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EFFECT OF YEAST ON SUGAR BEET PRODUCTIVITY UNDER DIFFERENT LEVELS OF POTASSIUM AND BORON WITH WASTES OF SUGAR FACTORIES

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ABSTRACT

Two field experiments were carried out at Mallawi Research Station, El-Minia Governorate, Egypt, during the two successive seasons 2010/11 and 2011/12. This work aimed to study the effect of different levels of potassium fertilizer, yeast and boron with wastes of sugar factories (bagasse ash) as well as their interactions on yield characters and quality properties of sugar beet. The experiments were carried out in split-split plot design. The main plots were assigned to potassium fertilizer treatments, 100% wastes of sugar factories (24 kg K_2O/fed.),100% K (as foliar application), 100%mineral K(24 kg K_2O/fed as soil application), 50% K (foliar application) + 50% wastes of sugar factories (12 kg K_2O/fed.) as soil application and 50% K (12 kg K_2O/fed as soil application) + 50% wastes of sugar factories (12 kg K_2O/fed) as soil application. The sub-plots were allocated with three yeast levels (0 , 2 and 4 kg wet yeast/fed.) and the sub-sub plots were occupied with three boron levels (0, 1 and 2 g boron /L.). The results of this study revealed that in order to maximizing sugar beet production 24 kg K_2O/fed. mineral potassium as soil application and adding 2 kg yeast/fed. as soil application with 400 g boron/fed. (2 g / liter) have to be used under the environment conditions of Minia Governorate.

INTRODUCTION

Sugar beet is considered as a very important sugar crop all over the world. It provides about 40 percent of the world sugar production. Sugar beet also, is considered the second important sugar crop in Egypt after sugar cane and both crops cooperate for increasing local sugar production and to fill the gab in sugar requirements in Egypt, which imports about 35-40 percent of the sugar demand yearly. The importance of sugar beet crop to agriculture is not only confined to sugar production, but also it is well known to be adopted to poor, saline, alkaline and calcareous soils. The economic way of increasing sugar productivity could be achieved through developing appropriate new technology package for sugar beet crop that includes using the best varieties and adapting cultural practices for sugar production such as fertilization by macro-elements (nitrogen, phosphorus and potassium) (Orlovius, 1993; Abou-Amou *et al.*, 1996; El-Maursy *et al.*, 1998; and Laila, 2000). The effect of nitrogen, phosphorus and potassium fertilization on sugar beet production were studied by several authors. However, there are a few studies about the role of yeast, boron and sugar factories waste alone or in combination with potassium on the sugar beet production. Low quality of sugar beet roots is a major problem which face expanding of sugar beet agriculture in middle Egypt, particularly at El- Minia Governorate. Potassium is one of the major elements needed for vegetative growth of plant and sugar synthesis and its accumulation in storage tissue. Modern agricultural practice has been relying heavily on the use of chemical fertilizers to meet this challenging demand. Chemical fertilizers cause farmland degradation, and reduced soil fertility and biodiversity. Continued use of chemical fertilizers could not increase crop yields in number of countries. It costs billions of dollars a year in loss of productivity and bio-diversity, as well as environmental pollution. Yeast contains cytokinin, IAA, proteins, amino acids such as, glycine, thistidine, threonine and treptophan. Also, it contains fat, nucleic acid, adenylic acid enzymes, vitamin B1 and B6. It is very beneficial and essential for the synthesis of aminoleulinic acid and is necessary for the formation of protaperphyrin the precursor of chlorophyll (Subba Rao, 1984; Abou-Zaid, 1984 and Stemwedel, 2009).

The objective of the present investigation was studying the effect of potassium, yeast, boron and their interactions on yield and quality of sugar beet .

MATERIALS AND METHODS

Two field experiments were carried out at Mallawi Research Station, El-Minia Governorate, Egypt, during the two successive seasons 2010/11 and 2011/12 seasons. This work aimed to study the effect of yeast on sugar beet productivity under different levels of potassium and boron with wastes of sugar factories (bagasse ash) as well as their interactions on yield characters and quality properties of sugar beet (the seeds of sugar beet cultivar namely Kawamera). 45 treatments were distributed in a split-split plot design with 4 replicates, the main plots were assigned to five potassium fertilizer treatments (A1 =100% wastes of sugar factories (24 kg K_2O/fed.), A2 = 100% K (foliar application), A3 =100% mineral K (24 kg K_2O/fed. as soil application), A4 = 50% K (foliar application) + 50% wastes of sugar factories (12 kg K_2O/fed.).and A5 = 50% mineral K (12 kg K_2O/fed., soil application) + 50% wastes of sugar factories (12 kg K_2O/fed). Wastes of sugar factories (as potassium source,7.97- 9.08 % k) is considered as a waste product of sugar cane industry after bagasse oven was added at mentioned rate (301.1-264.3kg/fed (100% wastes of sugar factories K application) and 150.5-132.1kg/fed (50% wastes of sugar factories K application) after ridging, planting and before irrigation. Mineral potassium (form of potassium sulphate 48% K_2O) as soil application was added with the second dose of nitrogen fertilizer after thinning as side dressing in beet rows. Foliar potassium as potassin (Foliar potassium fertilizer 36.5 %K_2O Magics potassium liquid was received from Egypt-German Co. for Agriculture and chemicals (EGACO)) and was sprayed at rate 200 liters/fed. (2 g/L.) and applied at 80 days from sowing of sugar beet for rate of 24 kg K_2O/fed (100% foliar K application) and 1L/fed/200 liters at 80 days from sowing of sugar beet for rate of 12 kg K_2O/fed (50% foliar K application).

The sub- plots were allocated for three soil applications of active wet yeast levels (B1 = Zero kg/fed., B2 = 2 kg/fed. and B3 = 4 kg/fed).Yeast, *Saccharomyces cerevisae* strain,(Active wet yeast) obtained from the Egyptian Sugar and its Integrated Industries Company , Hawamdia , Egypt, Yeast solution was left stand about 38 C° for one hour before applying at age 50 days from sowing of sugar beet after the irrigation. Boron were sprayed in the form of boric acid at 75 days from sowing date, boron levels were (C1 = Zero g/liter, C2 = 1g/liter and C3 = 2 g/liter) in 200 liter water were distributed randomly in the sub- sub plots.

Each plot consisted of 5 rows, 7 m. in length and 0.6 cm in width. The area of each plot was 21 m^2. The seeds were sown in hills 20 cm. apart. 30 kg of P_2O_5 in the form of calcium super-phosphate (15 % P_2O_5) were applied at land preparation. The nitrogen fertilization was applied in form of urea (46% N) at rat of 80 kg /fed. at two equal doses, one after thinning and the other at month later, plants were thinned at 4 leaf stage (30 days from sowing) to one plant per hill. All agronomic practices in sugar beet field were done as usual. Mechanical and chemical properties of the soils of the experimental site was silty clay loam pH 7.50. Its chemical analysis cleared that soil contained 0.09 and 0.10 % N, available P 17.80 and 18.4 ppm, available B 36.0 and 38.0 ppm and 64.0 and 71.0 ppm K in 2010/ 2011 and 2011/ 2012 seasons, respectively.

Table(1-a): Chemical analysis of yeast (*Saccharomyces cerevisiae*).

Amino acid ppm/L		Mineral ppm/L		General composition %	
Aspartic	166	Fe	150	Protein	46.18
Threonine	54	K	628	Carbohydrates	46.59
Serine	62	Na	120	Ash	6.53
Glutamic	574	Mg	620	Fats	0.65
Glycine	50	Ca	664	Water	64.18
Alanin	170	Mn	21	Growth regulators ppm/L	
Valine	89	Cu	29	GA_3	626
Isoleucine	64	P	12500	IAA	123
Leucine	163	S	13500	ABA	566
Tyrosine	39	Zn	170	Cytokines	60
Phenylalanine	38	Mo	30	Vitamins (Mg/100g)	
Histadine	45	Si	13500	B1	2.23
Lysine	131			B2	1.33
Arginine	46			B6	1.25
				B12	0.15

Effect of yeast on sugar beet productivity under different levels

Composition of wastes of sugar factories (bagasse ash) obtained from Abou-korkas sugar factory at Minia Governorate was found in Table (1-b).

Table(1-b): Chemical analysis of wastes of sugar factories during 2010/11 and 2011/12 seasons.

Elements	2010/11 season	2011/12 season
K %	7.97	9.08
P %	2.9	3.13
Mg %	3.98	4.22
Ca %	7.6	7.22
Na %	0.62	0.59
Si %	62.11	61.55

Data recorded:

A- Yield components :

At harvest, samples of roots were taken at random from the three middle rows of each plot to record, 1- root length (cm). and root diameter (cm).

B- Quality parameters:

1- Pol percent was determined by using saccharometer according to the procedure outlined by Le Docte (1927).

2- Sugar recovery percentage = (pol%-[0.29+0.343(k+na) +alpha N (0.094)]

3 -Alpha amino nitrogen meq /100g beet was estimated as meq /100g beet according to the procedure described by the sugar company using Auto Analyzer (Cooke and Scott, 1993).

4- Sugar loss percentage = [0.29+0.343(k+na)+ alpha N (0.094)]

5- Quality index = (Sugar recovery % x100) / pol %

C- Yield traits (ton/fed):

The plants from the three middle rows of each plot were harvested and cleaned, roots and tops were separated and weighted in kg, then converted to estimate:

1- Root yield (ton/fed). 2- Top yield (ton/fed).

3- Recoverable sugar yield (ton/fed). It was calculated from the following equation:

Recoverable sugar yield (ton/fed) = Root yield X Sugar recovery %.

Collected data were subjected to the proper analysis of variance (ANOVA). The proper statistical of all data was carried out according to Gomez & Gomez (1984). Homogeneity of variance and differences among treatments were evaluated by the least significant difference test (LSD) at 5%.

RESULTS AND DISCUSSION

A- Yield components :

The results tabulated in Tables (2 and 3) indicated that potassium fertilizer, yeast and boron levels, treatments exhibited a significant effect on root length and diameter in the two growing seasons. As shown from data potassium in the form mineral and wastes of sugar factories had a significant effect on root length and diameter in both seasons. Whatever, it could be noticed that 100% mineral K (24 kg K_2O/ fed), as soil application (A3) produced the highest values of root length (35.58 and 35.82 cm) and root diameter of 12.23 and 12.38 cm. at the first and second seasons, respectively. This increase in root traits as influence of potassium fertilization could be attributed to the important role of potassium in physiological processes in the plant such as translocation of sugars and carbohydrates. These results are in agreement with those obtained by El-Shafei (2000), Attia (2000) and Ahmed (2005).

Also, it could be observed from data that the highest values of root length (33.51and 33.79 cm) and root diameter (11.02 and11.19 cm) of sugar beet at the first and second seasons, respectively, were recorded with soil application yeast at rate of 2 kg/fed. (B2) compared with the others. These results might be attributed to enhancement of soil beneficial microorganisms. Soil fertilized with prolonged application of yeast has shown improvement in humus content and organic carbon content, and significantly lower specific gravity (bulk density) when compared to the soil treated with chemical fertilizer. These findings are in the same trend with those obtained by Stemwedel, (2009), Rosa-Maril *et al.* (2011), Ferweez *et al.*(2011) and Mohamed (2012).

The obtained data indicated that the highest values of root length (32.04 and 32.77cm) and root diameter (10.37 and 10.56 cm) of sugar beet were recorded by boron at rate of 2 g. boron/liter (C3) in the first and second seasons, respectively. The pronounced effect of boron on this trait may be due to its effect on the growing which in turn effect on root length. and diameter (cm) of sugar beet. Similar results obtained by Ahmed (2005) and Moustafa and Omran (2006).

Data presented in Table (2&3) indicated that the highest values of root length (39.68 and 40.03 cm) and root diameter (13.88 and 14.05 cm) were obtained from application potassium fertilizer by rate of 24 kg K_2O /fed., yeast by rate of 2.0 kg/fed. and spraying boron at rate of 2g/ liter in the first and second seasons respectively.

B- Quality parameters:

Data in Tables (4 to 8) showed that potassium fertilizer treatments had a significant effect on pol percent, sugar recovery percentage, alpha amino nitrogen meq /100g beet, sugar loss percentage and quality index of sugar beet in the two growing seasons. It could be noted from the presented data that the highest values(17.21 and 17.24%) of sugar beet pol % scored by applying K_2O at the rate of (24 kg K_2O/ fed) 100% mineral K (A3), as soil application in the first and second seasons, respectively. Applying potassium fertilizer in form 100% K (foliar application) (A2) recorded the highest values of quality index (87.91 and 87.86 %) and the lowest values of sugar loss percentage (1.98 and 2.01%) in the first and second seasons , respectively. The lowest values of alpha amino nitrogen content (1.81 and 1.77 meq /100 g beet) were obtained by applying 100% wastes of sugar factories (24 kg K_2O/fed) (A1) in the first and second seasons, respectively. This increasing might be due to the role of potassium which encourage carbohydrates translocation to store in roots, then transformed to sucrose which contributes in increasing sucrose % of beet roots, where potassium used as co-enzyme with phosphorase to form sucrose (El-Harriri & Gobarh (2001))

Tables (2 and 3): Effect of yeast, potassium, boron and their interactions on root length (cm) and root diameter(cm) of sugar beet during 2010 / 11 and 2011/12 seasons.

Treatments		Root length cm.								Root diameter cm.							
K Levels (A)	Yeast Levels(B)	2010/11				2011/12				2010/11				2011/12			
		Boron Levels (C)								Boron Levels (C)							
		C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
A1	B1	27.20	27.85	28.15	27.73	27.45	28.00	28.08	27.84	7.53	7.90	8.20	7.88	7.95	8.00	8.25	8.07
	B2	30.05	30.60	31.15	30.60	30.85	31.30	31.58	31.24	9.23	9.33	9.53	9.36	9.43	9.53	9.73	9.56
	B3	27.97	28.45	29.80	28.74	28.23	28.55	30.00	28.93	8.35	8.53	9.03	8.63	8.48	8.80	9.13	8.80
	Mean	**28.41**	**28.97**	**29.70**	**29.03**	**28.84**	**29.28**	**29.88**	**29.34**	**8.37**	**8.58**	**8.92**	**8.62**	**8.62**	**8.78**	**9.03**	**8.81**
A2	B1	28.75	29.58	30.20	29.51	28.55	29.90	30.58	29.68	8.58	8.78	9.35	8.90	8.68	8.68	9.65	9.00
	B2	31.83	33.18	33.73	32.91	31.98	33.23	33.75	32.98	9.90	10.18	10.53	10.20	10.15	10.45	10.85	10.48
	B3	28.83	29.25	30.20	29.43	28.90	29.80	30.43	29.71	9.20	9.48	9.53	9.40	9.35	9.58	9.98	9.63
	Mean	**29.80**	**30.67**	**31.38**	**30.61**	**29.81**	**30.98**	**31.58**	**30.79**	**9.23**	**9.48**	**9.80**	**9.50**	**9.39**	**9.57**	**10.16**	**9.71**
A3	B1	33.60	33.75	34.08	33.81	33.65	33.90	34.10	33.88	10.78	11.03	11.33	11.04	10.85	11.13	11.53	11.17
	B2	37.30	37.98	39.68	38.32	37.75	38.40	40.03	38.73	13.50	13.60	13.88	13.66	13.75	13.78	14.05	13.86
	B3	34.25	34.58	35.00	34.61	34.45	35.00	35.08	34.84	11.78	12.05	12.15	11.99	11.83	12.20	12.28	12.10
	Mean	**35.05**	**35.43**	**36.25**	**35.58**	**35.28**	**35.77**	**36.40**	**35.82**	**12.02**	**12.23**	**12.45**	**12.23**	**12.14**	**12.37**	**12.62**	**12.38**
A4	B1	27.58	28.43	28.95	28.32	27.93	28.85	28.90	28.56	7.95	8.05	8.23	8.08	8.33	8.35	8.53	8.40
	B2	31.35	31.63	32.40	31.79	31.35	31.75	32.48	31.86	9.40	9.53	10.08	9.67	9.63	9.85	10.13	9.87
	B3	28.60	29.25	29.55	29.13	28.78	30.30	30.75	29.94	8.55	8.73	9.10	8.79	9.05	9.13	9.25	9.14
	Mean	**29.18**	**29.77**	**30.30**	**29.75**	**29.35**	**30.30**	**30.71**	**30.12**	**8.63**	**8.77**	**9.13**	**8.84**	**9.00**	**9.11**	**9.30**	**9.14**
A5	B1	29.78	30.40	31.20	30.46	30.85	30.70	31.40	30.98	9.50	9.80	10.88	10.06	9.60	10.03	11.05	10.23
	B2	33.03	34.18	34.65	33.95	33.20	34.58	34.63	34.13	11.68	12.05	12.86	12.20	11.43	12.10	12.95	12.16
	B3	29.88	31.15	31.85	30.96	30.58	31.60	32.10	31.43	10.20	10.68	10.98	10.62	10.45	10.83	11.05	10.78
	Mean	**30.89**	**31.91**	**32.57**	**31.79**	**31.54**	**32.29**	**32.71**	**32.18**	**10.46**	**10.84**	**11.57**	**10.96**	**10.49**	**10.98**	**11.68**	**11.05**
Mean C		**30.67**	**31.35**	**32.04**	**31.59**	**30.96**	**32.21**	**32.77**	**31.73**	**9.74**	**9.98**	**10.37**	**10.03**	**9.93**	**10.16**	**10.56**	**10.22**
Mean B	B1	29.38	30.00	30.52	29.97	29.69	30.27	30.61	30.19	8.87	9.11	9.60	9.19	9.08	9.24	9.80	9.37
	B2	32.71	33.51	34.32	33.51	33.03	33.85	34.49	33.79	10.74	10.94	11.38	11.02	10.88	11.14	11.54	11.19
	B3	29.91	30.54	31.28	30.57	30.19	31.05	31.67	30.97	9.62	9.89	10.16	9.89	9.83	10.11	10.34	10.09
L.S.D At 5%	A	0.16				0.09				0.15				0.06			
	B	0.12				0.11				0.05				0.05			
	C	0.11				0.11				0.07				0.05			
	AB	0.25				0.25				0.17				0.11			
	AC	0.47				0.24				0.17				0.14			
	BC	0.22				0.19				0.11				0.11			
	ABC	0.49				0.44				0.27				0.24			

Application of yeast by rate of 2 kg/fed(B2) recorded the highest values of pol percent (16.8 and 16.85 %), sugar recovery percentage (14.47 and 14.51 %) in the first and second seasons , respectively. On the other hand the control treatment (zero yeast level) (B1) recorded the lowest values of alpha amino nitrogen (1.87 and 1.89 meq /100 g beet), sugar loss percentage (2.30 and 2.27%) and the highest values of quality index % (86.99 and 86.38 %) in the first and second seasons, respectively. Similar results were recorded by Shahin *et al.* (2004), Shalaby and El-Nady (2008) and Ferweez *et al* (2011).

Concerning the effect of boron, the recorded results in Tables (4 to 8) demonstrated that there were significant differences in alpha amino nitrogen content of sugar beet in the first season only. The highest values of pol percent (16.74 and 16.75%) were obtained from application of boron at rate of 2 g/liter (C3), while the lowest values (1.94 and 1.95 meq/100 g beet) were obtained from applying the control treatment of boron (zero level) (C1) in the first and second seasons, respectively. There were insignificant differences in sugar recovery percentage, sugar loss percentage and quality index of sugar beet in the two growing seasons.

All the interactions effect among the studied factors on all quality parameters were significant in both seasons except the interaction between potassium treatments and boron levels, the effect of this interaction on alpha amino nitrogen (meq /100 g beet) was insignificant in both seasons.

C- Yield traits (ton/fed):

The results in Tables (9, 10 and 11) indicated that potassium fertilizer, yeast and boron had significant effects on root yield (ton/fed), top yield (ton/fed) and recoverable sugar yield (ton/fed) in both seasons. Data cleared that the highest values of this characters were recorded with application of potassium fertilizer at rate of 24 kg K_2O in form 100% soil mineral K (A3), which gave (36.25 and 36.70 ton/fed.), (18.85 and 18.93 ton/ fed.) and (5.27 and 5.30 ton/ fed.) in the first and second seasons, respectively.

It would be observed that the soil application of yeast by rate of 2 kg/fed. (B2) produced the highest values of root yield (32.85 and

33.09 ton/fed), top yield (15.59 and 16.6 ton/ fed.) and recoverable sugar yield (4.74 and 4.76 ton/ fed.) at the first and second season, respectively. This result is in agreement with these obtained by Ferweez *et al.* (2011) who indicated that soil addition of yeast led to an increase in root yield (ton/ fed) of sugar beet. With regard to the effect of boron that the highest values of root yield of sugar beet were 32.12 ton/fed. with foliar boron application at 2g/liter (C3) in the first season and 32.65 ton/fed. with foliar boron application at 1gm/liter (C2) in the second season. It was noticeable that using 2 gm boron/liter (C3) was the most favorable boron level and produced the highest means of top yield (15.57 and 15.64 ton/ fed) and recoverable sugar yield of sugar beet (4.62 and 4.66 ton/ fed) in the first and second seasons, respectively. This increase may be due to boron role in photosynthetic. Similar results obtained by Mohamed (1993), El-Hawary (1999) and Ahmed (2005).

Insignificant interactions were recorded among all studied factors on root yield (ton/fed.) of sugar beet in both seasons. On the contrary there were significant interactions among all studied factors on top yield (ton/fed.) of sugar beet in both seasons. On the other hand the interaction between potassium fertilizer and yeast levels had a significant effect on recoverable sugar yield ton/ fed. in both seasons. The interactions among all tested factors (ABC) on recoverable sugar yield (ton/ fed.) were significant in the first season only.

In general, it can be concluded from the obtained results that in order to maximize sugar beet production, 24 kg K_2O/fed and 2 kg yeast/fed. as soil application with 400 g boron/fed. (2 g/liter),should be used under the environment conditions of Minia Governorate.

Tables (4 and 5): Effect of yeast, potassium, boron and their interactions on pol percentage and sugar recovery percentage of sugar beet during 2010 / 11 and 2011/12 seasons.

Treatments		Pol percentage								Sugar recovery percentage							
		2010/11				2011/12				2010/11				2011/12			
		Boron Levels (C)								Boron Levels (C)							
K Levels (A)	Yeast Levels (B)	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
A1	B1	17.10	16.80	16.60	16.83	16.40	16.30	16.70	16.47	14.55	14.77	14.70	14.67	14.55	14.21	14.09	14.28
	B2	16.70	17.00	16.90	16.87	16.90	17.20	16.50	16.87	14.90	14.72	14.51	14.71	14.68	14.51	14.48	14.56
	B3	16.70	16.80	16.90	16.80	16.70	16.60	16.90	16.73	14.40	14.55	14.58	14.51	14.28	14.59	14.91	14.59
	Mean	**16.83**	**16.87**	**16.80**	**16.83**	**16.67**	**16.70**	**16.70**	**16.69**	**14.62**	**14.68**	**14.60**	**14.63**	**14.50**	**14.44**	**14.49**	**14.48**
A2	B1	16.10	16.20	16.20	16.17	16.40	16.40	16.30	16.37	14.30	14.32	14.30	14.31	14.30	14.41	14.41	14.37
	B2	16.20	16.20	16.30	16.23	16.50	16.70	16.60	16.60	14.12	14.61	14.60	14.44	14.42	14.60	14.81	14.61
	B3	16.30	16.40	16.50	16.40	16.60	16.40	16.30	16.43	14.13	14.23	14.23	14.20	14.30	14.59	14.42	14.44
	Mean	**16.20**	**16.27**	**16.33**	**16.27**	**16.50**	**16.50**	**16.40**	**16.47**	**14.18**	**14.39**	**14.38**	**14.32**	**14.34**	**14.53**	**14.55**	**14.47**
A3	B1	17.00	16.70	17.10	16.93	16.80	17.20	17.10	17.03	14.58	14.81	14.51	14.63	14.65	14.80	14.35	14.60
	B2	17.30	17.60	17.30	17.40	1738	17.52	17.30	17.40	15.23	14.50	14.69	14.81	15.22	14.78	14.28	14.76
	B3	17.30	17.20	17.40	17.30	17.30	17.40	17.20	17.30	14.20	13.91	14.20	14.10	14.33	13.95	14.34	14.21
	Mean	**17.20**	**17.17**	**17.27**	**17.21**	**17.20**	**17.33**	**17.20**	**17.24**	**14.67**	**14.41**	**14.47**	**14.51**	**14.73**	**14.51**	**14.32**	**14.52**
A4	B1	16.40	16.80	16.40	16.53	16.70	16.40	16.70	16.60	14.30	14.15	14.34	14.26	14.15	14.11	14.10	14.12
	B2	16.90	16.50	16.90	16.77	16.70	16.70	16.90	16.77	14.11	13.27	14.39	13.92	14.25	14.32	14.20	14.26
	B3	16.60	16.20	16.80	16.53	16.60	16.60	16.80	16.67	13.91	14.30	13.83	14.01	14.10	14.82	13.90	14.27
	Mean	**16.63**	**16.50**	**16.70**	**16.61**	**16.67**	**16.57**	**16.80**	**16.68**	**14.11**	**13.91**	**14.19**	**14.07**	**14.17**	**14.42**	**14.07**	**14.22**
A5	B1	16.50	16.20	16.60	16.43	16.40	16.40	16.50	16.43	14.33	14.22	14.32	14.29	14.29	14.22	14.26	14.26
	B2	16.90	16.40	16.90	16.73	16.60	16.60	16.70	16.63	14.40	14.28	14.67	14.45	14.29	14.25	14.50	14.35
	B3	16.30	17.50	16.30	16.70	16.40	16.70	16.70	16.60	14.11	15.20	14.20	14.50	14.51	14.48	14.27	14.42
	Mean	**16.57**	**16.80**	**16.60**	**16.62**	**16.47**	**16.57**	**16.63**	**16.55**	**14.28**	**14.57**	**14.40**	**14.41**	**14.36**	**14.32**	**14.34**	**14.34**
Mean C		**16.69**	**16.70**	**16.74**	**16.71**	**16.70**	**16.73**	**16.75**	**16.73**	**14.37**	**14.39**	**14.41**	**14.39**	**14.42**	**14.44**	**14.35**	**14.40**
Mean B	B1	16.62	16.58	16.54	16.58	16.66	16.54	16.54	16.58	14.41	14.45	14.43	14.43	14.39	14.35	14.24	14.33
	B2	16.80	16.86	16.74	16.80	16.80	16.92	16.84	16.85	14.55	14.28	14.57	14.47	14.57	14.49	14.45	14.51
	B3	16.64	16.78	16.82	16.75	16.78	16.74	16.72	16.75	14.15	14.44	14.21	14.26	14.30	14.49	14.37	14.39
L.S.D At 5%	A	0.09				0.24				0.12				0.27			
	B	0.01				N.S				0.11				0.14			
	C	N.S				N.S				N.S				N.S			
	AB	0.22				0.31				0.25				0.34			
	AC	N.S				0.19				0.19				0.19			
	BC	0.13				0.16				0.13				0.16			
	ABC	0.33				0.36				0.27				0.36			

Tables (6 and 7): Effect of yeast, potassium, boron and their interactions on alpha amino nitrogen (meq/100 g beet) and sugar loss percentage of sugar beet during 2010 / 11 and 2011/12 seasons.

Treatments		Alpha amino nitrogen (meq/100 gm beet)								Sugar loss percentage							
K Levels (A)	Yeast Levels (B)	2010/11				2011/12				2010/11				2011/12			
		Boron Levels (C)								Boron Levels (C)							
		C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
A1	B1	1.90	1.50	1.50	1.63	1.40	1.40	1.90	1.57	2.20	2.10	2.10	2.13	2.20	2.10	2.10	2.13
	B2	1.60	1.90	1.90	1.80	1.90	1.80	1.60	1.77	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20
	B3	1.90	2.10	2.00	2.00	2.00	2.10	1.80	1.97	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
	Mean	**1.80**	**1.83**	**1.80**	**1.81**	**1.77**	**1.77**	**1.77**	**1.77**	**2.23**	**2.20**	**2.20**	**2.21**	**2.23**	**2.20**	**2.20**	**2.21**
A2	B1	1.90	1.70	1.70	1.77	1.60	1.70	1.90	1.73	2.20	1.90	1.90	2.00	2.20	2.00	1.90	2.03
	B2	1.70	2.10	2.00	1.93	1.90	2.10	1.90	1.97	1.90	2.00	1.90	1.93	2.00	2.00	2.00	2.00
	B3	2.00	2.10	2.10	2.07	2.10	2.10	2.00	2.07	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	Mean	**1.87**	**1.97**	**1.93**	**1.92**	**1.87**	**1.97**	**1.93**	**1.92**	**2.03**	**1.97**	**1.93**	**1.98**	**2.07**	**2.00**	**1.97**	**2.01**
A3	B1	2.00	1.80	1.80	1.87	1.80	1.90	2.30	2.00	2.20	2.70	2.70	2.53	2.10	2.60	2.60	2.43
	B2	1.80	2.00	1.90	1.90	2.00	2.00	1.80	1.93	2.70	2.80	2.80	2.77	2.70	2.80	2.80	2.77
	B3	2.00	2.10	2.00	2.03	2.10	2.00	2.00	2.03	2.80	2.90	2.80	2.83	2.90	2.80	2.80	2.83
	Mean	**1.93**	**1.97**	**1.90**	**1.93**	**1.97**	**1.97**	**2.03**	**1.99**	**2.57**	**2.80**	**2.77**	**2.71**	**2.57**	**2.73**	**2.73**	**2.68**
A4	B1	2.00	2.00	2.00	2.00	2.00	2.10	2.10	2.07	2.70	2.50	2.50	2.57	2.70	2.40	2.50	2.53
	B2	2.00	2.10	2.10	2.07	2.00	2.10	2.00	2.03	2.60	2.50	2.50	2.53	2.60	2.50	2.50	2.53
	B3	2.00	2.10	2.10	2.07	2.10	2.20	2.10	2.13	2.50	2.50	2.50	2.50	2.60	2.50	2.50	2.53
	Mean	**2.00**	**2.07**	**2.07**	**2.05**	**2.03**	**2.13**	**2.07**	**2.08**	**2.60**	**2.50**	**2.50**	**2.53**	**2.63**	**2.47**	**2.50**	**2.53**
A5	B1	2.00	2.00	2.20	2.07	2.20	2.00	2.10	2.10	2.43	2.17	2.18	2.26	2.41	2.15	2.19	2.25
	B2	2.20	2.10	2.00	2.10	2.10	2.30	2.10	2.17	2.20	2.24	2.21	2.22	2.16	2.21	2.20	2.19
	B3	2.10	2.10	1.90	2.03	2.10	2.10	2.10	2.10	2.24	2.31	2.26	2.27	2.19	2.29	2.30	2.26
	Mean	**2.10**	**2.07**	**2.03**	**2.07**	**2.13**	**2.13**	**2.10**	**2.12**	**2.29**	**2.24**	**2.22**	**2.25**	**2.25**	**2.22**	**2.23**	**2.23**
Mean C			**1.94**	**1.98**	**1.95**	**1.96**	**1.95**	**1.99**	**1.98**	**1.98**	**2.34**	**2.34**	**2.32**	**2.33**	**2.35**	**2.32**	**2.33**
Mean B	B1	1.96	1.80	1.84	1.87	1.80	1.82	2.06	1.89	2.35	2.27	2.28	2.30	2.32	2.25	2.26	2.27
	B2	1.86	2.04	1.98	1.96	1.98	2.06	1.88	1.97	2.32	2.35	2.32	2.33	2.33	2.34	2.34	2.34
	B3	2.00	2.10	2.02	2.04	2.08	2.10	2.00	2.06	2.37	2.40	2.37	2.38	2.40	2.38	2.38	2.38
L.S.D At 5%	A	0.06				0.03				0.11				0.06			
	B	0.04				0.02				0.02				0.02			
	C	0.02				N.S				N.S				N.S			
	AB	0.08				0.11				0.05				0.05			
	AC	N.S				N.S				0.05				0.05			
	BC	0.08				0.10				0.02				0.05			
	ABC	0.19				0.22				0.11				0.11			

Tables (8 and 9) Effect of yeast, potassium, boron and their interactions on quality index % and recoverable sugar yield (ton/fed) of sugar beet during 2010/11 and 2011/12 seasons.

Treatments		Quality index%								Recoverable sugar yield (ton/fed)							
		2010/11				2011/12				2010/11				2011/12			
		Boron Levels (C)								Boron Levels (C)							
K Levels (A)	Yeast Levels (B)	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
A1	B1	85.38	88.1	88.55	87.34	88.41	87.12	84.43	86.65	4.15	4.05	4.14	4.10	4.13	4.10	4.11	4.10
	B2	89.22	86.47	85.8	87.16	86.98	84.3	87.88	86.39	4.22	4.27	4.28	4.30	4.23	4.12	4.15	4.20
	B3	86.23	86.31	86.39	86.31	85.63	87.95	88.17	87.25	4.09	4.14	4.16	4.10	4.08	4.31	4.23	4.20
	Mean	**86.94**	**86.96**	**86.91**	**86.94**	**87.01**	**86.46**	**86.83**	**86.76**	**4.15**	**4.15**	**4.19**	**4.17**	**4.15**	**4.18**	**4.16**	**4.17**
A2	B1	88.82	88.27	88.27	88.45	87.2	87.8	88.34	87.78	4.40	4.56	4.59	4.50	4.50	4.67	4.65	4.60
	B2	87.04	90.12	89.57	88.91	87.27	87.43	89.16	87.95	4.62	4.67	4.69	4.70	4.67	4.75	4.77	4.70
	B3	86.5	86.59	86.06	86.38	86.14	89.02	88.34	87.83	4.50	4.53	4.57	4.50	4.56	4.59	4.72	4.60
	Mean	**87.45**	**88.33**	**87.97**	**87.91**	**86.87**	**88.08**	**88.61**	**87.86**	**4.51**	**4.59**	**4.62**	**4.57**	**4.58**	**4.67**	**4.71**	**4.63**
A3	B1	85.88	88.62	84.8	86.43	86.9	86.05	84.8	85.92	5.25	5.09	5.07	5.10	5.31	5.17	5.18	5.20
	B2	87.86	82.39	84.97	85.07	85.87	83.9	85.55	85.11	5.62	5.60	5.78	5.70	5.68	5.69	5.82	5.70
	B3	82.08	80.81	81.61	81.50	82.66	79.89	83.72	82.09	4.95	5.02	4.91	5.00	5.02	5.12	4.95	5.00
	Mean	**85.27**	**83.94**	**83.79**	**84.33**	**85.14**	**83.28**	**84.69**	**86.14**	**5.27**	**5.24**	**5.25**	**5.27**	**5.34**	**5.33**	**5.32**	**5.30**
A4	B1	87.2	83.93	87.8	86.31	84.43	85.98	84.43	84.95	4.11	4.18	4.09	4.10	4.07	4.14	4.16	4.10
	B2	83.43	83.03	84.62	83.69	85.03	85.03	84.02	84.69	4.18	4.25	4.14	4.20	4.29	4.27	4.32	4.30
	B3	83.73	88.27	82.14	84.71	84.94	85.54	82.74	84.41	4.06	4.06	4.20	4.10	4.15	4.11	4.25	4.20
	Mean	**84.79**	**85.08**	**84.85**	**84.91**	**84.80**	**85.52**	**83.73**	**84.68**	**4.12**	**4.16**	**4.14**	**4.13**	**4.17**	**4.17**	**4.24**	**4.20**
A5	B1	86.67	86.42	86.14	86.41	87.2	86.59	86.06	86.62	4.81	4.91	4.75	4.80	4.78	4.87	4.78	4.80
	B2	85.21	86.59	86.98	86.26	86.14	85.54	86.83	86.17	4.85	4.86	4.78	4.80	4.87	4.85	4.88	4.90
	B3	86.5	86.86	85.89	86.42	88.41	86.23	85.63	86.76	4.71	4.71	5.13	4.90	4.91	4.84	4.86	4.90
	Mean	**86.13**	**86.62**	**86.34**	**86.36**	**87.25**	**86.12**	**86.17**	**86.51**	**4.79**	**4.83**	**4.89**	**4.83**	**4.85**	**4.85**	**4.84**	**4.87**
Mean C		**86.12**	**86.19**	**85.97**	**86.09**	**86.21**	**85.89**	**86.01**	**86.04**	**4.57**	**4.59**	**4.62**	**4.59**	**4.62**	**4.64**	**4.66**	**4.63**
Mean B	B1	86.79	87.11	87.07	86.99	86.83	86.71	85.61	86.38	4.54	4.56	4.53	4.52	4.56	4.59	4.58	4.56
	B2	86.55	85.72	86.39	86.22	69.26	85.24	86.69	80.40	4.70	4.73	4.73	4.74	4.75	4.74	4.79	4.76
	B3	85.01	85.77	84.42	85.07	85.56	85.73	85.72	85.67	4.46	4.49	4.59	4.52	4.54	4.59	4.60	4.58
L.S.D At 5%	A	0.6				0.54				0.06				0.09			
	B	0.19				0.19				0.02				0.05			
	C	N.S				N.S				0.02				N.S			
	AB	0.45				0.48				0.11				0.14			
	AC	0.44				0.41				N.S				N.S			
	BC	0.33				0.33				0.08				N.S			
	ABC	0.77				0.75				0.19				N.S			

Tables (10 and 11) : Effect of yeast, potassium, boron and their interactions on root yield (ton/fed.) and top yield (ton/fed.) of sugar beet during 2010 / 11 and 2011/12 seasons.

Treatments		Root yield (ton/fed.)								Top yield (ton/fed.)							
K Levels (A)	Yeast Levels (B)	2010/11				2011/12				2010/11				2011/12			
		Boron Levels (C)								Boron Levels (C)							
		C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
A1	B1	27.95	28.00	28.18	28.04	28.00	28.70	28.55	28.42	12.42	12.49	12.61	12.51	12.54	12.60	12.76	12.63
	B2	28.95	28.98	29.00	28.98	28.00	29.30	30.00	29.10	13.32	13.96	14.12	13.80	13.52	14.06	14.23	13.94
	B3	28.43	28.50	28.68	28.54	29.30	30.00	29.3	29.53	13.38	13.50	13.70	13.53	13.55	13.65	13.74	13.65
	Mean	**28.44**	**28.49**	**28.62**	**28.52**	**28.43**	**29.33**	**29.28**	**29.02**	**13.04**	**13.32**	**13.48**	**13.28**	**13.20**	**13.44**	**13.58**	**13.41**
A2	B1	31.15	31.23	31.53	31.30	30.90	31.50	32.20	31.53	15.09	15.33	15.34	15.25	14.38	14.69	14.67	14.58
	B2	32.38	32.7	32.88	32.65	33.00	33.10	33.60	33.23	14.62	14.73	14.84	14.73	15.40	15.56	15.29	15.42
	B3	31.83	31.83	32.13	31.93	31.80	31.60	32.90	32.10	14.29	14.64	14.86	14.60	14.54	14.92	14.83	14.76
	Mean	**31.79**	**31.92**	**32.18**	**31.96**	**31.90**	**32.07**	**32.90**	**32.29**	**14.67**	**14.90**	**15.01**	**14.86**	**14.77**	**15.06**	**14.93**	**14.92**
A3	B1	34.63	34.75	34.95	34.78	34.70	35.30	34.90	34.97	17.45	17.59	18.75	17.93	17.58	17.57	18.94	18.03
	B2	38.45	38.68	39.08	38.74	37.90	40.00	39.00	38.97	19.02	19.81	20.57	19.80	19.59	19.90	20.39	19.96
	B3	34.98	35.25	35.45	35.23	36.90	36.40	35.20	36.17	18.69	18.72	19.02	18.81	18.66	18.73	18.99	18.79
	Mean	**36.02**	**36.23**	**36.49**	**36.25**	**36.50**	**37.23**	**36.37**	**36.70**	**18.39**	**18.71**	**19.45**	**18.85**	**18.61**	**18.73**	**19.44**	**18.93**
A4	B1	28.78	29.03	29.08	28.96	28.90	30.00	28.90	29.27	19.55	12.53	13.27	15.12	12.75	12.63	13.47	12.95
	B2	29.70	29.80	30.10	29.87	29.90	29.60	31.00	30.17	13.47	14.04	14.63	14.05	14.70	14.73	14.98	14.80
	B3	29.20	29.35	29.45	29.33	30.40	30.80	31.20	30.80	14.69	14.84	14.46	14.66	13.53	14.05	14.58	14.05
	Mean	**29.23**	**29.39**	**29.54**	**29.39**	**29.73**	**30.13**	**30.37**	**30.08**	**15.90**	**13.80**	**14.12**	**14.61**	**13.66**	**13.80**	**14.34**	**13.94**
A5	B1	33.30	33.35	33.45	33.37	33.10	31.90	34.30	33.10	15.03	15.57	15.67	15.42	15.39	15.68	15.78	15.62
	B2	33.85	33.98	34.18	34.00	33.50	35.50	33.00	34.00	15.45	15.64	15.62	15.57	15.92	16.30	16.36	16.19
	B3	33.50	33.60	33.70	33.60	32.80	36.00	33.00	33.93	15.61	16.08	16.12	15.94	15.46	15.52	15.66	15.55
	Mean	**33.55**	**33.64**	**33.78**	**33.66**	**33.13**	**34.47**	**33.43**	**33.68**	**15.36**	**15.76**	**15.80**	**15.64**	**15.59**	**15.83**	**15.93**	**15.79**
Mean C		**31.81**	**31.93**	**32.12**	**31.96**	**31.94**	**32.65**	**32.47**	**32.35**	**15.47**	**15.30**	**15.57**	**15.45**	**15.17**	**15.37**	**15.64**	**15.40**
Mean B	B1	31.16	31.27	31.44	31.29	31.12	31.48	31.77	31.46	15.91	14.70	15.13	15.25	14.53	14.63	15.12	14.76
	B2	32.67	32.83	33.05	32.85	32.46	33.50	33.32	33.09	15.18	15.64	15.96	15.59	15.83	16.11	16.25	16.06
	B3	31.60	31.71	31.90	31.74	32.31	32.65	32.41	32.46	15.33	15.56	15.63	15.51	15.15	15.37	15.56	15.36
L.S.D At 5%	A	0.36				0.3				0.09				0.21			
	B	0.28				0.31				0.08				0.11			
	C	0.33				0.30				0.08				0.11			
	AB	0.65				0.71				0.19				0.25			
	AC	N.S				N.S				0.19				0.24			
	BC	N.S				N.S				0.13				0.19			
	ABC	N.S				N.S				0.36				0.44			

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تأثير الخميرة على إنتاجيه بنجر السكر تحت مستويات مختلفة من البوتاسيوم و البورون مع مخلفات مصانع السكر.

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أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بملوي محافظة المنيــا خــلال موسمي 2010/11 و 2011/12 بهدف دراسة تأثير صور مختلفة من السماد البوتاســي من مصادر مختلفه (معدني إضافة أرضية ورش و رماد القصب بمصانع الــسكر) و مستويات مختلفة من الإضافة الأرضية للخميرة و التسميد بالبورون على جودة وإنتاجية بنجر السكر و استخدم تصميم القطع المنشقة مرتين حيث اشتملت القطع الرئيــسية علــى مصادر و صور إضافة السماد البوتاسي (24 كجم بو$_2$أ/ فدان في صــورة رمــاد – ما يعادل 24 كجم بو$_2$أ/ فدان من السماد الورقي رشاً – 24 كجم بو$_2$أ/ فدان في صورة سماد معدني إضافة أرضية – ما يعادل 12 كجم بو$_2$أ/ فدان سماد ورقي + 24 كجم بو$_2$أ/ فدان في صورة رماد – 12 كجم بو$_2$أ/ فدان سماد معدني إضافة أرضية + 12 كجم بو$_2$أ/ فدان في صورة رماد) واشتملت القطع الشقية الأولى على ثــلاث مــستويات مــن الإضــافة

الأرضية للخميرة (صفر، 2,1 كجم خميرة للفدان) بينما احتوت القطع الشقية الثانية على ثلاث مستويات من التسميد بالبورون (صفر، 1، 2 جرام بورون للتر الواحد).

أوضحت النتائج المتحصل عليها أن :

إضافة البوتاسيوم بمعدل 24 كجم بو$_2$أ/ فدان في صورة سماد معدني (إضافة أرضية) أعطت أعلى قيم للصفات المدروسة (سمك الجذر، طول الجذر، الحلاوة، محصول الجذور، وزن العرش و محصول السكر) بينما أفضل قيم لمعامل الجودة ، النسبة المئوية لفقدان السكر نتجت عن إضافة السماد البوتاسي (24 كجم بو$_2$أ/ فدان من السماد الورقي رشاً **أعطت** الإضافة الأرضية للخميرة بمعدل 2 كجم خميرة/فدان أعلى قيم للصفات تحت الدراسة (سمك الجذر، طول الجذر، محصول الجذور، وزن العرش و محصول السكر) بينما أفضل قيم لصفات الجودة سجلت عند عدم إضافة خميرة للتربة، أدت زيادة مستوى البورون إلى 2جرام/لتر (200 جرام/فدان) إلى تسجيل أعلى قيم للصفات (سمك الجذر، طول الجذر، محصول الجذور، وزن العرش و محصول السكر)، أما صفات الجودة تحت الدراسه فلم تتأثر معنويا بمستويات البورون المختلفة في كلا الموسومين.

بناء على ذلك يمكن التوصية بتسميد بنجر السكر بالبوتاسيوم بمعدل 24 كجم بو2أ/فدان (سماد معدني إضافة أرضية) مع الأضافة الأرضية للخميرة بمعدل 2 كجم خميرة / فدان مع استخدام 2 جرام بورون/ لتر (200 جرام/فدان) لزيادة إنتاجية بنجر السكر تحت ظروف محافظة المنيا.