Yield and Quality of Sugar Beet under Boron and Mineral and Bio- Nitrogen Fertilization

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ABSTRACT

Two field experiments were carried out at Al- Sabhia, the Agricultural Research Station, Alexandria, Egypt during 2015/2016 and 2016/2017 seasons, to study the effect of mineral nitrogen with the bio-fertilizer (Rhizobacterin) and foliar application of boron levels on sugar beet. The experiment was conducted a split-plot design in three replications, where the main plots were assigned for mineral- bio nitrogen fertilizer levels, while the subplots were occupied by two levels of boron. The results indicated that increasing nitrogen fertilizer levels from 60 up to 100 kg N/fed combined with bio- fertilizer (Rhizobacterin) significantly increased fresh top yield, sugar yield, T.S.S.%, sucrose percentage and purity of sugar beet through the two seasons. Root yield significantly increased by increasing boron fertilizer levels from 0.5 up to 1 kg B /fed Application of mineral with bio- nitrogen fertilizers and foliar application of boron were associated with the significant effect on crop growth rate, leaf area index, root yield, sugar yield, TSS% and sucrose% under study conditions.

INTRODUCTION

Sugar beet crop (*Beta vulgaris* L.) is the main source for sugar production in Egypt. Many factors such as mineral and bio- nitrogen fertilizer effect of sugar production from sugar beet in addition to spraying boron element, which have an important role in plant physiology and cell structure. Improving sugar beet yield and quality are the main goals of the governmental policy to increase sugar production in order to gradually cover the gap between sugar consumption and production (FAO 2016). Using bio fertilizer with mixed Microbeen + Rhizobacterin led to an increase in values of mentioned. Mineral nitrogen fertilizer at high levels 80 or 120 kg N/fed have a significant increase in most characters under study. Application of the mixture of Microbeen + Rhizobacterin + Phosphorien as biofertilizers and adding 120 kg N/fed as a mineral fertilization maximized the productivity of sugar beet under (Ismail *et al.,* 2016).

Nitrogen is considered the most important element of those supplied to sugar beet in fertilizer, because few soils contain sufficient in an available form, as nitrate or ammonium, to provide maximum growth. Where the element is in short supply, the yield is drastically reduced, and may even be halted in some soils. In Egypt, nitrogen fertilizer of sugar beet differed from site to another, the optimum rate of applied nitrogen for maximum root yield varied from 45 kg N/fed to 120 kg N/fed (Mahmoud (2007). The

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most remarkable effect of nitrogen fertilizer on sugar beet will be noticeably by improving the leaf canopy. Salim *et al*. (2012), Gomaa *et al*. (2013) and El-Sarag and Moselhy (2013) found that increasing nitrogen rate increased root, top and sugar yields. However, Abo- Shady *et al*. (2010), Gehan *et al.* (2013) and Abd El-Hak and Neana (2014) revealed that application of nitrogen fertilizer at the rate of 100 kg/fed recorded the highest values in root length and diameter, root, top and sugar yields. Application of nitrogen at the rate of 100 N/fed significantly increased both root dimension, top, root and sugar yields. On the other hand, increasing N rate up to 100 kg N/fed tended to, purity%, TSS% as well as sucrose (Alla 2016).

Bio-fertilizers led to retard nitrification for sufficiently long time and increase the soil fertility. Whereas, Awad *et al*. (2013) indicated that bacterial inoculation of sugar beet seeds significantly increased root and sugar yields/fed Bacillus inoculation along with 40 kg N/fed gave root and sugar yields as those obtained by addition of 80 kg N/fed Furthermore, Bacillus inoculation along with the addition of the full N dose 80 kg/fed gave a significant increase which amounted to 18 and 39% in root and sugar yields, respectively compared to application of 80 kg/fed alone. Also, the positive effect on this features. Higher increase in yield under this fertilization was obtained during cultivation on soil with low content of boron. Foliar application of boron modified technological quality of roots. Dose of 2 kg/ha affected, irrespectively of soil conditions and content of this element, increase in content and efficiency of sucrose (Prosba, *et al*., 2016).

Boron as micro-nutrient is very important to have healthy plants and consequently, by high root yield, and sugar content. Boron deficiency was the cause of heart rot and dry rot of sugar beet (Mahmoud and Aboushal 2007). It is one of the seven essential micronutrients required for the normal growth and yield of most plants (Ali *et al*., 2015). It plays a major role in sugar transport as well as the formation and maintenance of cell wall and cell membrane integrity (Kabu and Akosman 2013). Boron content in soil depends on the type of soil, the amount of organic matter, which contains boron, and the volume of rainfall, which can remove boron from the soil. Indeed, coarse-textured acid soils of humid regions and those with low organic matter content are more prone to B deficiency (Niaz *et al.,* 2016). However, Armin and Asharipour (2012) and El − Sherief *et al.* (2016) revealed that foliar application of boron increased root weight/plant, top, root and sugar yields and root quality percentage sugar, T.S.S%, purity % and extractable white sugar. An insufficient supply of boron results in reduced yield and sugar % in sugar beet production. This is because boron is involved in the process of transport and disposal of sugar in the root. The greatest need for boron is in the phase of intense leave growth, from closing the ranks until reaching the maximum leaf surface. Compared to the control variant, both boron fertilization (1 or 2 kg B/ha) achieved significant higher yield, sugar % and pure sugar yield (Kristek *et al*., 2018).

The objective of this investigation is to estimate the effect of mineral nitrogen and bio- fertilization with foliar application of boron on sugar beet poly germ variety (Beta 283).

MATERIALS AND METHODS

Two field experiments were carried out at Al Sabhia, the Agricultural Research Station in, Alexandria, Egypt during 2015/2016 and 2016/2017 seasons, to investigate the effect of nitrogen fertilization levels, bio- fertilizer inoculation and foliar application of boron on sugar beet (*Beta vulgaris L.* cv Beta 283).

The preceding summer crop was maize (*Zea mays* L.) in both seasons. Before planting, soil samples were randomly taken from the experimental site at a depth of 0 to 30 cm from soil surface and prepared for chemical analysis according to Ankerman and Large (1974) which presented in (Table1).

The experimental design was split plot design block in three replications, experiment unit was 10.5 m^2, each experimental basic unit included 5 ridges, 60 cm apart and 3.5 m long, (1/400 fed, fed= 4200 m^2 = 0.405 hectare). The main plots were occupied by three levels of nitrogen fertilizer + Rhizobacterin as biofertilizer (60, 80, 100 kg N/fed, 60 + Rhizobacterin, 80 + Rhizobacterin, and 100 kg N/fed + Rhizobacterin, while the subplots units were allocated by boron (0.5 and 1.0 kg/fed).

Nitrogen fertilizer treatments in the form of urea (46% N) was applied in two equal doses, the first dose was after thinning and the second one month later. Seeds of sugar beet were inoculated with biofertilizer (Rhizobacterin) as a commercial biofertilizer contain active bio-nitrogen fixation bacteria (*Azospirillum* spp.).

Table 1. Some physical and chemical properties of the experimental soil sites during the two cropping seasons.

Seasons		
Soil properties	2015/2016	2016/2017
A- Mechanical		
Clay %	43.64	44.50
Silts %	44.70	43.85
Sands	12.06	11.65
Texture soil	clay loam	clay loam
B- Chemical analysis clay loam soil		
PH	8.10	8.00
Ec (ds/m)	2.90	3.05
Anions (meq/l)		
HCo$_3$	1.80	1.90
Cl$^-$	24.60	25.1
So$_4$	1.70	1.80
Cations (meq/l)		
Cu^{++} (meg/l)	5.95	5.85
Mg^{++} (meg/l)	6.15	6.10
Na^{++} (meg/l)	13.60	12.1
K$^+$ (meg/l)	1.50	1.20
Available nitrogen (ppm)	90.00	83.00
Boron (ppm)		
Organic matter (%)	1.50	1.45

Foliar application of boron in the form of sodium borate (Borax) $Na_2B_4O_7 .10 H_2O$ (11% B) at the rate of (0.5 and 1 kg B fed) which were applied in two equal doses after 120 and 150 days after sowing.

The soil of field experiments was prepared through two ploughing and leveling, Calcium super phosphate (12.5 % 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 24 kg K_2O/fed with the first irrigation. Plants were kept free from weeds, which were manually controlled by hand hoeing at three times. The common agricultural practices for growing sugar beet according to the recommendations of Ministry of Agriculture were followed, except for the factors under study.

Sugar beet cultivar poly germ (Beta 283) was obtained from Sugar Crop Research Institute Agricultural Research Center, Giza. Seeds were hand sown as the usual dry

sowing on one side of the ridge in hills 20 cm apart at the rate of 4-5 seed ball per hill on sown at 10th and 11th October and harvested after 6 months seasons, respectively.

Growth characters i.e., Crop growth rate (C.G. R) = W_2- W_1/ SA (T_2- T_1) g/cm^2/day according to (Charles, 1982), Net assimilation rate (N.A.R.) = (W2 − W1) (log A_2 − log A_1) / (A2- A1) (T_2 − T_1) g/cm^2/day according to Waston (1958), Leaf area index (LAI) = Unit leaf area /unit of ground area according to (Watson 1958) and total chlorophyll (SPAD unit) in leaves were determined. Estimation of chlorophyll content of plants recorded according to the described method by Yadava (1986).

Root yield of each treatment was analyzed for sucrose according to the method described by Le Docte (1927), yields components, fresh top, roots and sugar yields (ton/fed) and juice quality (TSS %, sucrose% and purity %) were computed.

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split-split plot design as published by Gomez and Gomez (1984). Least Significant Difference (LSD) method was used to test the differences between treatment means at 5% level of probability. Correlations of the traits obtained from the experiment were computed using Costat program. All the statistical analyses were performed using CoStat V 6.4 (2005) for Windows.

RESULTS AND DISCUSSION

A. Growth Characters:

Data presented in Table (2) showed that the application of 100 kg N/fed as mineral fertilizer and Rhizobacterin as biofertilizer were associated with a significant increase on crop growth rate (1.93 and 2.94 g/m^2/day) and leaf area index (1.94 and 4.29) and chlorophyll (75.53 and 79.31 SPAD unit) in the two seasons, respectively. The superiority in plant characters by treating seeds with biofertilizer inoculation may be attributed to Rhizobacterin, which reduce the soil p^H, especially in the rhizosphere, thereby increasing the availability of most essential macro and micro nutrients and reflecting the important role of nitrogen in building up the photosynthetic and growth of beet plants. On the other hand, application of mineral nitrogen fertilizer and bio-fertilizer led to insignificant increase in NAR while the highest mean values were resulted from using mineral nitrogen fertilizer at 100 kg N/fed rate in both seasons. These results agree with those of Abou Zeid and Osman (2005), Soudi *et al.* (2008), Aly *et al.* (2009), EL-Fadaly *et al.* (2013) and Alla (2016).

Data presented in Table (2) cleared that the application of the high levels of boron with 1 kg B/fed was associated with significant increase on crop growth rate (1.69 and 2.44 g/m^2/day), net assimilation rate (2.93 and 4.06 g/g/day), leaf area index (1.69 and 3.26) and chlorophyll (61.01 and 61.84 SPAD unit) in the first and the second seasons, respectively. These results due to the pronounced stimulating influence of high levels of boron fertilizer in increasing growth traits of sugar beet which may be attributed to their role in stimulating the growth activity which contributes to the increase in number of cells in addition to cell enlargement and increasing vegetative growth of plants. These results agree with those of Soudi *et al.* (2008), Aly *et al.* (2009) and EL-Fadaly *et al.* (2013).

It is worthy to note that the interaction between all treatments of nitrogen fertilizer rates, bio-fertilizers in combined with mineral fertilizers and foliar spraying treatments of boron were insignificant in its effects on all physiological studied characters in both growing seasons (Table 2)

Table (2): CGR, NAR, LAI and Chlorophyll content of sugar beet as affected by mineral-bio- fertilizer and foliar application of boron levels in both seasons.

Mean followed by different letters within each column are significantly different at 0.05 level of probability
ns: not significant at 0.01 level of probability.

Treatments	CGR (g/m²/day)		NAR (g/g/day)		LAI		Total chlorophyll	
	Seasons							
	2015/2016	2016/2017	2015/2016	2016/2017	2015/2016	2016/2017	2015/2016	2016/2017
	A- Mineral with bio nitrogen							
60 kg/fed	1.21	2.07	2.48	3.27	1.13	2.27	47.80	47.02
80 kg/fed	1.53	2.40	2.91	3.93	1.44	3.11	55.82	56.38
100 kg/fed	1.70	2.60	3.59	4.34	1.64	3.45	62.45	64.00
60 kg/fed+ Rhizobacterin	1.40	2.19	2.26	3.62	1.34	2.61	52.81	51.58
80kg/fed+ Rhizobacterin	1.59	2.24	2.7	4.11	1.79	3.22	59.73	60.51
100 kg/fed+ Rhizobacterin	1.93	2.94	3.27	4.65	1.94	4.29	75.53	79.31
LSD 0.05.	0.17	0.25	ns	ns	0.11	0.51	2.60	3.02
	B- Boron Levels (kg/fed)							
0.5	1.42	2.37	2.8	3.91	1.41b	3.05	57.03	57.76
1.0	1.69	2.44	2.93	4.06	1.69	3.26	61.01	61.84
LSD 0.05	0.11	0.09	ns	ns	0.10	0.08	1.55	1.62
	The Interaction							
A x B	ns	ns	ns	ns	ns	ns	ns	ns

B. Yield and Yield Components:

Data presented in Table (3) resulted that root yield per feddan (28.27 and 23.58 ton/fed), fresh top yield per feddan (10.43 and 8.43 ton/fed) and sugar yield per feddan (5.39 and 6.69 ton/fed) were significantly increased in both growing seasons. Results pointed out that the highest mean values were obtained by adding 100 kg N/fed in combined with biofertilizer Rhizobacterin. This increase could be due to the important role of mineral N with Rhizobacterin (biofertilizer) that gave a large number of enzymes involved in nitrification and encouraged the increase in plant growth. Many reports had confirmed that the application of nitrogen fertilizer or increasing its

ability in the soil increased sugar beet yield. While the lowest values were recorded by 60 kg N/fed without biofertilizer treatments in the two seasons, which were expected since the soil of the experimental field was sandy with a poor fertility level in the two seasons, respectively (Table 2). These results are in harmony with those obtained by EL-Fadaly *et al*. (2013) and Abdelaa *et al*. (2015) which reported that application of Microbeen + Rhizobacterin+ Phosphorien gave the highest values of all studied characters in both growing seasons as compared with using each bio-fertilizer alone. It was followed by application of Microbeen + Rhizobacterin then apply the mixture of Rhizobacterin + Phosphorien in both seasons. It could be concluded that application the mixture of Microbeen + Rhizobacterin + Phosphorien and 105 kg N/fed for maximizing sugar beet productivity.

It is clear from data in (Table 3) that the root yield significantly increased by increasing boron fertilizer levels from 0.5 up to 1 B kg/fed The maximum yields of the root (22.30 and 21.62 ton/fed) were obtained under the application of 1kg B/fed in both seasons, respectively. The minimum   of root yield (17.69 ton/fed) was recorded by 0.50 kg B/fed in the second seasons. Data were showed that the top yield and sugar yield were insignificantly influenced by boron fertilizer levels during 2015/16 and 2016/2017seasons. The top yield of sugar beet plant was 6.94, and 7.32 ton/fed in the first season as well as 6.79, and 7.15 ton/fed in the second season in growing sugar beet plant under the application0.5 and1.0 B/fed, respectively. The highest sugar yields (4.31 and 5.6 ton/fed) were produced from the application of boron fertilizer level (1kg B/fed) in the first and second seasons respectively. Data cleared that there were no significant differences between applying 0.5 and 0.1 kg B/fed in both seasons on top and sugar yield. These results agreed with those of Hellal *et al.,* (2009), Abido (2012) and Dewdar *et al.* (2015).

Data cleared that the interaction between mineral nitrogen fertilizer at rate of 100 kg N/fed + Rhizobacterin and foliar application of boron fertilizer at the rate of (1 kg B/Fed) resulted a high significant effect on root yield (28.13 and 29.13 ton/fed) and sugar yield (6.89 and 6.48 ton/fed) in both seasons (Table 4).

Table (3): Root yield, top yield and sugar yield of sugar beet as affected by mineral- bio-fertilizer and foliar application of boron levels in both seasons.

Treatments	Root yield (ton/fed)		Fresh top yield (ton/fed)		Sugar yield (ton/fed)	
	Seasons					
	2015/2016	2016/2017	2015/2016	2016/2017	2015/2016	2016/2017
A- Mineral with bio nitrogen						
60 kg/fed	15.78	20.93	4.67	5.67	3.18	4.14
80 kg/fed	19.05	16.74	5.64	6.69	4.19	5.15
100 kg/fed	23.28	11.36	6.60	7.60	3.85	5.76
60 kg/fed+ Rhizobacterin	17.45	25.64	5.23	6.23	3.84	4.85
80kg/fed+Rhiz obacterin	26.20	20.19	10.21	7.21	5.29	6.26
100 kg/fed+ Rhizobacterin	28.27	23.58	10.43	8.43	5.39	6.69
LSD 0..05	ns	ns	3.88	1.7	1.27	0.27
B- Boron Levels						
0.5	21.05	17.69b	6.94	6.79	4.27	5.35
1.0	22.30	21.62	7.32	7.15	4.31	5.60
LSD 0.05	1.15	1.33	ns	ns	ns	ns
Interaction						
A x B	*	*	ns	ns	*	*

Mean followed by different letters within each column are significantly different at 0.05 level of probability
*   Significant at 0.05 level of probability
ns: not significant at 0.01 level of probability.

Table (4): The interaction effect between N- bio-fertilizers and foliar application of boron

on root yield and sugar yield in both seasons

Treatments	Root yield (ton/fed)				Sugar yield (ton/fed)			
	Seasons							
	2015/2016		2016/2017		2015/2016		2016/2017	
	A. Boron Levels (kg/fed)							
A-Mineral with bio nitrogen	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0
60 kg/fed	17.28	18.29	15.28	16.29	4.04	4.23	3.04	3.23
80 kg/fed	20.75	21.36	18.75	19.36	5.07	5.23	4.07	4.23
100 kg/fed	25.11	25.45	23.11	23.45	6.16	6.36	3.71	3.98
60 kg/fed+ Rhizobacterin	18.19	19.98	16.91	17.98	4.31	4.98	3.71	3.98
80kg/fed+ Rhizobacterin	23.98	24.42	25.98	26.42	5.63	5.89	5.63	5.71
100 kg/fed+ Rhizobacterin	26.42	28.13	27.42	29.13	6.48	6.89	5.48	5.89
LSD $_{0..05}$	6.79		5.19		1.69		3.80	

C. Juice Quality and Impurities Contents:

Data in (Table 5) revealed that the applied nitrogen levels on T.S.S.%, sucrose % and purity % of sugar beet insignificantly increased by increasing nitrogen fertilizer levels from 60up to 100 N kg/fed during the two seasons 2015/16 and 2016/17. It is clear from data that seed inoculation with different biofertilizer treatments were significantly increased on sucrose % and purity% less than 100 N kg/fed with biofertilizer compared without biofertilizer treatment. On the other hand, T.S.S % of sugar beet not significantly increased by increasing nitrogen fertilizer levels from 60up to 100 N kg / fed during the two seasons. The superiority in using nitrogen fertilizer may be due to the maintaining favorable balance between the studied amount of nitrogen in the soil and fertilizer and/or improving soluble solids accumulated in beet root reflected the vital role of N fertilizer on plant growth. These results were compatible with Aly *et al* (2009) and EL-Fadaly *et al.* (2013).

Data in (Table 5) recorded the effect of boron fertilization levels on T.S.S. %, sucrose% and purity % during two seasons 2015/16and 2016/17. Data cleared that T.S.S. % and sucrose% were no significant differences between applying 0.5 and 0.1 kg B/fed in both seasons. Also, data showed that purity % was significantly increased by increasing boron fertilizer levels during the two seasons. These results agree with those of El- Sherief (2016).

Total soluble solids and Sucrose percentage were significantly affected by the interaction between mineral nitrogen fertilizer at rate (100 kg N/fed) with Rhizobacterin as bio-fertilizer and foliar application of boron fertilizer at the rate of 1 kg B/fed Data in (Table 6) indicated that treatments recorded the highest values of total soluble solids (28.00 and 29.33) and the highest values of Sucrose percentage (20.48 – 21.48) in both seasons. This increase due to biofertilizer to the principle mechanism that biofertilizer could benefit the plant growth and its accumulation in the plant as a direct effect on growth hormones that released in root media by bacteria and affected positively its growth and sucrose accumulation in roots.

Table (5): Total soluble solids, sucrose percentage and purity as affected by mineral- bio-fertilizer and foliar application of boron levels in both seasons.

Treatments	T.S.S.%		Sucrose %		Purity %	
	Seasons					
	2015/2016	2016/2017	2015/2016	2016/2017	2015/2016	2016/2017
A- Mineral with bio nitrogen						
60 kg/fed	21.47	24.67	17.19	19.31	71.28	73.28
80 kg/fed	19.46	26.00	17.88	19.94	73.87	75.87
100 kg/fed	24.26	26.17	18.19	20.06	80.01	77.59
60 kg/fed+ Rhizobacterin	18.00	22.00	17.69	19.57	72.81	74.81
80 kg/fed+ Rhizobacterin	22.13	25.00	22.17	20.47	79.59	82.01
100 kg/fed+ Rhizobacterin	25.19	27.67	21.39	20.29	88.89	87.89
LSD $_{0.05}$	ns	ns	1.61	1.91	5.41	3.27
B- Boron Levels (kg/fed)						
0.5	25.17	25.00	19.01	19.84	76.62	77.46
1.0	25.67	25.5	19.16	20.00	78.86	79.69
LSD $_{0.05}$	ns	ns	ns	ns	1.272	1.45
Interaction						
A x B	*	*	*	*	ns	ns

Mean followed by different letters within each column are significantly different at 0.05 level of probability.
  * Significant at 0.05 level of probability
  ns: not significant at 0.01 level of probability.

Table (6): The interaction effect between N- bio-fertilizers and foliar application of boron on root yield and sugar yield in both seasons.

Treatments	T.S.S.%				Sucrose %			
	Seasons							
	2015/2016		2016/2017		2015/2016		2016/2017	
A-Mineral with bio nitrogen	B. Boron Levels (kg/fed)							
	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0
60 kg/fed	26.00	26.01	25.00	25.10	19.90	19.98	17.90	17.98
80 kg/fed	26.10	26.33	25.02	25.33	201.12	20.20	18.12	18.20
100 kg/fed	21.33	22.67	20.33	21.67	19.57	19.73	17.57	17.73
60 kg/fed+ Rhizobacterin	25.00	25.00	28.00	28.00	20.03	20.10	22.03	22.10
80 kg/fed+ Rhizobacterin	27.33	28.00	29.33	30.00	20.30	20.48	21.30	21.48
100 kg/fed+ Rhizobacterin	24.33	25.00	23.33	24.00	19.13	19.48	17.13	17.48
LSD $_{0.05}$	5.19		6.225		0.64		0.71	

CONCLUSION:

As a result of this two cropping seasons field study, it was concluded that yield, its components and quality of sugar beet crop increased with the mineral nitrogen of 100 kg/fed with Rhizobacterin and foliar application of boron at the rate of 1 kg/fed, under study conditions.

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ARABIC SUMMERY

حاصل وجودة بنجر السكر تحت الرش الورقي للبورون والتسميد النيتروجين المعدني والحيوي

نادية كامل الصافي

مركز البحوث الزراعية – معهد المحاصيل السكرية – الأسكندرية – مصر

أجريت تجربتان حقليتان محطة بحوث الصبحية بالأسكندرية خلال موسمي ٢٠١٥/٢٠١٦ و ٢٠١٦/٢٠١٧ ، لدراسة استجابة صنف بنجر السكر(Beta ٢٨٣) لمستويات المختلفة من السماد النيتروجيني المعدني والحيوي والرش الورقي بعنصر البورون.

وزعت المعاملات في تصميم القطع المنشقة مرة ، حيث كانت مستويات التسميد النيتروجيني المعدني والحيوي (٦٠ كجم نيتروجين للفدان – ٨٠ كجم نيتروجين للفدان – ١٠٠ كجم نيتروجين للفدان – ٦٠ كجم نيتروجين للفدان + الريزوباكترين – ٨٠ كجم نيتروجين للفدان + الريزوباكترين - ١٠٠ كجم نيتروجين للفدان + الريزوباكترين) في القطع الرئيسية ، ووزعت معدلي الرش الورقي بعنصر البورون (٠,٥ كجم بورون/فدان – ١كجم بورون/فدان) في القطع الشقية في ثلاثة مكررات.

أشارت النتائج المتحصل عليها الي وجود اختلافات معنوية بين المعاملات في الصفات الفسيولوجية مثل معدل النمو المحصولي ومعدل صافي التمثيل ودليل مساحة الأوراق ومحتوي الكلوروفيل حيث أدت زيادة معدلات التسميد المعدني مخلوطا بالمخصب الحيوي (١٠٠ كجم + الريزوباكترين) ، وكذلك الرش بالبورون بمعدل (١كجم بورون/فدان) لزيادة تلك الصفات معنوية مقارنة بباقي المعاملات.

أثرعاملي الدراسة معنوياً على كل من حاصل الجذور ومحصول السكر ونسبة السكروز والمواد الصلبة الذائبة الكلية حيث الزيادة في معدل السماد النيتروجيني المعدني والحيوي (١٠٠ كجم + الريزوباكترين) كما أن الرش بالبورون بمعدل (١كجم بورون/فدان) أدي لزيادة هذه الصفات معنوية مقارنة بباقي المعاملات.

أوضحت النتائج أن هناك تأثير معنوي بالتداخل بين معدلات السماد النيتروجيني المعدني والحيوي مع الرش الورقي لعنصر البورون حيث حققت المعاملات (١٠٠ كجم + الريزوباكترين + ١كجم بورون/فدان) أعلى قيم للصفات المحصولية خلال موسمي الدراسة.

وتوصي هذه الدراسة بتسميد صنف بنجر السكر عديد الأجنة (Beta 283) بمعدل السماد النيتروجيني المعدني والحيوي (١٠٠كجم نيتروجين للفدان + المخصب الحيوي الريزوباكترين) والرش بالبورون بمعدل ١كجم بورون للفدان علي جرعتين بعد ١٢٠ و ١٥٠ يوم من الزراعة ، حيث أدت هذه المعاملات لزيادة معنوية في صفات وجودة الحاصل تحت ظروف الزراعة.