Productivity and Quality of Sugar Beet in Relation to Humic Acid and Boron Fertilization Under Nubaria Conditions

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ABSTRACT

Two field Experiments were conducted at km 48 Nubaria region, Alex. Cairo Desert Road, El- Behiera Government, Egypt, during 2016/2017 and 2017/ 2018 seasons, to study the effect of three humic acid levels and four boron fertilization rates on yield and quality of sugar beet (*Beta vulgaris* L.) cultivar monogerm (cv. Francisco). Treatments were arranged in a split- plot design in three replicates. The three humic acid levels (0= water, 3 and 6 kg/fed) at the form of (humat potasium 80% K_2O) randomly assigned to the main plot. While, the four boron rates (0, 400, 800, and 1200 g/fed) were distributed at random within the sub plot at the form of Nutribor (8% Boric acid). Seeds were hand sown on 3rd and 5th October 2016/2017 and 2017/2018 seasons, respectively, in each (sub – plot), at the rate of 1 seed ball per hill on one side of the ridge at 20 cm apart. Root yield (ton/fed), top yield(ton/fed), biological yield(ton/fed), sugar yield (ton/fed), TSS%, sucrose%, purity %, extraction %, potassium %, α-amino nitrogen %, sodium %, and white sugar %, were determined in both seasons. The obtained results revealed that; 1). increasing humic acid rates from zero up to 6 kg /fed increased significantly root, biological, sugar yields ton/fed, TSS%, potassium percentage and white sugar percentage during 2016/2017 and 2017/2018 seasons. Where, the highest mean values were obtained by adding the higher level of humic acid (6 kg /fed). On the contrary, the lowest values were given by growing sugar beet plant under control treatment (zero kg/fed humic acid). On the other hand, increasing humic acid rates from zero up to 6 kg /fed decreased significantly extraction %, α-amino nitrogen %, sodium %, however, the lowest ones recorded with adding 6 kg/fed humic acid. Nevertheless, under this study, the highest mean values of these traits were obtained with control (zero kg/ fed humic acid) in both seasons, 2). increasing boron fertilization rates from zero to 400 g/fed, 800 g/fed and 1200 g/fed increased significantly the mean values of root yield, sugar yield, the total soluble solids (%), sucrose (%), purity (%), extraction (%) and white sugar (%). In addition, the highest mean values were recorded with application of 1200 g / fed, while the lowest mean values were obtained by growing sugar beet plant under the control treatment (zero boron= water) during the two seasons. On the contrast, increasing boron fertilization from zero up to 1200 g/fed decreased significantly potassium%, α- amino nitrogen (%), and sodium (%) in sugar beet root, meanwhile the lowest mean values were recorded when applying the rate of 1200 g/fed of boron fertilization. Whereas, the highest mean values were given under control treatment (zero g/fed) in the two seasons, 3). and the interaction between humic acid and boron fertilization affected significantly top yield ton/fed, biological yield ton/fed, the total soluble solids %, sucrose %, purity %, α- amino nitrogen% and sodium % during both seasons and sugar yield ton/fed during the first season 2016/2017. This showed that humic acid and boron fertilization act dependently on top yield, biological yield and sugar yield of sugar beet plant under this study.

Keywords: Sugar beet, humic acid, boron, yield and quality.

INTRODUCTION

Sugar beet (*Beta vulgaris,* L.) considered the second important sugar crop after sugarcane. It is a vital crop to man as a source of high energy and as an important source of feed to livestock. The importance of this crop comes from its growing in the newly reclaimed land and giving a high sugar recovery, as well as its lower water requirement, compared to sugarcane. Moreover, sugar beet is specialized as a short duration crop, where its growth period is about half that of sugarcane. Also, sugar beet being often, the most important cash crop in the rotation, it leaves the soil in good conditions for the following summer cereal crop. So that, it became the first source for the production of sugar in Egypt, as repeated. The production of sugar from sugar beet reached 56.61% (1.27 Million tons) of sugar production in Egypt, while the sugar cane production was 43.39% (0.931 Million tons) according to Sugar Crops Council (2017).

Nowadays Egypt faces many problems that affect the productivity of crops in general and sugar crops in particular, including sugar beet, which evolves, significantly, at the moment. Therefore, that humic acid (HA) is a main component of humic substances, which are the major soil organic constituents (humus). It is produced by biodegradation of organic matter. Humic acid is not a single acid; rather, it is a complex mixture of virous acids containing carboxyl and phenolate groups. Humic acids contain form complexes and ions that are commonly found in the environment creating

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humic colloids. Fulvic acids are humic acids of lower molecular weight and higher oxygen content than other humic acids however, they are commonly used as a soil supplement in agriculture. Whereas, Gomaa *et al*. (2014) reported that application humic acid at 6 kg/fed increased significantly grain yield of maize. Also, Rassam *at el.* (2015) studied the effect of using the humic acid in calcareous soil at concentrations, no application (zero) humic acid, 2.5 l/ ha and 5 l/ha., the application of humic acid caused a significant increase of sucrose%, root yield and refined sugar yield and a reduction in molasses forming substances content, compared to the control. However, EL-Hassanin *at el.* (2016) reported that foliar application of humic acid statistically improved sucrose, extractable sugar, purity, sugar lost to molasses, extractability percentages and yield of sugar beet.

Boron is an essential micro -nutrient for plants. Foliar application of boron is involved in several physiological and biochemical processes during plant growth. In general, sugar beet in special, boron it plays a major role in sugar transport as well as in formation and maintenance of cell wall and cell membrane integrity and consequently, high root yield, and sugar content (Kabu and Akosman, 2013). Foliar application of boron improved root weight/plant, top, root and sugar yields/fed and root quality percentage sugar, T.S.S%, purity % and extractable white sugar. In other wise, application of boron reduced N, Na, K contents, α-amino-N and loss sugar percentage (Armin and Asharipour, 2012; El- Sherief *et al.*, 2016). An insufficient boron due to reduction in yield and sugar % in sugar beet production. This is because boron is involved in the process of transportation and disposal of sugar in the roots. The greatest need for boron is in the stage of intense leave growth, from closing the ranks even reaching the maximum leaf surface. Compared to the control variant, both boron fertilization (1 or 2 kg B/ha), variants achieved significant higher yield, sugar % and pure sugar yield (Kristek *et al*., 2018).

Therefore, the objectives of the present work were to study the effect of humic acid and boron fertilization on yield and quality of sugar beet under Nubaria Region, EL- Behiera Governorate.

MATERIALS AND METHODS

Two field Experiments were conducted at Km 48 Nubaria region, Alexandria Cairo Desert Road, El-Behiera Government, Egypt during the two successive seasons of 2016/2017 and 2017/2018, to study effect of humic acid and boron fertilization on yield and quality of sugar beet (Beta vulgaris L.) cultivar monogerm (cv. Francisco), which obtained from Sugar Crop Research, Institute Agricultural Research Center, Giza.

The preceding summer crop was maize (*Zea mays* L.) in both seasons. Before soil preparation, soil samples were taken at a depth of 0: 30 cm from different experimental sites, to determine physical and chemical properties of soil according to Piper (1950) as shown in Table (1).

Table 1. Some physical and chemical properties of the experimental soil in 2016/2017 and 2017/ 2018 seasons

Soil properties	Season	
	2016/ 2017	2017/ 2018
A- Mechanical analysis		
Sand %	66.32	65.41
Clay %	11.43	11.95
Silt %	22.25	22.64
B- Soil texture		
pH (1:1)	8.25	8.10
E.C. (ds/m)	1.78	1.81
1- Soluble cations (1:2) (Cmo1/kg soil)		
K^+	1.30	1.40
Ca^{++}	3.50	3.30
Mg^{++}	2.50	2.60
Na^{++}	4.45	4.65
2- Soluble anions (1:2) (Cmo1/kg soil)		
CO^-_3+ HCO^-_3	3.73	3.71
CL^-	7.08	7.30
SO^-_4	0.96	0.83
Calcium carbonate	15.02	18.03
Total nitrogen (mg/kg)	20.00	19.10
Available Phosphorus (mg/kg)	3.14	3.19
Organic matter %	0.83	0.93
Available B(mg/kg)	0.03	0.06

All treatments were arranged in a split- plot design in three replicates. The treatments of the experiment were as follows:

I- Humic acid levels (Main plots):

1- (H_1) without humic acid = spraying water as control.

2- (H_2) 3 Kg humic acid/fed.

3- (H_3) 6 Kg humic acid/ fed.

II -Boron fertilizer levels (Sub plots):

1- (B1) without boron= spraying water as control.
2- (B2) 400 g boron / fed.
3- (B3) 800 g boron / fed.
4- (B4)1200 g boron /fed.

The experimental field was prepared through ploughing, and calcium super phosphate (15.5% P_2O_5)

was applied during tillage operation at the rate of 100 Kg / fed. Potassium sulfate (48% K_2O) was applied at the rate of 50 Kg / fed (24 Kg K_2O/fed). Nitrogen fertilizer was adding in from of urea (46%N) the rate of 100 kg N /fed, in two equal doses on half after thinning (before the first irrigation) and the other half before the second irrigation. Monogerm seeds (Francisco) cultivars was hand sown on 3rd and 5th October in 2016/2017 and 2017/2018 seasons, respectively, at the rate of 1 seed ball per hill on one side of the ridge in hill 20 cm apart. The experimental basic unit area was 10.5 m^2 (1/400 fed.) and included 5 ridges each of which 60 cm width and 3.5 meters' length.

The three humic acid levels (0, 3 and 6 kg/ fed) at the form of (humat potasium 80% K_2O) randomly assigned to the main plot treatment at one dose after thinning (before the second irrigation) after fifty days of planting. The four boron rates (0, 400, 800 and 1200 g / fed) were distributed at random as the subplot at the form of Nutribor (8% Boric acid) sprayed twice after 120 and 150 days from planting. All other cultural practices were carried out as recommended by Sugar Crops Research Institute, Agricultural Research Center, Giza, Ministry of Agriculture and Land Reclamation.

At harvest time, 180 days from planting in both seasons. Plant of all ridges of each sub plot, were harvested, cleaned, topped and weighed and the following characters were determined in both seasons; Root yield (ton/fed), top yield (ton/fed), biological yield (ton/fed), sugar yield (ton/fed), TSS%, sucrose%, purity (%), extraction (%), potassium (%), α-amino nitrogen (%), sodium (%), and white sugar (%).

The statistical analysis was carried out according to Steel and Torrie (1981). Treatment means were compared by L.S.D at 0.05 level of probability. The analysis of variance (ANOVA) was computed using CoStat V 6.4 (2005) program.

RESULTS AND DISCUSSION

Result in Table (2) showed the effect of humic acid, boron fertilization and their interaction on some yield attributes of sugar beet during 2016/2017 and 2017/2018 seasons.

Increasing humic acid (HA) rates from zero up to 6 kg /fed increased significantly root yield (ton /fed), biological yield (ton/fed) and sugar yield (ton/fed) during 2016/2017 and 2017/2018 seasons. The highest mean values were obtained by adding the highest application rate of humic acid (6 kg /fed). On the contrary the lowest mean values were obtained by growing sugar beet plant under control treatment (zero kg/fed) humic acid. Meanwhile there was a significant increase in top yield (ton / fed) of sugar beet plants by increasing humic acid rates from zero up to 3 kg / fed, further increase up to 6 kg /fed had no significant effect on the mean values of top yield during both seasons as shown in Table (2). These results are in harmony with those obtained by Shoae *et al* (2013), Motaghi and Nejad (2014), Shaban *et al*. (2014), Rassam *at el.* (2015) and EL-Hassanin *at el.* (2016) who revealed that increasing humic acid make up an increase in yield and its components of sugar beet.

Results in the same table showed that increasing boron fertilization rates from zero to 400 g/fed, 800 g/fed and 1200 g/fed increased significantly the mean values of root yield ton /fed and sugar yield ton/fed during 2016/2017 and 2017/2018 seasons. In addition the highest mean values of root yield (25.48 and 23.34 ton / fed) as well as the highest mean values of sugar yield (5.16 ton / fed and 4.77 ton / fed), were recorded when applying the 1200 g / fed concentration of boron fertilization, whereas, the lowest mean values of root yield (21.21 and 19.92 ton /fed), as well the lowest mean values of sugar yield (3.98 ton /fed and 3.75 ton /fed) were obtained by growing sugar beet plant under the control treatment (zero boron fertilization= water) during 2016 /2017 and 2017/2018 seasons, respectively. The results are in harmony with these obtained by Saif (1991), Armin and Asharipour (2012), El- Sherief *et al.* (2016) and Kristek *et al*. (2018) who reported that foliar application of boron increased yield and its components of sugar beet.

Result in Table (2) determined that increasing boron fertilization from zero up to 1200 g / fed had no significant effect on top yield of sugar beet plant during the first season (2016/2017). On the contrary during the second season, application of boron fertilization rates affected significantly the top yield ton / fed, where the highest mean value (9.19 ton / fed) produced at control treatment (zero g/fed boron) and the lowest value (6.89 ton / fed) realized under boron concentration of 1200 g / fed.

Results in the same table also stated that increasing boron fertilization from zero up to 1200 g /fed insignificantly affected the biological yield during the second season (2017/2018) Nevertheless, in the first season it significantly affected the biological yield,where the highest mean value 35.23 ton / fed at (boron 1200 g / fed) and the lowest mean value 31.60 ton / fed resulted under control treatment. The results are in harmony with these obtained by EL- Geddawy *et al.* (2007), Osman (2008), Mekdad (2015) and Abdel-Motagally (2015) who reported that foliar application of boron increased yield and its components of sugar beet.

The interaction between humic acid and boron fertilization affected significantly top yield, biological

Table 2. Some yield attributes of sugar beet as affected by humic acid, boron fertilization rates and their interaction during 2016/2017 and 2017/ 2018 seasons

Treatments	Root yield (ton/fed)		Top yield (ton/fed)		Biological yield (ton/fed)		Sugar yield (ton/fed)	
	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18
H) Humic acid (kg/fed)								
B_1 (0) water spraying	20.62c	16.15c	8.83b	5.99b	29.46c	22.14	3.92c	3.04c
H_2 (3)	23.21b	22.02b	10.64a	9.11a	33.85b	31.13	4.53b	4.31b
H_3 (6)	26.86a	26.45a	11.72a	9.69a	38.13a	36.15	5.31a	5.38a
LSD at 0.05	2.30	2.56	0.77	0.70	2.97	2.28	0.50	0.48
B) Boron (g/fed)								
B_1 (0) water spraying	21.21c	19.92c	10.38a	9.19a	31.60b	29.11	3.98c	3.75d
B_2 (400)	23.16b	20.80c	10.69a	8.82ab	33.85a	29.62	4.53b	4.04c
B_3 (800)	24.39ab	22.11b	10.16a	8.16b	34.56a	30.27	4.71b	4.41b
B_4 (1200)	25.48a	23.34a	9.75a	6.89c	35.23a	30.23	5.16a	4.77a
LSD at 0.05	1.43	0.95	NS	0.67	2.09	NS	0.27	0.20
Interaction								
H× B	NS	NS	2.99	2.02	6.28	3.92	0.82	NS

Means followed by the same letter in the same column are statistically equaled according to $L.S.D_{0.05}$ values.
NS: not significant difference at 0.05 level of probability.

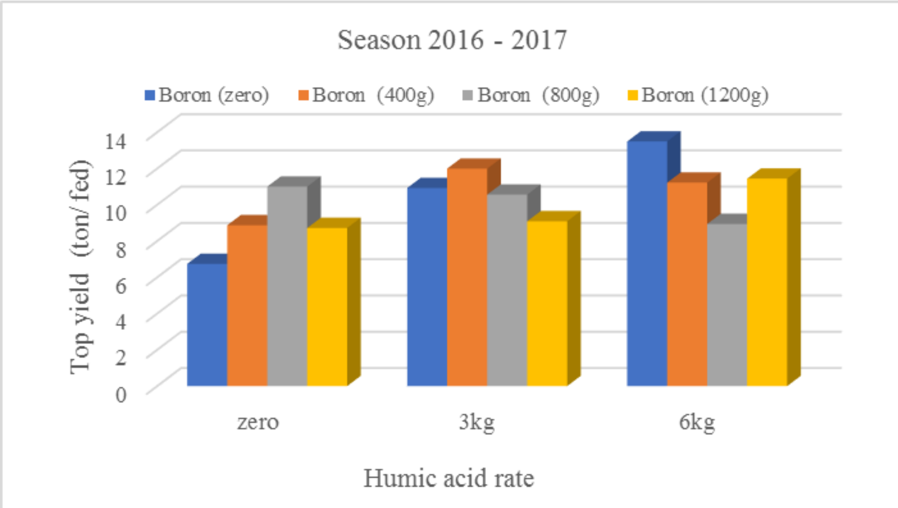

Fig 1.a. Top yield of sugar beet as affected by interaction between humic acid and boron fertilization during 2016/2017 season

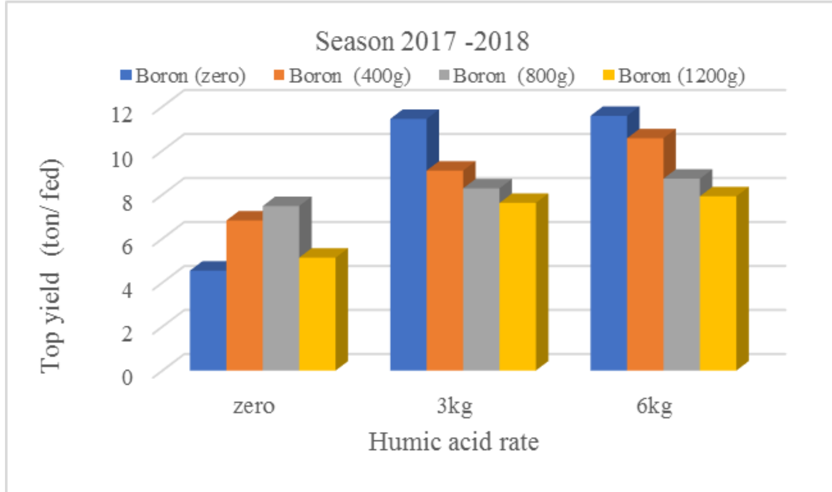

Fig 1.b. Top yield of sugar beet as affected by interaction between humic acid and boron fertilization during 2017/ 2018 season

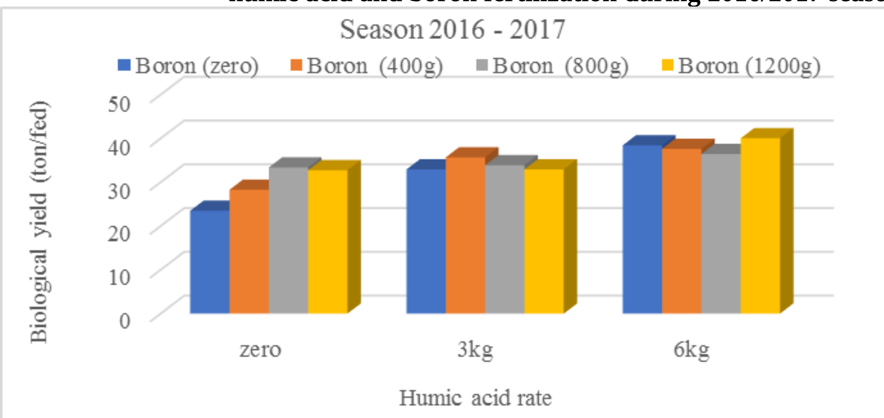

Fig 1.a. Biological yield of sugar beet as affected by interaction between humic acid and boron fertilization during 2016/2017 season

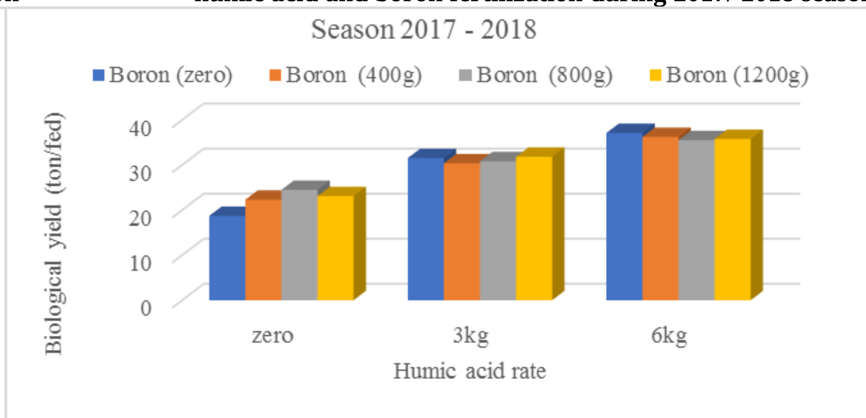

Fig 2.a. Biological yield of sugar beet as affected by interaction between humic acid and boron fertilization during 2017/2018 season

yield during 2016/2017 and 2017/2018 seasons and sugar yield during the first season 2016/2017 as shown in Table (2). This showed that humic acid and boron fertilization act dependently on top yield, biological yield and sugar yield of sugar beet plant under this study. This showed that under this study humic acid and boron fertilization act independently on root yield. In this respect figures 1 a, b and 2 a and b revealed that the highest top yield and biological yield/fed were recorded with foliar application of humic acid at the rate of 6 kg/fed and boron at the rate of 1200g/fed in both seasons. While, the lowest ones recoded with no application of humic acid and boron (water spraying) in both seasons.

In addition, data in Table (2) showed that the interaction between humic acid and boron fertilization had no significant effect on root yield ton/fed during the two seasons 2016/2017 and 2017/2018.

Results in Table (3) showed the effect of humic acid, boron fertilization and their interaction on sugar beet TSS%, sucrose%, purity% and extraction % of sugar during 2016/2017 and 2017/ 2018 seasons.

Results in that table recorded that increasing humic acid from zero up to 6 kg/fed increased significantly the total soluble solids percentage during 2016/2017 and 2017/2018 seasons and sucrose percentage during the second season 2017/2018, Where the highest mean values of TSS (23.61 and23.68%) when adding 6 kg / fed. However, the lowest mean values of TSS (21.80 and 22.11%) were obtained under the control treatment (zero humic acid) during the first and second seasons, respectively. While there, was no significant effect between the applications of. 3 kg/fed and 6 kg/fed on sucrose (%) during 2016/2017 season, as well as between the applications of zero kg / fed and 3kg / fed on TSS% during 2017/2018 season. These results are in agreement with those obtained by Motaghi and Nejad (2014) and Shaban *et al.* (2014) who reported that quality traits of sugar beet were significantly increased by increasing the rate of humic acid.

The results listed in Table (3) showed that increasing humic acid rates from zero up to 3 kg /fed increased significantly purity percentage during 2016/2017 and 2017/2018 seasons. Where the highest mean values obtained under the application of 3 kg / fed humic acid. While the lowest mean values were under control, treatment zero kg/fed humic acid during the two seasons. This result may be due to the effect of humic acid on soduim, potassium and α-amino nitrogen percentages in sugar beet root. The result is in confirmed with those reported by Motaghi and Nejad (2014) and Shaban *et al.* (2014).

Also, data presented in table (3) demonstrated that increasing humic acid rates decreased significantly extraction percentage during 2016/2017 and 2017/2018 seasons. Where the lowest mean values produced when adding 6kg/fed humic acid. Nevertheless, under this study, the highest mean values recorded under control treatment zero kg/ fed humic acid during 2016/2017 and 2017/2018 seasons. This result is to be expected due to the increase of potassium nitrate in the juice when the addition of the humic acid, which would block the crystallization of sugar and increase losses in molasses. The results are in the same line with those obtained by Motaghi and Nejad (2014) and Shaban *et al*. (2014).

Results reported in in same table pointed out determined that increasing boron fertilization from zero up to 1200g/fed increased, significantly, the total soluble solids %, sucrose% and extraction % during 2016/2017 and 2017/2018 seasons. Where the highest mean values of total soluble solids%, sucrose % and extraction % were recorded when applying the concentration of 1200 g / fed, while the lowest mean values were obtained under the control treatment (zero g/fed boron) during 2016 /2017 and 2017/2018 seasons. The results are in harmony with that obtained by Nemeat-alla and EL-Geddawy (2002), Aly (2005), Azzazy (2006), EL-Geddawy *et al* (2007), and EL-Kamash (2007) who reported that foliar application of boron increased quality of sugar beet.

In addition, the study confirmed that boron fertilization increased the sugar yield as shown previously in Table (2) and decreased the proportion of some salts in the juice and increased the percentage of sugar to increase the proportion of (white sugar) percentage and thus the lack of sugar loss, which increases the percentage of extraction. These results are also consistent, with that in a study of Ferweez *et al*. (2011) who stated that using the spray of boric acid gave a significant effect on quality characteristics (pol%, Na, K, a- N contents and sugar recovery %).

The interaction between humic acid and boron fertilization affected significantly the total soluble solids %, sucrose% and purity % during 2016/2017 and 2017/2018 seasons and extraction (%) during the second season only as shown in Table (3). This showed that humic acid and boron fertilization act dependently on total soluble solids (%), sucrose (%), purity (%) and extraction% of sugar beet plant under this study. In this concern, figures 3 a, b and 4 a and b revealed that the highest mean values of TSS and sucrose (%) were given with foliar application of humic acid at the rate of 6 kg/fed and boron at the rate of 1200g/fed during both seasons. While, the lowest ones recoded with no

Table 3. TSS (%), sucrose (%), purity (%) and extraction (%) of sugar of sugar beet as affected by humic acid, boron fertilization and their interaction during 2016/2017 and 2017/ 2018 seasons

Treatments	Total soluble solids (T.S.S %)		Sucrose %		Purity %		Extraction %	
	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18
H) Humic acid (kg/fed)								
H_1 (0)water spraying	21.80c	22.11b	19.05b	18.78c	84.7c	84.9b	87.24a	86.76a
H_2 (3)	22.51b	22.51b	19.50a	19.52b	86.6a	86.6a	86.69b	86.62ab
H_3 (6)	23.61a	23.68a	19.77a	20.35a	86.1b	86.2a	86.99ab	86.45b
LSD at 0.05	0.36	0.43	0.27	0.91	0.31	0.52	0.37	0.23
B) Boron (g/fed)								
B_1 (0) water spraying	21.89c	21.93d	18.60c	18.64d	84.9c	85.0c	84.90d	84.71d
B_2 (400)	22.59b	22.35c	19.49b	19.32c	86.3a	86.4a	86.88c	86.31c
B_3 (800)	22.55b	23.02b	19.40b	19.83b	85.9b	86.1b	87.44b	86.94b
B_4 (1200)	23.53a	23.77a	20.27a	20.41a	86.1ab	86.3ab	88.68a	88.47a
LSD at 0.05	0.24	0.41	0.27	0.91	0.26	0.28	0.52	0.45
<u>Interaction</u>								
H× B	0.72	1.23	0.23	0.32	0.80	0.85	NS	1.34

Means followed by the same letter in the same column are statistically equaled according to L.S. D $_{0.05}$ values
NS: not significant difference at 0.05 level of probability.

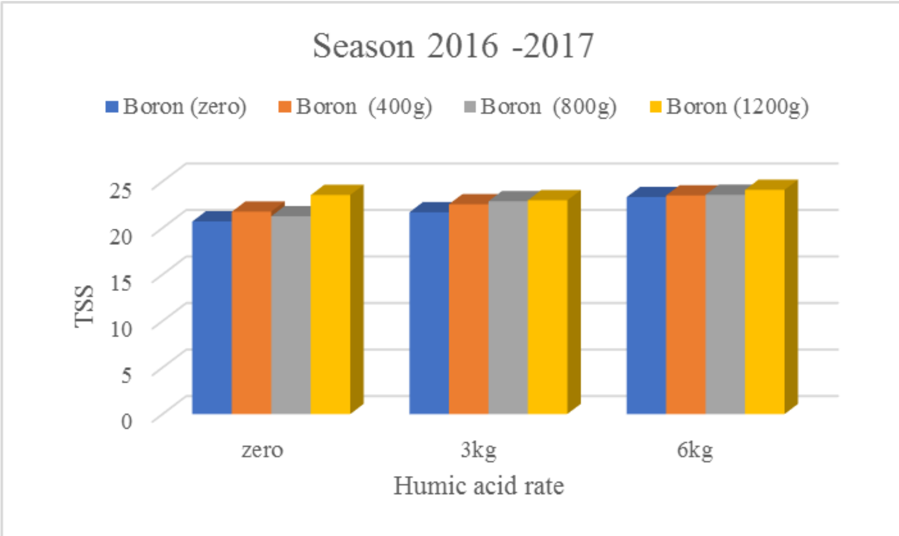

Fig 3.a. Total soluble solid (TSS) of sugar beet as affected by interaction between humic acid and boron fertilization during 2016/2017 season

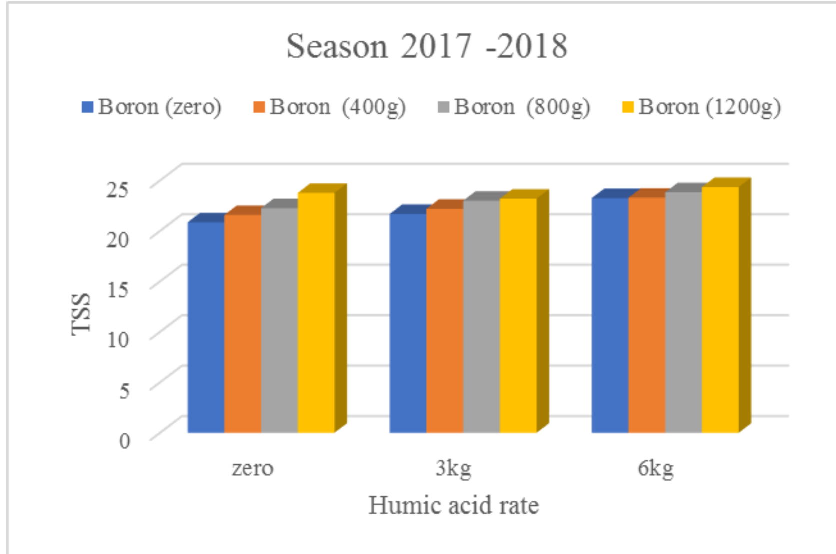

Fig 3.b. Total soluble solid (TSS) of sugar beet as affected by interaction between humic acid and boron fertilization during 2017/ 2018 season

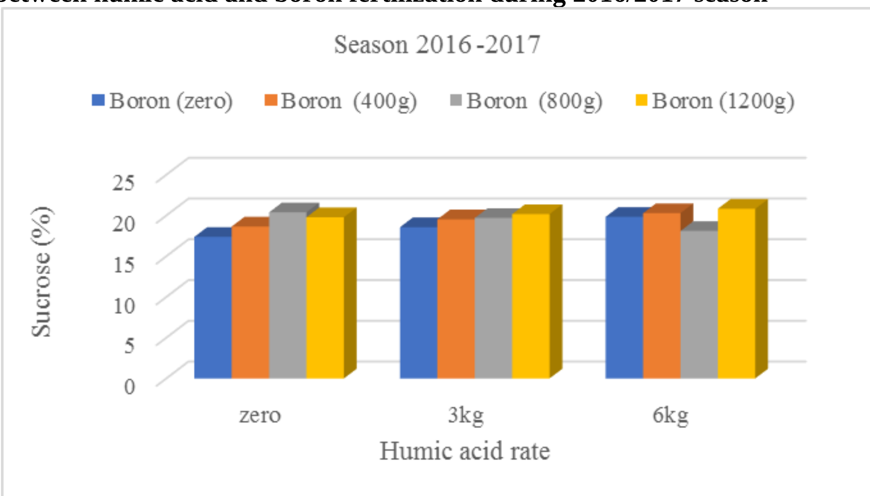

Fig 4.a. Sucrose (%) of sugar beet as affected by interaction between humic acid and boron fertilization during 2016/2017 season

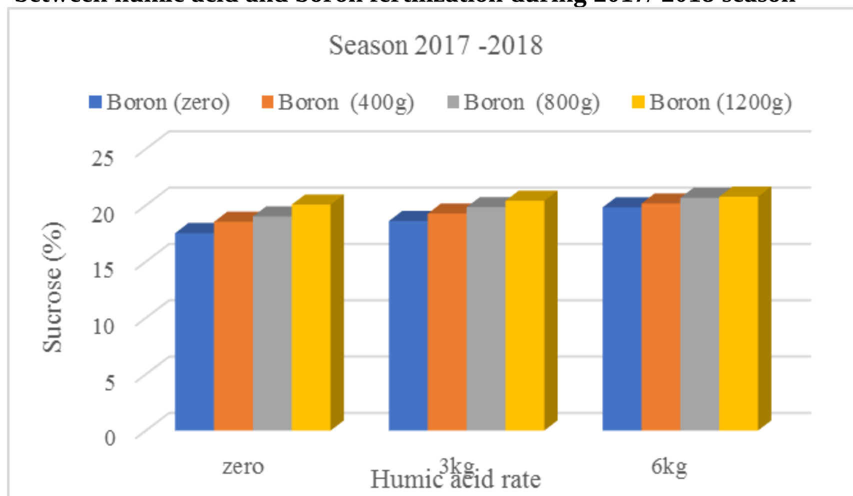

Fig 4.a. Sucrose (%) of sugar beet as affected by interaction between humic acid and boron fertilization during 2017/2018 season

application of humic acid and boron (spraying with water) in both seasons

Results in Table (4), demonstrated the effect of humic acid, boron fertilization and their interaction on potassium%, α- amino nitrogen%, sodium% and white sugar % during 2016/2017 and 2017/ 2018 seasons.

Results reported in that table demonstrated that increasing humic acid rates from zero to 3kg/fed and 6kg/fed decreased significantly α-amino nitrogen percentage and sodium percentage in sugar beet root, during 2016/2017 and 2017/2018 seasons, where the lowest mean values obtained when adding 6 kg / fed. Whereas the highest mean values resulted from growing sugar beet plant under the control treatment (zero humic acid / fed) This result is to be expected due to the increase of potassium nitrate in the juice when the addition of the humic acid, which would block the crystallization of sugar and increase losses in molasses. Similar results were obtained by Motaghi and Nejad (2014) and Shaban *et al*. (2014).

Increasing humic acid rates from zero up to 6 kg /fed increased significantly potassium percentage and white sugar percentage during 2016/2017 and 2017/2018 seasons as shown in Table (4). Where the highest mean values when adding 6 kg / fed. Whereas the lowest mean values obtained by growing sugar beet plant under control treatment (zero kg/fed humic acid) during the two seasons. While there, was no significant effect between the concentrations of 3kg/ fed and 6 kg /fed on the mean values of potassium percentage in the first season, as shown in table (4). These results are in harmony with tease obtained by Shoae *et al*. (2013), EL-Bassiouny *et al.* (2014), and Shaban *et al.* (2014). The study confirmed that humic acid application increased roots yield, sugar yield as shown previously in Table (2), and increased TSS%, sucrose %and purity % as shown in Table (3), as well as decreased the proportion of some salts in the juice such as α- amino nitrogen% and Na%. Table (4). Moreover, results presented in Table (4) showed that increasing boron fertilization from zero up to 1200g/fed decreased significantly potassium%, α- amino nitrogen%, and sodium% in sugar beet root during 2016/2017 and 2017/2018 seasons. Where the lowest mean values percentage were recorded when applying the rate of 1200 g / fed of boron during the two seasons. However, the highest mean values were recorded under control treatment (zero g/fed) during both seasons. These results are in harmony with these obtained by EL-Kamash (2007), Osman (2008) and Ferweez *et al*. (2011).

In addition, data reported in Table (4) demonstrated that increasing boron fertilization increased significantly white sugar percentage during 2016/2017 and 2017/2018 seasons. Where the highest mean values of white sugar percentage were recorded when applying 1200 g / fed boron fertilization. While the lowest mean values were under the control treatment zero boron g/fed during the two seasons. This result is in harmony with that obtained by EL-Geddawy *et al*. (2007), EL-Kamash (2007) and Osman (2008)

Table 4. Some quality attributes of sugar beet as affected by humic acid, boron fertilization and their interaction during 2016/17 and 2017/ 2018 seasons

Treatments	Potassium %		α-amino nitrogen %		Sodium %		White sugar % (ZB%).	
	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18
H) Humic acid (kg/fed)								
H_1 (0) water spraying	4.42b	4.75c	2.65a	2.73a	0.80a	0.81a	16.14c	16.31c
H_2 (3)	5.26a	5.46b	2.6a	2.44b	0.67b	0.69b	17.00b	16.94b
H_3 (6)	5.45a	5.68a	2.50b	2.52b	0.67b	0.67c	17.70a	17.70a
LSD at 0.05	0.23	0.13	0.13	0.086	0.0099	0.019	0.21	0.33
B) Boron (g/fed)								
B_1 (0) water spraying	5.69a	5.83a	2.94a	2.88a	0.79a	0.79a	15.90c	15.80d
B_2 (400)	5.12b	5.36b	2.72b	2.64b	0.71b	0.73b	16.94b	16.67c
B_3 (800)	4.85c	5.27b	2.51c	2.50c	0.68c	0.70c	16.96b	17.24b
B_4 (1200)	4.52d	4.73c	2.24d	2.24d	0.68c	0.67d	17.97a	18.23a
LSD at 0.05	0.26	0.23	0.073	0.075	0.015	0.0084	0.24	o.36
Interaction								
H× B	NS	0.68	0.22	0.23	0.041	0.025	0.73	NS

Means followed by the same letter in the same column are statistically equaled according to L.S.D0.05 values.
NS: not significant difference at 0.05 level of probability

Moreover, data in that table demonstrated that the interaction between humic acid and boron fertilization affected significantly α- amino nitrogen% and sodium% during 2016/2017 and 2017/2018 seasons and potassium% during the second season, only as well as white sugar% during the first season. This showed that humic acid and boron fertilization act dependently on α-amino nitrogen%, sodium%, potassium% and white sugar% under this study

CONCLUSION

According to this study, it could be concluded that Francisco sugar beet cultivar treated with 6 kg / fed humic acid and 1200 g of boron in the form of (Nutribor) to increase productivity parameters of sugar beet and decreased the proportion of some impurities in the juice therefore lack of sugar loss in molasses. As well as increase root and sugar yield ton/fed, sugar extraction percent and sugar quality under the conditions of Nubaria region.

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الملخص العربي

أنتاجية وجودة بنجر السكر وعلاقتهما بحامض الهيوميك والتسميد بالبورون تحت ظروف النوبارية

ابراهيم فتح الله رحاب ، سامية سعد السيد المغربى ، عصام اسماعيل اسماعيل قنديل و ناهد يوسف ابراهيم يوسف

أقيمت تجربتان حقليتان فى الكيلو ٤٨ طريق الاسكندرية القاهرة الصحراوى – منطقة النوبارية – البحيرة – مصر خلال موسمي ٢٠١٦ / ٢٠١٧ و ٢٠١٧ /٢٠١٨ لدراسة تاثير حامض الهيوميك والتسميد بالبورون على أنتاجية وجودة محصول بنجر السكر حيث استخدم حمض الهيومك فى ثلاثة مستويات (الرش بالماء (كنترول) ، ٣، ٦كجم /فدان) والبورن فى اربعة مستويات (الرش بالماء (كنترول) ، ٤٠٠ ، ٨٠٠ ، ١٢٠٠ جرام/فدان) وكان التصميم المستخدم القطع المنشقة مرة واحدة فى ثلاث مكررات وتم توزيع مستويات حامض الهيوميك فى القطع الرائسية ووممعدلات الرش الورقي للبورون فى القطع الفرعية (المنشقة).

وكان ميعاد الزراعة في ٣ ، ٥ اكتوبر خلال موسمي الدراسة على الترتيب ، وزرعت النباتات على مسافة ٢٠ سم بين الجور وبين الخطوط ٦٠ سم ، وكانت مساحة القطعة التجريبية ١٠,٥ م٢.وأجريت العمليات الزراعية الأخري على حسب توصيات وزارة الزراعة للمنطقة.

ولخصت أهم النتائج المتحصل عليها في التالى :

أثرت الزيادة في معدلات حامض الهيوميك معنوياً على صفات المحصول ومكوناته والجودة في بنجر السكر حيث ادى استخدام حمض الهيوميك ٦ كجم للفدان الى زيادة معنوية فى كل من محصول الجذور ومحصول الاوراق والمحصول البيولوجى ومحصول السكر ومحصول السكر الابيض (طن /للفدان) والنسبة المئوية للمواد الصلبة الكلية ونسبة السكروز في حين أن الزيادة في معدلات حامض الهيوميك أدت الى انخفاض نسبة شوائب الصوديوم والفا امينو نيتروجين .

كما أدت الزيادة في مستويات الرش الورقي لعنصر البورون لزيادة معنوية في صفات المحصول ومكوناته وصفات الجودة بنجر السكرحيث أنه بزيادة تسميد البورون الى ١٢٠٠ جرام /فدان اعطى زبادة فى عائد السكر ومحصول الجذور والسكر الابيض (طن /للفدان) ونسبة النقاوة وفي حين حدث انخفاضاً ملحوظاً فى نسبة الصوديوم والفا أمينو نيتروجين والبوتاسيوم.

كما أثر التفاعل بين حمض الهيوميك والتسميد بالبورون معنوياً على صفات المدروسة حيث زاد المحصول البيولوجى ومحصول السكر (طن /للفدان) زيادة معنوية وفي حين حدث انخفاض فى نسبة الشوائب فى العصير (الصويوم – الفا أمينو نيتروجين – البوتاسيوم) وايضا زاد النسبة المئوية للسكرونسبة المواد الصلبة الكلية والجودة فى الموسمين ونسبة الاستخلاص فى الموسم الثانى لبنجر السكر تحت ظروف هذه الدراسة.

وتوصي الدراسة بزراعة بنجر السكر والتسميد بحامض الهيوميك بمعدل ٦ كجم للفدان والرش الورقي بعنصر البورون بمعدل ١٢٠٠ جم للفدان حيث أن هذه التوليفة ادت لزيادة في صفات المحصول وجودته تحت ظروف منطقة النوبارية.