	**84.66**
72kgN/ fed	2.556	2.405	2.421	2.452	**2.458**	2.031	2.051	1.915	2.352	**2.087**	84.75	85.51	85.88	85.37	**85.38**
54kgN/ fed	2.498	2.394	2.334	2.384	**2.402**	1.962	2.025	1.968	2.243	**2.050**	84.40	85.71	85.93	85.64	**85.42**
36kgN/ fed	2.461	2.312	2.290	2.343	**2.352**	1.921	2.172	2.028	2.278	**2.100**	83.68	85.62	86.11	85.73	**85.46**
Mean	**2.559**	**2.425**	**2.407**	**2.447**		**2.014**	**2.090**	**1.978**	**2.247**		**84.24**	**85.40**	**85.76**	**85.35**	
LSD at 5% A					**0.083**					**NS**					**0.43**
B					**0.175**					**NS**					**0.75**
AxB					**0.265**					**NS**					**0.56**
2014/ 2015															
90kgN/ fed	2.329	2.226	2.107	2.140	**2.205**	2.903	3.337	3.535	3.483	**3.314**	86.01	86.93	87.33	87.19	**86.86**
72kgN/ fed	2.294	2.182	2.072	2.137	**2.172**	2.990	3.356	3.606	3.490	**3.361**	86.27	87.11	87.51	87.18	**87.02**
54kgN/ fed	2.232	2.165	2.046	2.059	**2.126**	3.084	3.334	3.801	3.876	**3.524**	86.10	87.18	87.56	87.46	**87.07**
36kgN/ fed	2.187	2.017	1.847	2.058	**2.027**	3.253	4.438	6.160	3.883	**4.433**	86.43	87.82	88.36	87.44	**87.52**
Mean	**2.266**	**2.148**	**2.018**	**2.099**		**3.058**	**3.616**	**4.276**	**3.683**		**86.20**	**87.26**	**87.69**	**87.32**	
LSD at 5% A					**0.106**					**NS**					**0.37**
B					**0.153 NS**					**0.51**					
AxB					**0.241**					**NS**					**0.94**

Table.5 Effect of humic acid substances on top, roots and sugar yields (tons/ fed) of sugar beet roots in (2013/ 2014 and 2014/ 2015) seasons

N-fertilization rates	Top yield (tons/ fed)				Mean	Root yield tons/ fed)				Mean	Sugar yield/(tons/ fed)				Mean
	Control	Humic	Fulvic	Humate K		Control	Humic	Fulvic	Humate K		Control	Humic	Fulvic	Humate K	
2013/ 2014															
90kgN/ fed	7.222	8.232	10.04	7.692	**8.297**	23.61	26.46	32.06	27.94	**27.52**	4.160	4.697	5.847	4.954	**4.914**
72kgN/ fed	7.231	7.461	9.114	8.448	**8.064**	22.57	26.23	28.17	24.51	**25.37**	3.958	4.652	5.175	4.367	**4.538**
54kgN/ fed	7.202	7.201	8.435	7.447	**7.571**	20.75	25.43	25.31	21.11	**23.15**	3.476	4.566	4.534	3.755	**4.083**
36kgN/ fed	6.623	7.038	7.645	7.266	**7.143**	20.17	21.20	21.77	20.74	**20.97**	3.166	3.676	3.901	3.668	**3.603**
Mean	**7.070**	**7.483**	**8.809**	**7.713**		**21.78**	**24.83**	**26.83**	**23.58**		**3.690**	**4.398**	**4.864**	**4.186**	
LSD at 5% A					**0.613**					**0.76**					**0.401**
B					**1.247**					**4.25**					**1.172**
AxB					**1.615**					**4.41**					**0.913**
2014/ 2015															
90kgN/ fed	7.133	7.333	7.867	7.333	**7.417**	22.53	22.83	23.47	23.07	**22.90**	4.085	4.291	4.378	4.300	**4.263**
72kgN/ fed	6.533	6.933	7.467	7.733	**7.167**	20.67	22.27	23.47	22.81	**22.31**	3.759	4.188	4.393	4.246	**4.147**
54kgN/ fed	6.533	6.667	7.467	7.200	**6.967**	20.53	21.87	21.23	21.07	**21.18**	3.600	4.110	3.956	3.909	**3.894**
36kgN/ fed	5.867	6.267	7.067	6.933	**6.534**	20.13	21.61	21.73	20.67	**21.04**	3.574	4.078	4.038	3.826	**3.879**
Mean	**6.517**	**6.800**	**7.467**	**7.300**		**20.97**	**22.15**	**22.48**	**21.91**		**3.755**	**4.167**	**4.191**	**4.070**	
LSD at 5% A					**0.562**					**0.83**					**0.235**
B					**0.652**					**0.81**					**0.271**
AxB					**1.034**					**1.13**					**0.394**

Foliar application

Fig.1 Effect of humic acid substances on extractability (%) of sugar beet.

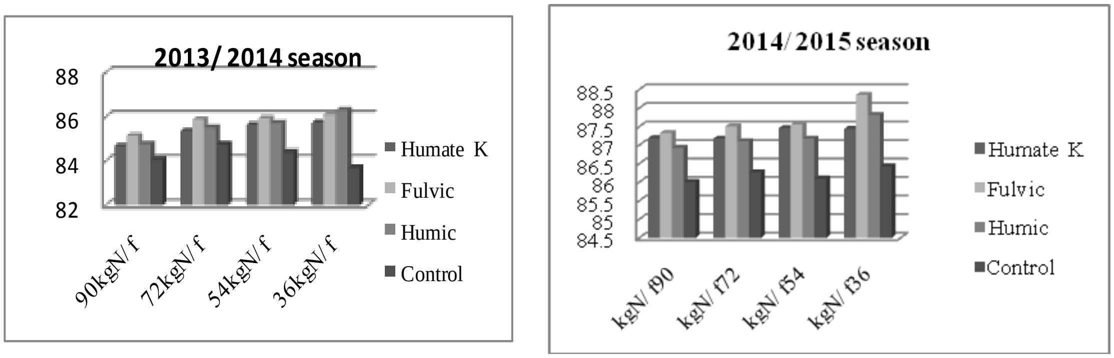


Fig.2 Effect of humic acid substances on root yield of sugar beet(tons/ fed)

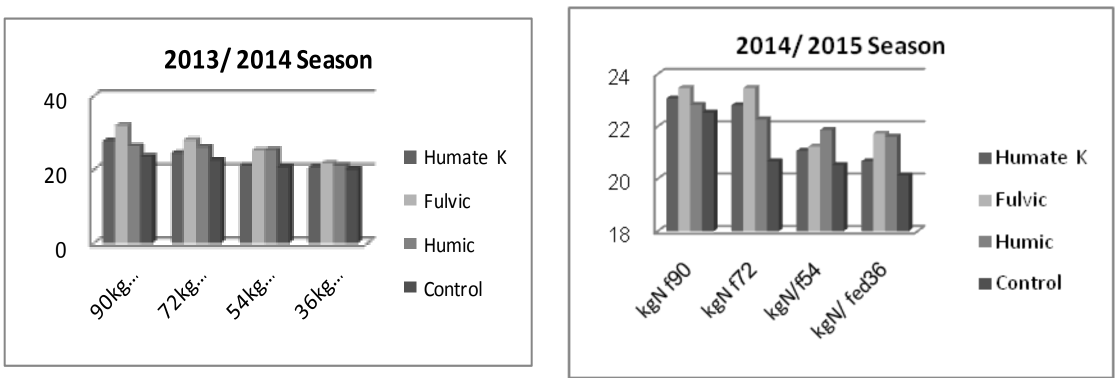
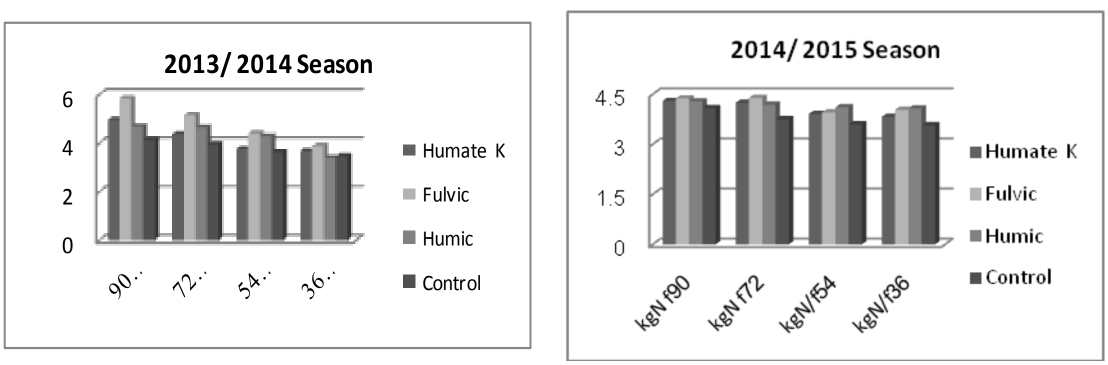


Fig.3 Effect of humicacid substances on sugar yield of sugar beet(tons/ fed).



Yields of top root and sugar

Evidentially, data predicted In Table (5) and Figs. (2 &3) revealed that foliar application with humic substances significantly increased top, root and sugar yields (tons/ fed) compared with those untreated in both seasons. This could be attributed to the influence related to fulvic acid application to plant foliage which affects the process of translocation of trace elements directly to metabolic sites in plant cell and thus maximizing the plants productive capacity. These results coincided with those found by Kabeel *et al.*, (2008) as they showed that humic substances improve nutrient uptake, increase chlorophyll synthesis, better seed germination, increase fertilizer retention, stimulate beneficial microbial activity and produce healthier plants and improve yield. Meanwhile, Hye (2014) demonstrated that foliar application of fulvic acid at 0.8 g L^- could be used to promote plant growth and increase marketable yield in tomato production. In this respect, Eisa, Salwa (2011) and Ibrahim Dina *et al.*, (2013) revealed that, foliar application with humic acid increased sugar yield of sugar beet.

Also, the same data presented in Tabled (5) and Figs. (2&3) showed that top, root and sugar yields (tons/ fed) were significantly increased by N- fertilizer application. The treatment of 72kg/ fed significantly surpassed the other levels in both levels. According to these results , it is worthy to mention that increasing top, root and sugar yields with increasing N-fertilization may be attributed to the increase in N uptake which positively influenced photosynthesis process indirectly, which in turn was reflected on top and root growth and consequently on ultimately enhancing higher yield Shafika and EL-Masry (2006).

Concerning the interaction effect among humic acid substances as foliar application and nitrogen fertilization data collected in Table (5) and Figs.(2&3), it is clear that the highest top, root and sugar yields recorded 9.114, 28.17 and 5.157 tons/ fed. in the 1^{st} season, as well as 7.733, 23.47 and 4.393 tons/ fed in the 2^{nd} season for top, root and sugar yields, respectively, due to the foliar application with fulvic acid and soil N fertilization by 72kg N/fed.

Based on the obtained results, it could be concluded that under the condition of this work when foliar application of fulvic acid sprayed at rate 8cm/Land fertilized with nitrogen as soil application at level of 72kg/ fed were extremely effective in increasing top, root and sugar yields/ fed as well as juice quality which in turn improved extractable sugar.

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