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Role of Foliar Spraying with Biostimulants Substances in Decreasing Mineral Nitrogen Fertilizer of Sugar Beet

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ABSTRACT

In order to study the role of foliar spraying with biostimulants substances and fertilizing with nitrogen mineral fertilizer on productivity and quality of sugar beet, a field experiment was performed during 2015/2016 and 2016/2017 winter seasons at Tag Al-Ezz, Agricultural Research Station Farm, Dakahlia Governorate, Egypt. Strip-plot designs with four replicates were used. Spraying plants with 150 ml yeast extract/liter plus 1.5 ml humic acid/liter as mixture recorded the highest means of all studied characters. However, spraying with 150 ml yeast extract/liter came in the second rank, followed by spraying with 1.5 ml humic acid/liter, then spraying with water and lastly without (control treatment) in the two seasons. Decreasing mineral nitrogen fertilization from 100 to 85, 70 and 55% from the recommended dose (90 kg N/fed) caused gradual reduction in all studied characters, with exception sucrose and apparent purity in both seasons. Highest values of root, top and sugar yields per fed were recorded with adding 100 or 85 % from the recommended dose without significant differences between them during growing seasons. For maximizing sugar beet productivity and quality and decreasing environmental pollution and cost could be succeeded with spraying plants twice with the mixture of 150 ml yeast extract/liter plus 1.5 ml humic acid/liter and fertilizing with 76.5 kg N per fed as soil application under environmental conditions of Dakahlia Governorate, Egypt.

Keywords: Sugar beet, biostimulants, yeast extract, humic acid, nitrogen fertilizer levels, growth, yields, quality.

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) is considering one of the main sources of sugar beside sugar cane in the world and Egypt. Increasing production of sugar as of unit area is attractive one of the essential domestic targets to reduce the gap between sugar consumption and production. So, farmers require using additional nutrient inputs, especially mineral nitrogen fertilizers to improve growth characters and root yield per unit area. Increasing mineral nitrogen fertilizer caused many problems like higher emission of N_2O to the atmosphere (Bronson *et al.*, 1997) and NO_2 pollution of groundwater and soil acidification (Shrestha and Ladha, 1998). For these problems, a great effort has been concentrated for using other fertilizers, including organic sources and non-polluting sources like biostimulants *i.e.* humic acid substances.

Natural and non-harmful substances like yeast extract can use as foliar application due to it plays a vital role as induction gibberellic acid (GA), indole acetic acid (IAA) and phytohormones (cytokinins) as endogenous hormones, rich sources of enzymes, vitamins, essential minerals and amino acids (Natio *et al.*, 1981 and Mok and Mok, 2001). In addition, Castelfranco and Beale (1983) found that development and division of cells, synthesis of nucleic acid and protein and the formation of chlorophyll significantly affected by using yeast extract. Essam *et al.* (2012) and Aly *et al.* (2014) indicated that using yeast extract at the rate of 5 g/liter as a soil application and a foliar spraying on sugar beet plants increased root yield components and root and gross sugar yields/fed in both seasons. Awad and Moustfa (2014) found that spraying sugar beet plants with yeast significantly increased percentage of root juice purity and sugar yield/fed. Abdou (2015) showed that spraying sugar beet plants with yeast resulted in significant increases in the averages of all studied characters, except root diameter and root juice apparent purity percentage as compared with the control treatment.

The compounds of humic acid have multifarious roles which can significantly effects on the structure of soil characters, aggregation, aeration, permeability, water-holding capacity and activity of soil microbial populations, permeability and absorbency of plant cell and the uptake of nutrients (Akinremi *et al.*, 2000, Nardi *et al.*, 2002 and Tan, 2003). Moreover, humic acid play an important role and effect on the process of the functions of cell membrane by stimulating nutrients uptake, respiration, chlorophyll content, photosynthesis, biosynthesis of DNA, absorption of ions and intensify of system of enzyme as well as control the activity of H^+ and ATP in plasmalema and tonoplast (Yang *et al.*, 2004 ; Fathy *et al.,* 2009 ; Khaled and Fawy, 2011 ; Seydabadi and Armin, 2014 and Abd El-Hai and El-Saidy, 2016). Rassam *et al.* (2015) and El-Hassanin *et al.* (2016) revealed that foliar application with humic acid significantly enhanced growth, root yield/fed, sucrose content, purity percentage of sugar yield. El-Gamal *et al.* (2016) showed that foliar spraying with 25 g/litter of humic acid produced the maximum values of leaves area, relative growth rate, crop growth rate and sugar and top yields/fed.

Sugar beet, need big amounts of nitrogen due to nitrogen is one of the most important yield carrier, and element that improve growth characters, yield, its attributes and root quality. So, nitrogen has a marked effect on plant growth characters. In addition, application mineral nitrogen fertilizer increase the formed of protoplasm and chlorophyll, protein content, building up metabolites and activation of enzymes that associate with carbohydrate accumulation, to increasing division and elongation of cells, accordingly increasing growth and yield of plants. In this connection, El-Sarag (2009), Ferweez *et al.* (2011) and Shaban *et al.* (2014) concluded that root length, root diameter and root, top as well as sugar yield per fed were increased with increasing the levels of nitrogen fertilizer to 100 or 110 kg N per fed. Moreover, Abdelaal and Tawfik (2016) and El-Hassanin *et al.* (2016) confirmed that increasing nitrogen fertilizer levels caused increase in chlorophyll content, foliage length, area of leaves, fresh weights of foliage and root, root length, diameter of roots and top, root as well as sugar yield per fed. In contrast, Monreala *et al.* (2007), El-Geddawy *et al.* (2008) and Abdelaal and Tawfik (2016) reported that sucrose and purity percentages were a decrease due to increasing the levels of nitrogen fertilizer, this might be as a result of the increases of amino compounds caused by the extreme of nitrogen uptake.

Therefore, this study aimed to enhance growth, yield and its attributes as well as quality of sugar beet plants by foliar spraying with some biostimulants substances and reducing mineral nitrogen fertilization and environmental pollution under the conditions environments of the Governorate of Dakahlia, Egypt.

MATERIALS AND METHODS

A field experiments was conducted during 2015/2016 and 2016/2017 winter seasons at Tag Al-Ezz, Agricultural Research Station Farm, Dakahlia Governorate, Agricultural Research Center, Egypt, to assess the role of foliar spraying with biostimulants substances and the levels of nitrogen mineral fertilizer on growth, productivity and quality parameters of sugar beet cv. Oskarpoly.

A strip-plot design with four replicates was used. Foliar spraying with biostimulants substances i.e. without (control treatment), water, 150 ml/Liter of yeast extract, 1.5 ml/Liter of humic acid and mixture of 150 ml/Liter of yeast extract beside 1.5 ml/Liter of humic acid were arranged in the vertical plots. Foliar solution volume was 200 Liter/fed sprayed by hand sprayer on units of experimental twice until the saturation point later than 50 & 70 days from sowing (DFS).

According to Spencer *et al.* (1983) 1 gram from active dry yeast were liquefied in one liter of water followed by adding sugar at the same rate then saved for activation, multiplied efficiently and reproduction of yeast during beneficial aerobic. Sugars, carbohydrates, amino acids, proteins, hormones and fatty acids were produced, then yeast cells components could be release out easily by two freezing rotation and defrosting for causing disruption in yeast cells and producing their content.

Uni-humic, which contains 18.5 % high purity humic acid in liquid form, 1.5% folic acid, 0.5 % K_2O and 0.5-1.0 % micronutrients (Fe, Zn and Mn) as a source of humic acid, it was manufactured by United for Agricultural Development.

Nitrogen fertilizer levels (100, 85, 70 and 55% from the recommended dose "90 kg N/fed") i.e. 90, 76.5, 63.0 and 49.5 kg N/fed were distributed in the horizontal plots. The nitrogen in the form of urea (46.0 % N) were added in similar two portions, the first one was added after the thinning (35 DFS) and prior to the 2nd irrigation, and the other dose was added after (50 DFS) and before the 3rd irrigation.

According to the soil properties of the experimental site, the soil texture was clay loam, pH (7.65), electrical conductivity (2.25 dSm^{-1}), organic matter (1.49 %), available nitrogen (34.35 ppm), available phosphorous (7.7 ppm) and exchangeable potassium (221 ppm), all these data were estimated as an averages over both growing seasons of 2015/2016 and 2016/2017.

The unit basic area of each experimental was 10.5 m^2 (1/400 fed) included five ridges, each of (60 cm width) apart and 3.5 m long. Rice was the preceding summer crop during two growing seasons.

The experimental field was well prepared, then divided to experimental units. During soil preparation, 150 kg calcium superphosphate "15.5 % P_2O_5" per feddan was applied. Hand dry sowing method of sugar beet used, which 3-5 balls per hill were sown in hills 20 cm apart on one side of the ridge, the date of sowing was 15th of October in both seasons. After sowing all plots directly were irrigated and plants were thinned after full germinated after 35 DFS to produce one plant/hill, plant population (35000 plants/fed). The recommendations for growing sugar beet of the Ministry of Agriculture were applied, excluding the factors under study.

Data recorded:

Growth characters:

At 120 DFS, five guarded plants were collected randomly from the two outer ridges of each plot to estimate the following traits:

1. Total chlorophyll (SPAD): by using SPAD-502 (Minolta Co. Ltd., Osaka, Japan) total chlorophyll content was estimated.
2. Leaves area/plant (cm^2): It was estimated by applying the dry-weight method as confirmed by Roads and Bloodwoath (1964).
3. Foliage length (cm).

After 120 and also 150 days DFS, samples of five plants were collected randomly from the two outer ridges of each plot to estimate the dry weight of chosen plants, where the portions of all plant were air-dried, then at 70^{0}C it was oven dried till constant weight, to calculate the following traits:

4. Crop growth rate (CGR) in g/week was calculated by using equation as confirmed by Radford (1967):

$$CGR = \frac{W_2 - W_1}{T_2 - T_1}$$

Where: **W_1 and W_2 refers to plant dry weight at sampling recorded at time (T_1) and time (T_2) after 120 and 150 DFS, respectively.**

5. Relative growth rate (RGR) in g/g/week as described by Radford (1967) was estimated by using the following equation:

$$RGR = \frac{Log_e W_2 - Log_e W_1}{T_2 - T_1}$$

Where: **Log_e refer to the natural log and W_1 and W_2 refers to plant dry weight at sampling recorded at time (T_1) and time (T_2) after 120 and 150 DFS, respectively.**

Yield and its components and quality characters:

After 210 DFS, randomly five guarded plants were collected from the external ridges of each plot to measure the following characters:

1- Fresh weight of roots (g/plant).
2- Fresh weight of foliages (g/plant).
3- Length of roots (cm). 4- Diameter of roots (cm).
5-Total soluble solids (TSS %) was estimated in juice of fresh roots by using Hand Refractometer.
6- Sucrose (%) was determined Polarimetrically according the method confirmed by Carruthers and OldField (1960).
7- Apparent purity (%) was calculated as following equation (Carruthers and OldField, 1960).

$$\text{Apparent purity (\%)} = \frac{\text{Sucrose (\%)}}{\text{TSS \%}} \times 100$$

All Plants in the three inner ridges of each plot were harvested, cleaned and root and foliage were separated and weighted to calculate the following characters:

1-Root yield (t/fed). 2- Top yield (t/fed).
3- Sugar yield (t/fed): it was calculated by multiplying sucrose % by root yield/fed.

The collected data were subjected to the proper analysis of variance (ANOVA) for the strip-plot design as described by Gomez and Gomez (1984). Least significant of differences (LSD) technique was applied to compare the differences among treatments means at the probability level of (0.05) as confirmed by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

A- Impact of foliar spraying with biostimulants substances:

Foliar spraying with biostimulants substances i.e. without (control treatment), foliar spraying twice with water, 150 ml/Liter of yeast extract, 1.5 ml/Liter of humic acid and mixture of 150 ml/Liter of yeast extract beside 1.5 ml/Liter of humic acid markedly affected growth traits i.e. total chlorophyll, leaves area/plant, foliage length, crop growth rate (CGR) and relative growth rate (RGR) "Table 1", yield attributes i.e. root fresh weight, root length and root diameter, root juice quality i.e. TSS, sucrose, apparent purity percentages "Table 2" and yields i.e. root yield, top yield and sugar yields/fed in both seasons "Table 3". The results indicated that all studied characters were increased due to foliar spraying twice after 50 and 70 DFS with biostimulants substances as compared with control treatment during growing seasons.

Results revealed that maximum values of studied characters were recorded from foliar spraying with mixture of yeast extract plus humic acid during growing seasons. While, using yeast extract came in the second rank, followed by humic acid, then water and lastly the control treatment in both seasons.

In general, using mixture of 150 ml/Liter of yeast extract plus 1.5 ml/Liter of humic acid significantly increased total chlorophyll by (10.10%), leaves area/plant by (9.20%), foliage length by (13.91%), CGR by (19.70%), RGR by (11.26%), root fresh weight by (19.98%), root length by (19.15%), root diameter by (27.00%), TSS by (7.03%), sucrose % by (12.88%), apparent purity by (5.44%), root yield/fed by (8.19%), top yield/fed by (26.79%) and sugar yield/fed by (22.81%), respectively as an average over two growing seasons as compared with without foliar spraying (control treatment).

Table 1. Total chlorophyll, leaves area/plant, foliage length at 120 DFS, crop growth rate (CGR) and relative growth rate (RGR) as affected by foliar spraying with biostimulants substances and nitrogen fertilizer levels as well as their interaction during 2015/2016 and 2016/2017 seasons.

Characters / Treatments	Total chlorophyll (SPAD)		Leaves area /plant (cm^2)		Foliage Length (cm)		CGR (g/week)		RGR (g/g/week)	
Seasons	2015 /2016	2016 /2017	2015 /2016	2016 /2017	2015 /2016	2016 /2017	2015 /2016	2016 /2017	2015 /2016	2016 /2017
A- Foliar spraying with biostimulants substances:										
Without	44.88	47.41	3207.22	3307.55	42.24	46.43	9.67	10.64	0.067	0.069
Water	46.04	48.38	3248.85	3402.13	44.99	47.38	10.56	11.47	0.070	0.072
Yeast extract	47.07	49.03	3363.46	3482.24	48.62	49.26	12.55	12.78	0.075	0.077
Humic acid	46.54	48.04	3351.14	3420.90	46.46	48.21	11.52	12.40	0.073	0.075
Yeast extract + humic acid	50.07	51.51	3535.94	3577.27	50.35	50.44	13.13	13.20	0.078	0.080
LSD at 5 %	0.59	0.62	16.61	22.15	1.25	0.49	0.28	0.27	0.002	0.002
B- Nitrogen fertilizer levels (from the recommended dose):										
100% (90 kg N/fed)	49.43	50.58	3374.43	3485.76	49.39	50.85	12.28	12.57	0.075	0.078
85% (76.5 kg N/fed)	49.15	50.14	3371.18	3482.65	49.01	50.66	12.14	12.45	0.075	0.077
70% (63.0 kg N/fed)	47.00	48.92	3328.66	3406.96	45.36	47.92	11.18	11.90	0.072	0.074
55% (49.5 kg N/fed)	42.10	45.84	3291.02	3376.70	42.37	43.94	10.36	11.46	0.069	0.070
LSD at 5 %	1.43	0.96	14.56	20.89	1.49	1.23	0.15	0.19	0.001	0.001
C- Interaction (F. test):	NS	*	*	*	*	*	*	*	NS	NS

Table 2. Root fresh weight, root length, root diameter, total soluble solids (TSS), sucrose and apparent purity percentages as affected by foliar spraying with biostimulants substances and nitrogen fertilizer levels as well as their interaction during 2015/2016 and 2016/2017 seasons.

Characters / Treatments	Root fresh weight (g)		Root length (cm)		Root diameter (cm)		TSS (%)		Sucrose (%)		Apparent purity (%)	
Seasons	2015 /2016	2016 /2017	2015 /2016	2016 /2017	2015 /2016	2016 /2017	2015 /2016	2016 /2017	2015 /2016	2016 /2017	2015 /2016	2016 /2017
A- Foliar spraying with biostimulants substances:												
Without	636.60	647.03	22.21	23.60	8.73	9.67	22.15	22.53	18.64	19.03	84.34	84.60
Water	652.32	658.00	23.41	25.98	9.68	10.84	22.38	22.87	19.88	20.37	89.07	89.13
Yeast extract	711.98	702.67	26.05	28.05	11.69	12.41	23.95	23.98	20.95	20.98	87.62	87.70
Humic acid	667.80	676.40	25.05	27.06	10.50	12.09	23.40	23.69	21.50	21.79	92.00	92.06
Yeast extract + humic acid	776.69	795.57	28.80	29.95	12.81	13.19	24.18	24.25	22.68	22.75	93.95	93.96
LSD at 5 %	5.39	4.81	0.96	0.79	0.40	0.16	0.35	0.40	0.35	0.40	0.28	0.30
B- Nitrogen fertilizer levels (from the recommended dose):												
100% (90 kg N/fed)	708.56	721.30	26.84	29.55	11.40	12.36	23.92	24.00	19.76	20.02	82.57	83.36
85% (76.5 kg N/fed)	707.94	720.96	26.54	29.18	11.28	12.16	23.70	23.92	20.50	20.96	86.44	87.62
70% (63.0 kg N/fed)	680.89	680.80	24.45	25.70	10.37	11.34	22.99	23.44	21.22	21.44	92.23	91.36
55% (49.5 kg N/fed)	658.93	660.70	22.59	23.28	9.69	10.70	22.24	22.50	21.44	21.52	96.36	95.61
LSD at 5 %	5.63	5.77	0.51	0.38	0.22	0.14	0.50	0.42	0.50	0.42	3.87	2.76
C- Interaction (F. test):	*	*	*	*	*	*	NS	NS	NS	NS	NS	NS

Table 3. Root, top and sugar yields/fed as affected by foliar spraying with biostimulants substances and nitrogen fertilizer levels as well as their interaction during 2015/2016 and 2016/2017 seasons.

Treatments (Characters / Seasons)	Root yield (t/fed)		Top yield (t/fed)		Sugar yield (t/fed)	
	2015 /2016	2016 /2017	2015 /2016	2016 /2017	2015 /2016	2016 /2017
A- Foliar spraying with biostimulants substances:						
Without	21.950	22.908	9.675	10.033	4.086	4.353
Water	23.075	24.417	10.833	11.217	4.582	4.971
Yeast extract	25.017	25.517	12.517	13.208	5.231	5.338
Humic acid	23.658	24.825	11.492	12.308	5.084	5.402
Yeast extract + humic acid	25.700	25.992	13.750	14.208	5.815	5.900
LSD at 5 %	0.182	0.384	0.205	0.310	0.101	0.124
B- Nitrogen fertilizer levels (from the recommended dose):						
100% (90 kg N/fed)	25.313	26.660	13.020	13.440	5.024	5.352
85% (76.5 kg N/fed)	25.220	26.567	12.933	13.353	5.196	5.584
70% (63.0 kg N/fed)	22.780	23.100	10.967	11.667	4.845	4.962
55% (49.5 kg N/fed)	22.207	22.600	9.693	10.320	4.774	4.873
LSD at 5 %	0.227	0.110	0.280	0.479	0.221	0.293
C- Interaction (F. test):	*	*	*	*	*	*

The considerable effect of foliar spraying of sugar beet plants twice with yeast extract plus humic acid on the growth traits, yields and its attributes and quality may be ascribe to the mixture in the desired impact of them. Meanwhile, yeast extract (YE) plays a vital role as inductor of endogenous hormones, rich sources of vitamins, cytokinins, enzymes, vital minerals and amino acids (Natio *et al*., 1981 and Mok and Mok, 2001). Also YE had beneficial effects on the processes of cell division, the synthesis of protein and DNA and the formation of chlorophyll (Castelfranco and Beale, 1983). However, humic acid (HA) have multifarious roles, which can significantly increase mechanisms involved in plant growth stimulation, the uptake of nutrients and the permeability of cell (Akinremi *et al*., 2000 ; Nardi *et al.,* 2002 and Tan, 2003). Also, HA play an important role and effect on the process of cell membrane functions by stimulating nutrients uptake, respiration, chlorophyll content, photosynthesis, ion absorption, nucleic acid biosynthesis, intensify enzyme system and controls the activity of H^+ and ATP in plasmalema and tonoplast (Yang *et al*., 2004 ; Fathy *et al.,* 2009 ; Khaled and Fawy 2011 and Seydabadi and Armin, 2014). These findings are in a good line with thus confirmed by Rassam *et al.* (2015), El-Gamal *et al.* (2016) and El-Hassanin *et al.* (2016).

B- Effect of mineral nitrogen fertilizer levels:

Studied characters *i.e.* growth traits, yield and its components and quality significantly increased with increasing levels of mineral nitrogen from 55 to 70, 85 and 100% from the recommended dose, these levels equal (49.5, 63.0, 76.5 and 90 Kg N/fed) during both growing seasons, with exception sucrose and apparent purity percentages as presented in Tables 1, 2 and 3. Application of mineral nitrogen at the highest levels (100% from the recommended dose "90 kg N/fed") recorded the maximum values of total chlorophyll (49.43 and 50.58 SPAD), leaves area/plant (3374.43 and 3485.76 cm^2), foliage length (49.39 and 50.85 cm), CGR (12.28 and 12.57 g/week), RGR (0.075 and 0.078 g/g/week), root fresh weight (708.56 and 721.30 g), root length (26.84 and 29.55 cm), root diameter (11.40 and 12.36 cm), TSS (23.92 and 24.00 %), root yield (25.313 and 26.660 t/fed) and top yield (13.020 13.440 t/fed) in the first and second seasons, respectively as shown in Tables 1, 2 and 3. Whereas, fertilizing sugar beet plants with 85% from the recommended dose (76.5 kg N/fed) recorded the highest values of sugar yield (5.19 and 5.58 t/fed), followed by fertilizing with 100% without significant differences between them in both seasons. While, the minimum levels of mineral nitrogen fertilizers (55% from the recommended dose "49.5 kg N/fed") resulted the lowest averages of growth, yields and yield components in both seasons. Moreover, increasing mineral nitrogen fertilizers from 55 to 70, 85 and 100% (from the recommended dose) were associated with gradual reduction in sucrose and apparent purity percentages during two growing seasons. Maximum percentages of sucrose and apparent purity were recorded with the lowest level of mineral nitrogen fertilizer 55% from the recommended dose.

From the obtained results, it could be cleared that fertilizing sugar beet plant with 100 or 85% from the recommended dose exceeded other treatments without significant differences between them. Moreover, using 100% from the recommended dose caused increases estimated by (0.35, 11.68 and 13.74%) in root yield and by (0.65, 14.48 and 24.38%) in top yield as an average over both seasons as compared with using 85, 70 and 55% from the recommended dose, respectively. While, the highest sugar yield/fed was resulted from soil fertilizing with 85 or 100% as compared with other mineral nitrogen treatments.

The considerable effect of mineral nitrogen levels on growth, yields and its attributes and quality may be due to the necessary role of nitrogen as macronutrients in building up metabolites and activation of enzymes that associate with accumulation of carbohydrates, which translated from leaves to developing roots. Also, increasing division and elongation of cells, consequently increasing growth parameters such as, chlorophyll content, leaves area per plant, length of foliage, CGR, RGR, yield attributes such as, root length and root diameter, root fresh weight, sugar quality such as TSS and yield parameter such as; top, root as well as sugar yields per fed. These results are in harmony with those obtained by El-Sarag (2009), Ferweez *et al.* (2011), Shaban *et al.* (2014), Abdelaal and Tawfik (2016) and El-Hassanin *et al.* (2016).

Concerning to sugar quality (sucrose % and apparent purity %), the reduction of sugar quality due to increasing the levels of mineral nitrogen fertilizer can be ascribed to the vital role in enhancing root length and weight as well as diameter, water content of tissue and increasing the amount of non-sucrose substances i.e. alpha amino acid and proteins therefore, minimizing sucrose and apparent purity percentages in the roots of sugar beet. Authorizing these findings, Monreala *et al*. (2007), El-Geddawy *et al*. (2008) and Abdelaal and Tawfik (2016) they reported that the decrease in both of sucrose % and purity % may be due to the increase in amino compounds caused by the extreme of nitrogen uptake.

C- Effect of the interaction:

Concerning to the relation between studied characters (biostimulants substances and mineral nitrogen fertilizer levels) there were a significant effects on Total chlorophyll (in the second season only), leaves area/plant, foliage length, CGR, root fresh weight, root length, root diameter, root yield, foliage yield as well as sugar yield in two growing seasons as presented in Tables 1, 2 and 3. The recommended treatment that produced the highest values of leaves area/plant "Fig 1", foliage length "Fig 2", CGR "Fig 3", root fresh weight "Fig 4", root length "Fig 5", root diameter "Fig 6", root yield "Fig 7", top yield "Fig 8" and sugar yield "Fig 9" were resulted from foliar spraying with the mixture of yeast extract at the rate of 150 ml/Liter plus humic acid at the rate of 1.5 ml/Liter beside fertilization with soil mineral nitrogen fertilizer at the 100% from the recommended dose (90 kg N/fed). This treatment was followed by foliar spraying with the same biostimulants substances beside applying 85% from the recommended dose of nitrogen (76.5 kg N/fed) without significant differences between them in both seasons. Therefore, this treatment considered the favorable treatments due to its importance in saving about 15 kg N/fed and the reduction in root yield and top yield of sugar plant not exceeded (0.35 and 0.65%) as an average of both seasons, respectively. Vice versa, the minimum values of above mentioned characters were obtained from control treatment (without foliar spraying) beside mineral nitrogen fertilizer (55% from the recommended dose) in both growing seasons.

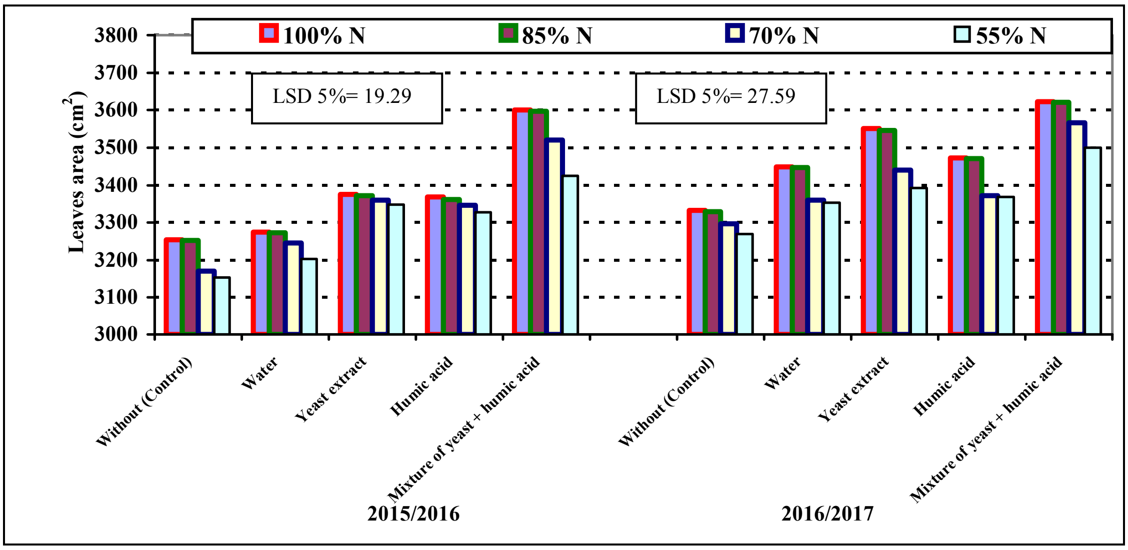

Fig. 1. Leaves area/plant (cm^2) of sugar beet as affected by the interaction between foliar spraying with biostimulants substances and nitrogen fertilizer levels during 2015/2016 and 2016/2017 seasons.

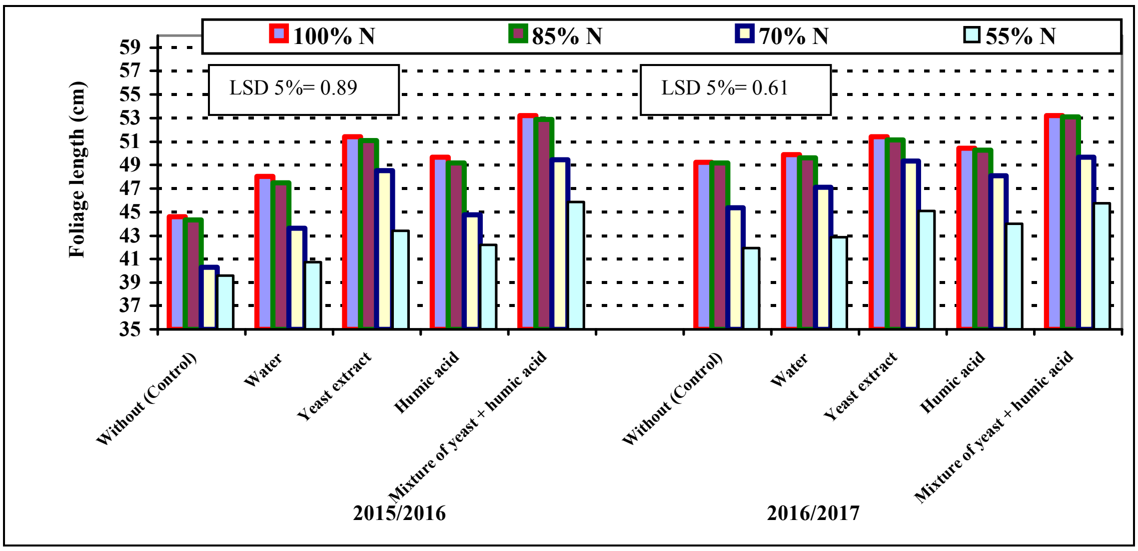

Fig. 2. Foliage length (cm) of sugar beet as affected by the interaction between foliar spraying with biostimulants substances and nitrogen fertilizer levels during 2015/2016 and 2016/2017 seasons.

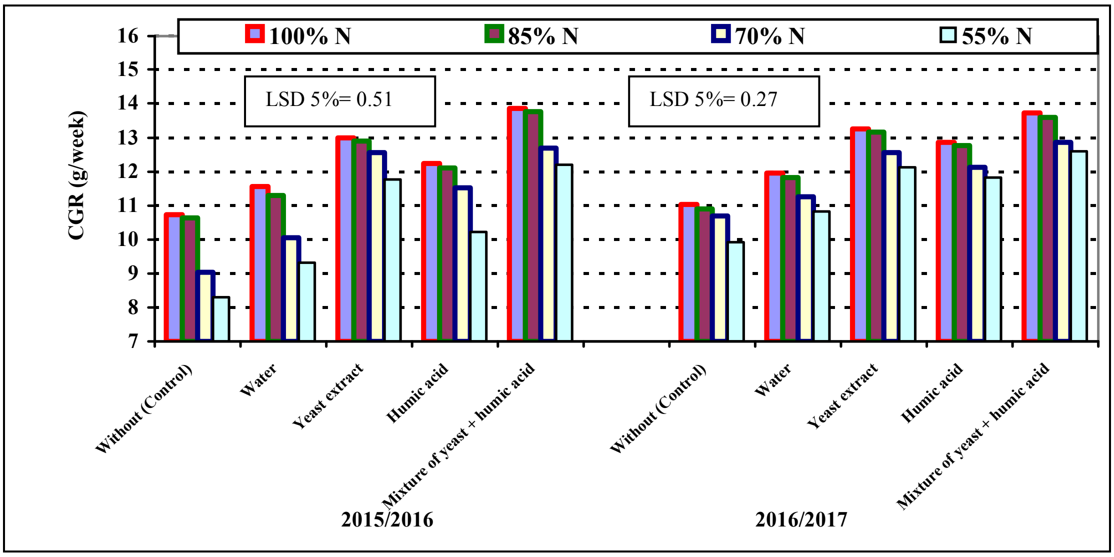

Fig. 3. Crop growth rate (g/week) of sugar beet as affected by the interaction between foliar spraying with biostimulants substances and nitrogen fertilizer levels during 2015/2016 and 2016/2017 seasons.

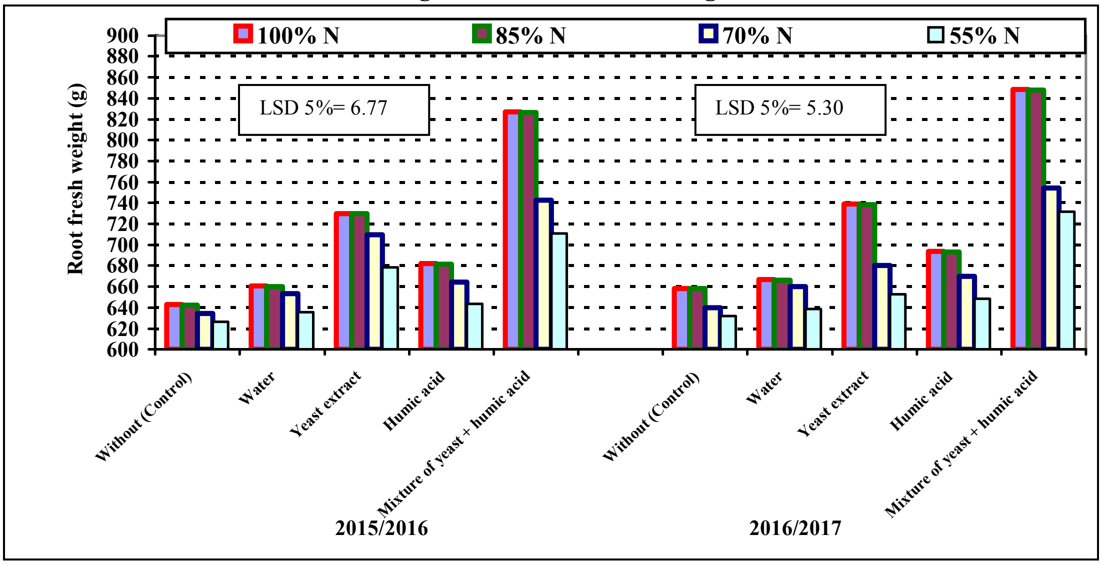

Fig. 4. Root fresh weight (g) of sugar beet as affected by the interaction between foliar spraying with biostimulants substances and nitrogen fertilizer levels during 2015/2016 and 2016/2017 seasons

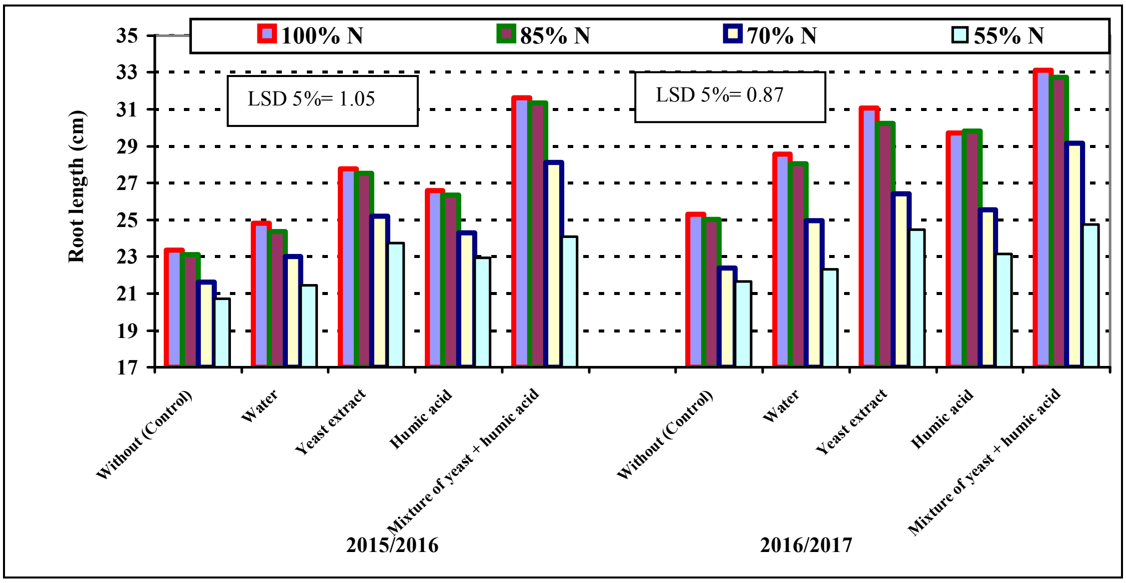

Fig. 5. Root length (cm) of sugar beet as affected by the interaction between foliar spraying with biostimulants substances and nitrogen fertilizer levels during 2015/2016 and 2016/2017 seasons.

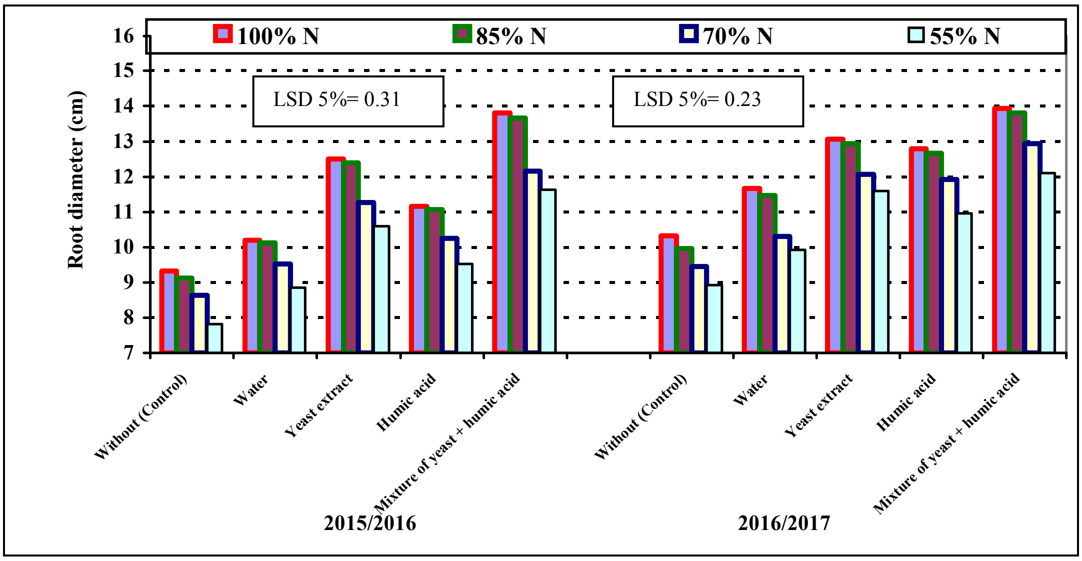

Fig. 6. Root diameter (cm) of sugar beet as affected by the interaction between foliar spraying with biostimulants substances and nitrogen fertilizer levels during 2015/2016 and 2016/2017 seasons.

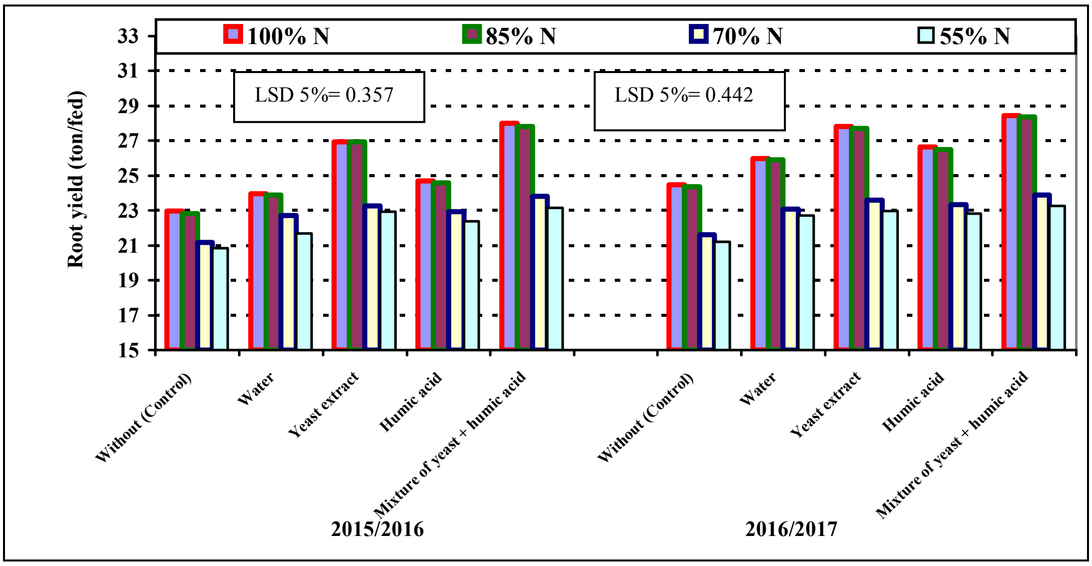

Fig. 7. Root yield (t/fed) of sugar beet as affected by the interaction between foliar spraying with biostimulants substances and nitrogen fertilizer levels during 2015/2016 and 2016/2017 seasons.

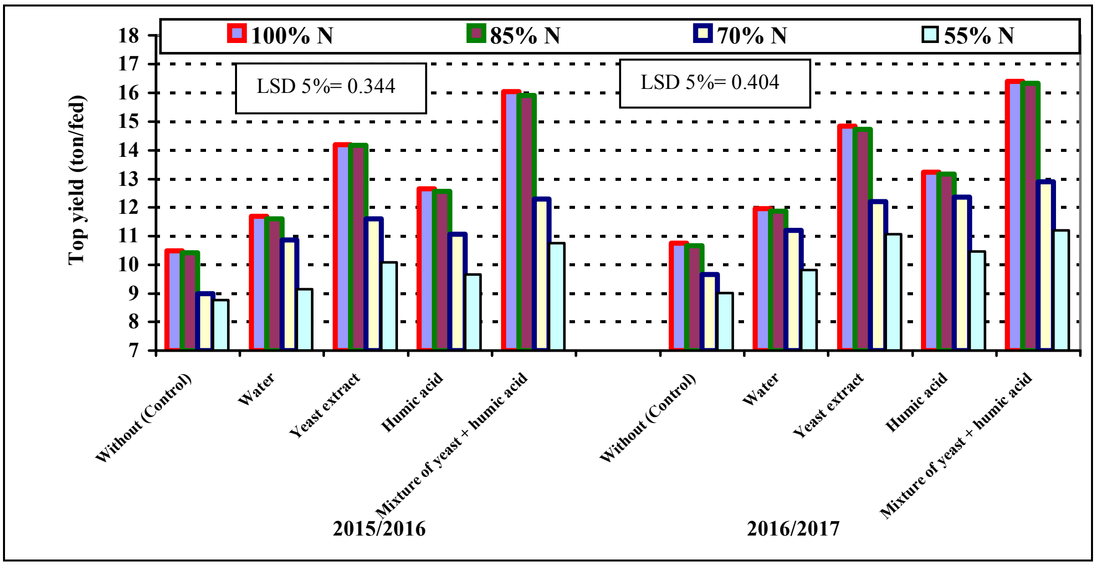

Fig. 8. Top yield (t/fed) of sugar beet as affected by the interaction between foliar spraying with biostimulants substances and nitrogen fertilizer levels during 2015/2016 and 2016/2017 seasons.

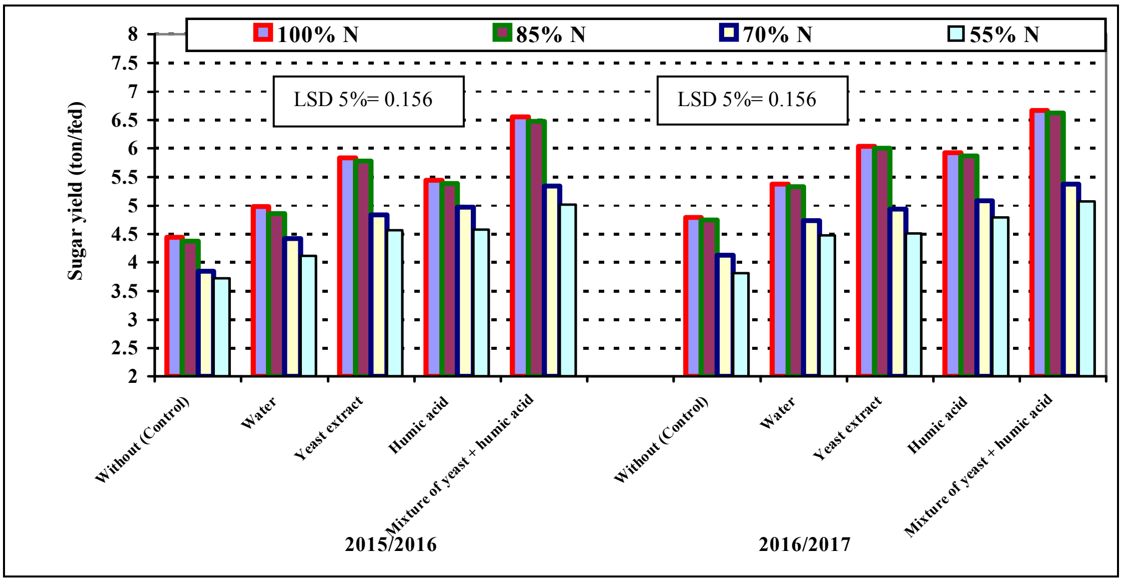

Fig. 9. Sugar yield (t/fed) of sugar beet as affected by the interaction between foliar spraying with biostimulants substances and nitrogen fertilizer levels during 2015/2016 and 2016/2017 seasons.

CONCLUSION

In conclusion, it could be recommended that foliar spraying twice with the mixture of 150 ml/Liter of yeast extract plus 1.5 ml/Liter of humic acid beside nitrogen fertilizing with 76.5 kg N/fed as soil application led to maximize growth traits, yields and its components quality of sugar beet in addition and saving 15 kg N/fed and reducing the environmental pollution under the environmental conditions of this study.

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دور الرش الورقي بالمواد المنشطة للنمو في تقليل السماد النيتروجينى لبنجر السكر

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تم إجراء تجربة حقلية بمحطة البحوث الزراعية بتاج العز بمحافظة الدقهلية خلال موسمي 2016/2015 و2017/2016 لدراسة تأثر نمو بنجر السكر والمحصول ومكوناته وصفات الجودة بالرش الورقي بالمواد المنشطة للنمو مع تقليل السماد النيتروجينى للحد من التلوث البيئى. تم تنفيذ التجربة فى تصميم الشرائح المتعامدة فى أربع مكررات، حيث اشتملت الشرائح الرأسية على معاملات الرش الورقي بالمواد المنشطة للنمو وهي؛ بدون رش ورقى (معاملة المقارنة)، الرش الورقى بالماء، مستخلص الخميرة بمعدل 150 مل / لتر، حمض الهيوميك بمعدل 1.5 مل / لتر وخليط من مستخلص الخميرة بمعدل 150 مل / لتر + حمض الهيومك بمعدل 1.5 مل / لتر، في حين اشتملت الشرائح الأفقية على مستويات السماد النيتروجيني المعدني وهي: 100٪، 85٪، 70٪ و55٪ من المعدل الموصى به (90 كجم نيتروجين للفدان) .أظهرت النتائج المتحصل عليها من هذه الدراسة أن أعلى القيم لصفات النمو والمحصول ومكوناته وصفات الجودة لبنجر السكر خلال الموسمين تم الحصول عليها نتيجة الرش الورقى بخليط من مستخلص الخميرة بمعدل 150 مل / لتر + حمض الهيومك بمعدل 1.5 مل / لتر. في حين جاء الرش الورقي بمستخلص الخميرة بمعدل 150 مل / لتر في المرتبة الثانية يليه الرش الورقى بحمض الهيومك بمعدل 1.5 مل / لتر، يليه الرش الورقي بالماء، ثم معاملة المقارنة (بدون رش ورقى) في كلا موسمى الدراسة .أدى انخفاض مستويات السماد النيتروجيني المعدني من 100 إلى 85 و70 و55٪ من المعدل الموصى به إلى انخفاض تدريجي في جميع الصفات المدروسة، مع زيادة النسبة المئوية للسكروز والنقاء الظاهرية في كلا الموسمين. كما أن التسميد النيتروجينى بـ 100 أو 85٪ من المعدل الموصى به أنتج أعلى القيم لمحصول الجذور، العروش والسكر للفدان بدون وجود فروق معنوية بينهما في كلا الموسمين .لزيادة نمو بنجر السكر والمحصول ومكوناته وصفات الجودة مع توفير 15 وحدة نيتروجين للفدان والحد من التلوث البيئي، يوصى بالرش الورقي مرتين بخليط من مستخلص الخميرة بمعدل 150 مل / لتر + حمض الهيومك بمعدل 1.5 مل / لتر مع التسميد المعدنى الأرضى بـ 76.5 كجم نيتروجين للفدان تحت الظروف البيئية لمحافظة الدقهلية، مصر.