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EFFECT OF YEAST APPLICATION METHOD AND NUMBER ON YIELD AND QUALITY OF SUGAR BEET UNDER DIFFERENT LEVELS OF NITROGEN

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ABSTRACT

Two field trials were carried out in the two successive seasons of 2012/2013 and 2013/2014 at EL-Ettehad Village, Kafr ELSheikh Governorate to study the grow yield and quality of sugar beet as affected by methods and numbers of yeast application in combination with nitrogen levels. The study included 24 treatments which were the combination between two application methods of yeast (soil 15 g/l and foliar 5 g/l), four application numbers (0, 1, 2 and 3) and three nitrogen fertilization levels (60, 80 and 100 kg/fed). A split–split plot design with three replications was used. Yeast application method were assigned the main plots whereas the nitrogen levels were allocated in the sub plots and number of yeast application were occupied the sub–sub plots.

The results obtained pointed out that root dimensions as well as root/top ratio positively and significantly responded to yeast application methods, yeast foliar application over passed soil application with respect to root dimensions and root/top ratio. Data showed that juice parameters of sugar beet roots in terms of sucrose and purity percentages significantly affected by application methods of yeast. The foliar application recorded the positive and significant superiority for both of sucrose and purity percentages. Application methods significantly effected on the values of extractable sugar % in both growing seasons, however the values of sugar loss to molasses % insignificantly affected by yeast application method. It could be noted that the highest values extractable sugar % was recorded with foliar application at the meantime the lowest values of sugar loss to molasses % was attained with yeast foliar application. Foliar application of yeast attained an increase in root, top and sugar yields amounted by 38.43 % & 12.14 %, 17.87 % & 17.54 % and 67.56 % & 27.52 % in the 1st and 2nd season, respectively, over those of soil application of yeast. It could be noted that the most effective of yeast foliar treatment was that on sugar yield.

The available results revealed that sugar beet plants appeared a continuous and significant increase in root dimensions due to the increase in the additional rates of nitrogen up to 100 kg N/fed. Also, increasing nitrogen application from 60 up to 100 kg N/fed let to positive response in the extractable sugar %, potassium %, α-amino nitrogen %, sucrose %, extractable sugar %, sugar loss to molasses % and root, top and sugar yields in both seasons, where as , the same rates significantly decreased purity %.

Increasing number of yeast application caused to significant increase values of root dimensions, root/top ratio, sodium %, potassium %, α-amino nitrogen %, sucrose %, extractable sugar %, sugar loss to molasses % and top and sugar yields in both seasons, meanwhile, decreased purity %.

The interaction between yeast application methods, application numbers of yeast and nitrogen levels significantly on top yield, sucrose% and sugar yield in the first season.

The different combinations between the studied factors showed that foliar application of yeast three times with 100 kg N/fed was the recommended combination

to attain the highest values of top and sugar yields as well as sucrose % under these conditions of the study.
Keywords: *Sugar beet, yeast application, nitrogen fertilization, yield.*

INTRODUCTION

The continuous expand in the growing area with sugar beet make it in the industrial map as one of the important manufacturing crop. The cultivated area increased from 20000/fed at 1980 to reach 530000/fed at 2015. Nutrient program became one of the critical process which facing the policy maker and growers as a result to the increase in fertilizer's prices from one side and their pollution from the other side.

Organic farming strategy is growing rapidly all over the world to conserve human health and the environment, which became under risk because of the unbalance use of pesticides and chemical fertilizers (Agamy *et al.,* 2013). The dangerous effect is because the repeated use of chemical fertilizers destroys soil biota (Boraste *et al.,* 2009). Organic farming is 'zero impact' on the environment. Bio-fertilizers are formulations of beneficial microorganisms, which upon application can increase the availability of nutrients by their biological activity and help to improve the soil health. Microorganisms secrete various plant growth and health promoting substances (Pandya and Saraf, 2010). Bio-fertilizers are considered as a low cost, effective and renewable source of plant nutrients to supplement chemical fertilizers (Boraste *et al.,* 2009). They also mentioned that yeasts synthesize antimicrobial and other useful substances required for plant growth from amino acids and sugars secreted by bacteria, organic matter and plant roots*. Saccharomyces cerevisiae* is considered as a new promising plant growth promoting yeast for different crops. Recently, it became a positive alternative to chemical fertilizers safely used for human, animal and environment (Omran, 2000). The yeast (*Saccharomyces cerevisiae*) is a byproduct obtained from the recovery, processing and drying of the yeast surplus generated during the alcoholic fermentation from sugar can must. It is a natural bio- product rich in proteins, carbohydrates, minerals and vitamins (Brown *et al.*,1996), beside, hormones and other growth regulating substances (Nagodawithana, 1991). A growing number of studies indicate that plant root growth may be directly or indirectly enhanced by yeasts in the rhizosphere (Nassar *et al.,* 2005; El-Tarabily and Sivasithamparam, 2006 and Cloete *et al.,* 2009). Mahmoud (2001) and Mok and Mok (2001) reported that the positive effect of yeast on rapeseed yield and its components may be resulted in its action as a co-factor for ever 60 enzymes which catalyze many biochemical pathways involving amino acids and removing amine groups from amino acids to be used for energy that involved in several bioactivities including cell division. El-Tarabily (2004) stated that yeast significantly increase root and top fresh weights. This effect due to yeast is considered as a natural source of cytokines and has stimulated effect on cell divisions and enlargement. Shahin *et al.* (2004) reported that foliar application of yeast on sugar beet caused to significant increase in top, root and sugar yields, as well as TSS, sucrose and purity percentages. Shalaby and El-Nady (2008) concluded that foliar spraying of yeast on sugar beet at rate of 5 g/l increase leaf area, root length, root diameter, root fresh weight as well as TSS and sucrose percentages. Hamada (2009) claimed that application of amino acid and effective micro organisms as a foliar spray increased root fresh weight, root length, root diameter, purity %, sucrose % and yields of root and sugar (ton/fed). Sharaf *et al.* (2012) stated that the highest values of yield and its components traits were found either with yeast treatment or by using the mixture of macro & micro spray treatment with amino acid. Agamy *et al.* (2013) concluded that used yeast as bio fertilizer for sugar beet gave significant increase in sucrose % total soluble solids (TSS), fresh and dry weights of top, root length, root diameter and number of leaves in both seasons.

Nitrogen have important role in sugar beet production result from high growth rate but caused some pollution for soil. So, we need to other safe source and low price as yeast (*Saccaromycesr cervisiae*) to complete our need for sugar beet nutrition. Allam *et al.* (2005) and El-Geddawy *et al.* (2006) investigate the effect of three nitrogen (65, 80 and 95 kg/fed) on sugar beet. They found that significant effect was found on some character as leaf area, leaf area index (LAI), net assimilation rate (NAR), root fresh weight, root yield and TSS %. The significant increase in LAI, root and top yields were found where sugar beet plants received up to 120 kg N/fed. On the other side with the same rate quality traits were reducing in both seasons. To study the effect of nitrogen fertilizer rates at 80, 100 and 120 kg/fed, Nemeat Alla *et al.* (2007) found that increasing nitrogen rate up to 120 kg/fed caused a significant increase in root characters, sugar % and root/top ratio, whereas, TSS and purity percentages significantly reduction, this was fairly true in both seasons. Zalat *et al.* (2011) tested the effect of nitrogen rates on sugar beet. They found that raising N levels from 90 to 120 Kg/fed in form of ammonia gas caused a significant increase in mean values of top, root and sugar yields as well as top/root ratio and extractability percentage. On the other hand, significant decrease in sucrose, purity and alkaline coefficient percentages in both seasons. Sharaf *et al.* (2012) found that increasing nitrogen fertilizer significantly increased the yield and its component traits, while the quality traits were decreased. El-Geddawy, Dalia and Makhlouf (2015) showed that root length, diameter and root fresh weight, potassium and sodium concentrations in root as well as yields of root and top were significantly increased by increasing nitrogen levels from 80 to 120 kg N/fed. They added that the highest average of sucrose percentage was recorded with 100 kg N/fed, whereas, sugar yield was the highest with 120 kg N/fed.

The main objectives for this study are to study yield and quality of sugar beet as affected by number and method of yeast application under different nitrogen levels.

MATERIALS AND METHODS

Two field trials were carried out in two successive seasons (2012/2013 and 2013/2014) at El-Ettehad Village, KafrElSheikh Governorate to study the yield and quality of sugar beet as affected by methods and numbers of yeast application in combination with nitrogen levels. The preceding crop was maize in the two seasons. Physical and chemical analysis of the experimental soil was taken at 0 - 30 cm depth before sowing as shown in Table 1.

Table 1: Physical and chemical analysis of soil at the experimental sites in 2012/2013 and 2013/2014 seasons.

Variable	**Seasons**	
	2012/2013	**2013/2014**
Physical analysis		
Sand %	25.46	24.87
Silt %	22.59	23.35
Clay %	51.95	51.78
Texture class	Clay	Clay
Chemical analysis		
Soil reactions pH 1:7.5	8.40	8.29
EC ds/m in soil paste	3.34	3.42
Organic matter %	2.00	2.11
Available N ppm	18.65	18.58
Available P ppm	7.01	7.21
Available K ppm	5.62	5.54
Soluble cations meq/L		
Ca^{++}	2.23	2.17
K^{+}	0.39	0.38
Na^{+}	7.46	7.51
Fe	1.78	1.73
Cu	0.62	0.69
Zn	0.43	0.41
Soluble anions meq/L		
Hco_3^-	5.44	5.38
Cl^-	7.64	7.58
So_4^-	0.28	0.31

A split–split plot design with three replications was used in both seasons. The study included 24 treatments which were the combination between two application methods of yeast (soil 15 g/l and foliar 5 g/l), four application numbers (0, 1, 2 and 3) and three nitrogen fertilization levels (60, 80 and 100 kg/fed). Yeast application methods were assigned the main plots whereas the nitrogen levels were allocated in sub plots and number of yeast application were occupied in the sub–sub plots. Nitrogen fertilizer was added as urea (46.5 % N) in two equal doses, the 1^{st} after thinned and the 2^{nd} one month later, meanwhile, yeast application times were done at 60 days, 75 days and 90 days from sowing. Phosphorus fertilizer (30 kg P_2O_5/fed) was added in the type of superphosphate (15.5 % P_2O_5) during land preparation, meanwhile potassium fertilizer was applied at 48 kg K_2O/fed in type of potassium sulphate (48 % K_2O) with 1^{st} application of nitrogen fertilizer. Each sub–sub plot consists of six ridges 55 cm apart and 7 m long.

Sowing date was on the third and fourth week of September in the 1^{st} and 2^{nd} season, respectively. Multigerm variety viz "Hosam" was sowing in hills 20 cm apart. Plants were thinned to one plant per hill at four true leaves age. The other cultural practices were done as recommended.

At harvest (210 days from sowing), ten guarded plants were taken at random from the sub-sub plot to determine the following characteristics:

A. Root criteria: root length, root diameter and root/top ratio.

B. Quality parameters:

Juice impurities:

Potassium and sodium percentages were determined using flame photometer and α–amino N was using ninhydring and hydrindantin method according to the Carruthers *et al.* (1962).

Root juice quality:

Sucrose percentage was determined according to Le Doct (1927).

Juice purity percentage was calculated according to the following formulas:

Purity % = 99.36 – [14.27 (Na% + K% + α–amino N %) / sucrose %]. (Deviller, 1988).

Extractable sugar % = sucrose % – SM – 0.6 (Dexter, *et al.,* 1967).

Sugar loss to molasses (SM) and sugar extractable were calculated according to the following equations:

SM = 0.14 (Na% + K%) + 0.25 (α–amino N %) + 0.5 (Deviller, 1988).

C. Root, top and sugar yields:

At harvest, the four middle ridges of each plot were harvested to determine root and top yields.

Sugar yield was calculated according to the following formula:

Sugar yield (ton/fed) = root yield (ton/fed) x sucrose %.

Statistical analysis

Data collected were subjected to proper statistical analysis of variance as described by Gomez and Gomez (1984). To compare between means Duncans' Multiple Range test (Duncan, 1955).

RESULTS

Root criteria:

Results given in Table 2 show the influence of method & number of yeast application and nitrogen fertilizer levels on root characteristics at harvest, the results obtained pointed out that root dimensions as well as root/top ratio positively and significantly responded to yeast application methods, yeast foliar application over passed soil application with respect to root dimensions and root/top ratio. This finding was fairly true in both seasons. This results may be due to foliar application has a direct effect on plant metabolism. The fruitful of yeast on plant growth had been reported by Pandya and Saraf (2010).

Regarding number of application of yeast on root criteria, the collected data in Table 2 cleared that yeast foliar application three times significantly superior the other treatments in respect to their effect on root dimensions and root/top ratio in the two growing seasons. The values of these traits with control assured the pronounced role of yeast on plant growth.

Concerning nitrogen effect on root dimensions and root/top ratio, the available results revealed that the plants appeared a continuous and significant increase in these traits due to the increase in the additional rates of nitrogen up to 100 kg N/fed. This result is in accordance with Allam *et al.* (2005).

Table 2: Root dimensions and root/top ratio as affected by method and number of yeast application under different levels of nitrogen during 2012/2013 and 2013/2014 seasons.

Treatments	Root length (cm)		Root diameter (cm)		Root/top ratio	
	Seasons					
	2012/ 2013	2013/ 2014	2012/ 2013	2013/ 2014	2012/ 2013	2013/ 2014
Yeast application methods						
Soil (15 g/l)	20.93 b	20.96 b	12.51 b	10.13 b	1.83 b	1.68 b
Foliar (5 g/l)	23.95 a	26.28 a	14.15 a	12.81 a	2.36 a	1.86 a
F-test	**	**	**	**	**	*
Nitrogen levels (kg/fed)						
60	19.91 c	22.26 c	11.93 c	10.81 c	1.77 c	1.64 b
80	22.71 b	23.63 b	13.69 b	11.30 b	2.14 b	1.77 ab
100	24.70 a	24.97 a	14.38 a	12.30 a	2.38 a	1.90 a
F-test	**	**	**	**	*	*
Application numbers of yeast						
0	21.27 d	22.77 d	12.82 d	11.09 c	1.90 d	1.67 b
1	22.18 c	23.38 c	13.13 c	11.33 bc	2.04 c	1.75 ab
2	22.76 b	23.78 b	13.53 b	11.43 b	2.15 b	1.79 ab
3	23.56 a	24.55 a	13.85 a	12.02a	2.29 a	1.86 a
F-test	**	**	**	*	*	*

Juice impurities:

Data in table 3 clears the influence of method & number of yeast application and nitrogen fertilizer levels on sugar beet juice impurities at harvest. Data obtained demonstrated that soil application of yeast increased juice impurities of sugar beet in terms as Na, K and α-amino nitrogen percentages in the two seasons, however this influence was significantly in both season with respect to potassium % and in the 1st seasons only with respect to sodium % and α-amino nitrogen %. The superiority of soil application in these respects may be due to soil application save a permanent supplying of such element as a result to soil reaction of microorganisms with yeast which lead to more absorption of soil nutrients by Abdou (2015).

Data in Table 3 cleared that application number of yeast significantly increased the various juice impurities of sugar beet roots. So, it could be recommended by the low number of yeast application to decrease those values which directly have a negative influence on juice quality in turn sugar extraction.

As for, the influence of nitrogen fertilizer rates on juice impurities of sugar beet roots, the available results revealed that the additional dose of nitrogen was accompanied by the additional increase in the values of sodium, potassium and α-amino nitrogen percentages. This effect was significantly for K % and α-amino nitrogen percentages in both season and in the 1st season for Na %. This result may be pays the attention toward the applied dose of nitrogen which attain higher yield with less juice impurities to reach to the higher sugar extraction.

Root juice quality:

Data in Table 4 indicate to juice quality parameters of sugar beet roots as affected by method & number of yeast application and nitrogen fertilizer levels. The collected data showed that juice parameters of sugar beet roots in terms of sucrose and Purity percentages significantly affected by application methods of yeast. The foliar application recorded the positive and significant superiority for both of sucrose and purity percentages in both seasons. This observation may be due to foliar application of yeast lead to direct improving in plant metabolism which reflected on storage materials in terms of sucrose consequently improving purity %.The influence of yeast on juice quality of sugar beet roots had been reported by Agamy *et al.* (2013) and Abdou (2015).

Table 3: Juice impurities of sugar beet root juice as affected by method and number of yeast application under different levels of nitrogen during 2012/2013 and 2013/2014 seasons.

Treatments	Na %		K %		α-amino nitrogen %	
	Seasons					
	2012/ 2013	2013/ 2014	2012/ 2013	2013/ 2014	2012/ 2013	2013/ 2014
Yeast application method						
Soil (15 g/l)	2.02 a	1.71	6.31 a	6.01 c	2.26 a	2.03
Foliar (5 g/l)	1.70 b	1.60	5.62 b	5.85 b	2.04 b	1.94
F-test	**	NS	*	*	*	NS
Nitrogen level (kg/fed)						
60	1.78 b	1.61	5.72 b	5.78 b	1.97 c	1.82 c
80	1.76 b	1.66	6.02 a	5.94 ab	2.13 b	1.99 b
100	2.37 a	1.71	6.15 a	6.06 a	2.35 a	2.16 a
F-test	*	NS	*	*	*	*
Application numbers of yeast						
0	1.64 c	1.52 c	5.68 b	5.69 c	2.00 d	1.88 c
1	1.77 b	1.63 bc	5.97 a	5.90 b	2.13 c	1.95 c
2	1.97 a	1.71 ab	6.06 a	6.00 ab	2.19 b	2.00 b
3	2.05 a	1.77 a	6.15 a	6.12 a	2.27 a	2.12 a
F-test	*	*	*	*	*	*

Results given in Table 5 showed that yeast application methods significantly effected on the values of extractable sugar % in both growing seasons, however the values of sugar loss to molasses % insignificantly affected by yeast application method. It could be noted that the highest values of extractable sugar % was recorded with foliar application at the meantime the lowest values of sugar loss to molasses % was attained with yeast foliar application. This finding may be due to the pronounced effect of foliar treatment on the values of sucrose % (Table 4) which in turn positively reflected on the extractable sugar % and negatively on sugar loss to molasses %. The influence of yeast application on the extractable sugar % had been reported by Shalaby *and El-Nady.* (2008).

Table 4: Root juice quality as affected by method and number of yeast application under different levels of nitrogen during 2012/2013 and 2013/2014 seasons.

Treatments	**Sucrose %**		**Purity %**	
	Seasons			
	2012/2013	**2013/2014**	**2012/2013**	**2013/2014**
Yeast application method (a)				
Soil (15 g/l)	17.23 b	17.64 b	90.54 b	91.23 b
Foliar (5 g/l)	19.80 a	19.76 a	92.59 a	92.86 a
F-test	**	**	**	**
Nitrogen level (kg/fed) (b)				
60	16.60 c	18.21 b	92.06 a	92.16 a
80	18.24 b	18.80 a	91.49 b	92.12 a
100	20.69 a	19.07 a	91.14 c	91.86 b
F-test	**	*	*	*
Application numbers of yeast (c)				
0	18.02 c	18.34 c	91.87 a	92.26 a
1	18.46 b	18.62 b	91.57 b	92.08 ab
2	18.51 b	18.79 b	91.35 b	91.96 b
3	19.06 a	19.06 a	91.46 b	91.90 b
F-test	*	*	*	*
Interactions				
a×b	*	NS	NS	NS
a×c	**	NS	NS	NS
b×c	*	NS	NS	NS
a×b×c	**	NS	NS	NS

Actually, increasing nitrogen application from 60 up to 100 kg N/fed let to positive response in the extractable sugar % in both seasons, it was accompanied by continuous increase in sugar loss to molasses %. This effect may be due to the bad influence of the excess nitrogen application on juice impurities % in terms of potassium % sodium % and α-amino nitrogen % (Table, 3). This result is in accordance with El-Geddawy, Dalia and Makhlouf (2015).

Once more, it is obviously show that increasing foliar application number of yeast was accompanied by significant increase in the extractable sugar % as well as sugar loss % to molasses.

Table 5: Extractable sugar and sugar loss to molasses percentages as affected by method and number of yeast application under different levels of nitrogen during 2012/2013 and 2013/2014 seasons.

Treatments	Extractable sugar%		Sugar loss to molasses	
	Seasons			
	2012/2013	2013/2014	2012/2013	2013/2014
Yeast application method (a)				
Soil (15 g/l)	14.40 b	14.74 b	2.23	2.09
Foliar (5 g/l)	17.17 a	17.20 a	2.03	2.03
F-test	**	**	NS	NS
Nitrogen level (kg/fed) (b)				
60	13.96 c	15.21 b	2.04 c	1.99 c
80	15.52 b	16.22 a	2.12 b	2.06 b
100	17.86 a	16.47 a	2.23 a	2.13 a
F-test	**	**	*	*
Application numbers of yeast (c)				
0	15.40 c	15.55 c	2.02 d	1.98 c
1	15.74 b	15.86 b	2.12 c	2.04 b
2	15.74 b	15.99 b	2.17 b	2.08 b
3	16.25 a	16.47 a	2.22 a	2.14 a
F-test	*	*	*	*
Interactions				
a×b	NS	NS	NS	NS
a×c	NS	NS	NS	NS
b×c	NS	NS	NS	NS
a×b×c	NS	NS	NS	NS

Data Table 6 pointed out root, top and sugar yields as affected by method & number of yeast application and nitrogen fertilizer levels. The collected data showed that the abovementioned traits significantly and positively responded to yeast application methods, foliar application of yeast attained an increase in root, tops and sugar yield amounted by 38.43 % & 12.14 % , 17.87 % & 17.54 % and 67.56 % & 27.52 % in the 1st and 2nd season, respectively over those of soil application of yeast. It could be noted that the most effective of yeast foliar treatment was that on sugar yield. This result mainly due to the direct effect of foliar yeast application on enzyme activity which reflected positively on root yield itself and sugar yield too. This finding is in line with that found by Mok and Mok (2001).

Data obtained in Table 6 revealed that increasing the applied doses of nitrogen from 60 to 100 kg N/fed significantly raised the values of root, top and sugar yields, this increment amounted by 45.59 % & 36.90 %, 39.63 % & 30.53 and 91.85 & 48.80 % in the 1st and 2nd season successively. This result due to the pronounced effect of nitrogen on root yield and the extractable sugar % (Table 5) which reflected on sugar yield. These finding are in line with that reported by El-Geddawy, Dalai and Makhlouf (2015) they showed that the highest average of sucrose percentage was recorded with 100 kg

N/fed, whereas, sugar yield was the highest with nitrogen level(120 kg N/fed).

Table 6: Root, top and sugar yields as affected by method and number of yeast application under different levels of nitrogen during 2012/2013 and 2013/2014 seasons.

Treatments	Root yield (ton/fed)		Top yield (ton/fed)		Sugar yield (ton/fed)	
	Seasons					
	2012/ 2013	2013/ 2014	2012/ 2013	2013/ 2014	2012/ 2013	2013/ 2014
Yeast application methods (a)						
Soil (15 g/l)	18.63 b	22.82 b	9.62 b	12.54 b	2.96 b	3.67 b
Foliar (5 g/l)	25.79 a	25.59 a	11.34 a	14.74 a	4.96 a	4.68 a
F-test	**	*	*	*	*	**
Nitrogen levels (kg/fed) (b)						
60	17.61 b	20.54 c	8.78 c	11.79 c	2.70 c	3.34 c
80	23.36 a	23.95 b	10.40 b	13.75 b	3.99 b	4.20 b
100	25.64 a	28.12 a	12.26 a	15.39 a	5.18 a	4.97 a
F-test	**	*	**	**	**	**
Application numbers of yeast (c)						
0	21.24	22.36 d	9.61 c	13.00 c	3.62 d	3.85 c
1	22.66	23.37 c	10.30 b	13.26 c	3.97 c	4.07 b
2	23.26	24.72 b	10.89 a	13.92 b	4.06 b	4.20 b
3	21.67	26.37 a	11.13 a	14.39 a	4.18 a	4.55 a
F-test	NS	**	*	*	*	*
Interactions						
a×b	NS	NS	**	NS	*	NS
a×c	NS	NS	**	NS	**	NS
b×c	NS	NS	**	NS	**	NS
a×b×c	NS	NS	**	NS	**	NS

Once more, data in Table 6 indicated that number of yeast foliar application continuously and positively increased root and top yields as well as sugar yield. This finding was fairly true in the two seasons. This results may be indicate that foliar reiteration of yeast could be needed to better growth and cell reactions which in turn reflected on the final products *i.e*. sugar yield. This expectation was found by Mok and Mok (2001).

Interaction effect:

Data in Table 7 show the interaction effect of yeast application methods and nitrogen fertilizer levels and the results obtained cleared that top yield , sucrose % and sugar yield significantly affected by the different combination between method & number of yeast application and nitrogen fertilizer levels. It could be noted that there is a positive and significant increase in the values of top yield, sucrose % and sugar yield under the two application methods of yeast was accompanied to the increase in the applied doses of nitrogen from 60 up to 100 kg N/fed. However, the highest values of top yield ,sucrose % and sugar yield were recorded with the combination between yeast foliar application with 100 kg N/fed. This results may be clear the distinct role of yeast in plant activation even under the higher nitrogen level.

Table 7: Effect of interaction between yeast application method and nitrogen level on top yield, sucrose% and sugar yield during 2012/2013.

Yeast application methods	Nitrogen level (kg/fed)		
	60	80	100
Top yield (ton/fed)			
Soil (15 g/l)	7.95d	9.29 c	11.62 b
Foliar (5 g/l)	9.62 c	11.52 b	12.90 a
Sucrose %			
Soil (15 g/l)	15.46 e	16.56 d	19.66 b
Foliar (5 g/l)	17.73 c	19.93 b	21.73 a
Sugar yield (ton/fed)			
Soil (15 g/l)	2.11 f	2.77 e	3.99 c
Foliar (5 g/l)	3.30 d	5.21 b	6.37 a

Concerning, the interaction between yeast application method and its application number on top yield, sucrose % and sugar yield. The available results in Table 8 revealed that foliar application of yeast over passed significantly soil application methods with respect to the above mentioned traits. This finding was fairly true under the different number of yeast application. Once more, the highest values of top yield, sucrose % and sugar yield were attainable when the plant grown of sugar beet received yeast three spraying as a foliar application.

Table 8: Effect of interaction between yeast application method and application number of yeast on top yield, sucrose% and sugar yield during 2012/2013.

Yeast application methods	Application numbers of yeast			
	0	1	2	3
Top yield (ton/fed)				
Soil (15 g/l)	8.49 f	9.55 e	10.19 d	10.25 d
Foliar (5 g/l)	10.73 c	11.04 c	11.59 b	12.01 a
Sucrose %				
Soil (15 g/l)	16.74 f	16.89 f	17.25 e	18.02 d
Foliar (5 g/l)	19.30 c	20.02 ab	19.76 b	20.11 a
Sugar yield(ton / fed)				
Soil (15 g/l)	2.75 f	2.92 e	3.03 d	3.13 d
Foliar (5 g/l)	4.50 c	5.01 b	5.08 b	5.23 a

Results given in Table 9 cleared that the various combination between nitrogen fertilization rates and yeast application numbers significantly effected on the values of top yield, sucrose % and sugar yield. Almost there is a gradual increase in the values of top yield, sucrose % and sugar yield as the number of yeast application increased. This result was completely true for top yield and sucrose % and mostly for sugar yield under the different levels of nitrogen fertilizer. Once more, it could be noted that repeating the application number of yeast (three times) with the highest level of nitrogen (100 kg N/fed) was necessary to produce the highest values of top yield, sucrose % and sugar yield.

Table 9: Effect of interaction between nitrogen levels and application number of yeast on top yield, sucrose% and sugar yield during 2012/2013.

Nitrogen levels (kg/fed)	Application numbers of yeast			
	0	1	2	3
Top yield (ton/fed.)				
60	8.31 b	8.58 g	9.11 f	9.13 f
80	9.45 f	10.20 e	10.94 d	11.03 d
100	11.06 d	12.11 c	12.62 b	13.23 a
Sucrose %				
60	16.37 e	16.28 e	16.44 e	17.30 d
80	17.45 d	18.44 c	18.50 c	18.59 c
100	20.24 b	20.65 b	20.59 b	21.31 a
Sugar yield (ton/fed.)				
60	2.41 h	2.65 g	2,75 g	2.99 f
80	3.75 e	4.06 d	4.12 d	4.03 d
100	4.72 c	5.19 b	5.30 b	5.51 a

Table 10: Effect of interaction between yeast application method, nitrogen levels and application number of yeast on top yield, sucrose% and sugar yield during 2012/2013.

Yeast application methods	Nitrogen levels (kg/fed)	Application numbers of yeast			
		0	1	2	3
Top yield (ton/ fed)					
Soil (15 g/l)	60	7.39 k	7.77jk	8.31 ij	8.34 ij
	80	8.45 i	9.21 h	9.68 fgh	9.81 efgh
	100	9.637 fgh	11.67 cd	12.58 b	12.61 b
Foliar (5 g/l)	60	9.243 gh	9.39 fgh	9.91 efg	9.92 ef
	80	10.45 e	11.19 d	12.29 bc	12.25 bc
	100	12.49 b	12.55 b	12.67 b	13.85 a
Sucrose %					
Soil (15 g/l)	60	15.37 jk	14.84 k	15.38 jk	16.27 i
	80	15.52 j	16.24 i	16.74 i	17.72 h
	100	19.33 f	19.60 ef	19.65 ef	20.06 de
Foliar (5 g/l)	60	17.38 h	17.73 h	17.51 h	18.32 g
	80	19.37 f	20.64 cd	29.26 d	19.46 ef
	100	21.15 bc	21.70 b	21.53 b	22.55 a
Sugar yield (ton/ fed)					
Soil (15 g/l)	60	2.05 l	1.96 l	2.07 l	2.32 k
	80	2.53 j	2.75 i	2.92 i	2.87 i
	100	3.66 g	4.04 f	4.09 f	4.19 f
Foliar (5 g/l)	60	2.76 i	3.34 h	3.43 h	3.68 g
	80	4.95 e	5.38 d	5.32 d	5.19 d
	100	5.80 c	6.33 b	6.50 b	6.83 a

Data obtained in Table10 showed that the 2nd order interaction between yeast application methods, nitrogen fertilization levels and number of yeast application produced a significant influence on the values of top yield, sucrose % and sugar yield. It could be noticed that even under the different number of yeast application, increasing the applied dose of nitrogen increased the values of these parameters at the meantime, the response in the values of these criteria was higher with the foliar application compared with soil application, however, it could be concluded that the foliar application of yeast with 100 kg N/fed was the best combination to produce the highest values of top yield, sucrose % and sugar yield.

General discussion:

Based upon the obtained results, it could be deduced a distinct role for the selected studied factors, where in addition to the single effect of each factor lonely on the quantitative and qualitative characteristics it is became evident that the studied factors act together to attained the highest values of the final products *i.e.* sugar yield. The observed results were true whether in the level of 1^{st} and/or 2^{nd} order interactions.

The positive effect of yeast is supported by the findings of Mekki and Ahmed (2005). They stated that the increase in yield components because of yeast treatment is mainly attributed to the effect of yeast, which can play a very significant role in making available nutrient elements for plants. In addition, yeast content of macro and micronutrients, growth regulators and vitamins stimulate the plant to build up dry matters (Lorell *et al*., 2008 and Hesham and Mohamed, 2011).

The promoting effect of yeasts could be due to the biologically active substance produced by these bio- fertilizers such as auxins, gibberellins, cytokinins, amino acids and vitamins (Bahr and Gomaa, 2002). Agamy *et al*., (2013) concluded that application of yeasts increased the sugar content sugar beet by about 43%. It significantly enhanced the overall growth of the treated plants. The mechanisms which could be involved include the bio-availability of macro and micronutrients, production of growth hormones, and reduction of the phyto-pathogens' growth. In addition, they could improve the physical and chemical properties of soil that increase water holding capacity, prevent nutrient leaching and add more mineral nutrients to the soil. They also mentioned that data indicated that the three yeasts under their study induced sucrose formation in the beet roots significantly as compared with the control. They reclaimed that yeasts have positive effect on chlorophyll. a and b which is in consistence with the result obtained by Hayat (2007) and Stino *et al*. (2009), they stated that the increase in chlorophyll. a and b leads to a consequent increase in total carbohydrates, because the yeast application could enhance role in cell division, cell elongation producing more leaf area. Hussain et al. (2002) reported that Saccharomyces sp. is among the microorganisms, which improve crop growth and yield by increasing photosynthesis, producing bioactive substances, such as hormones and enzymes and controlling soil diseases.

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تأثير طرق وعدد مرات اضافة الخميره علي محصول وجودة بنجر السكر تحت مستويات مختلفة من الأزوت

هيثم السيد أحمد نعمت الله ، داليا إبراهيم الجداوى و باسـم صبحى إبراهيم مخلوف
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أقيمت تجربتان حقليتان في قرية الاتحاد بمحافظة كفر الشيخ خلال موسمي ٢٠١٢/٢٠١٣ ، ٢٠١٣/٢٠١٤ لدراسة تأثير طرق إضافة الخميرة (رش و أرضى) وعدد مرات إضافتها (٠ ، ١ ، ٢ ، ٣) بالتوافق مع مستويات من التسميد النيتروجيني (٦٠ ، ٨٠ ، ١٠٠ كجم ن/فدان) علي محصول وجوده بنجر السكر، وذلك في تصميم قطع منشقة مرتين فى ثلاث مكررات حيث وضعت طرق إضافة الخميرة في القطع الرئيسية ومستويات التسميد النيتروجيني في القطع الشقية بينما وضع عدد مرات إضافة الخميرة في القطع تحت الشقية.

أوضحت النتائج التفوق المعنوي لرش الخميرة علي الإضافة الأرضية في طول وقطر الجذر ونسبة الجذر/للعرش للنبات والنسبة المئوية للسكروز والنقاوة والسكر المستخلص%، في حين لم تتأثر معنويا قيم السكر المفقود في المولاس بطريقة الإضافة. أدي الرش بالخميرة في الموسم الأول والثاني الي زيادة في محصول الجذور والعرش والسكر بنسبة ٣٨.٤٣ % ، ١٢.١٤ % ، ١٧.٨٧ % ، ١٧.٥٤ % ، ٦٧.٥٦ % ، ٢٧.٥٢ % علي الترتيب وذلك مقارنة بطريقة الإضافة الأرضية.

أدت زيادة مستوي التسميد النيتروجيني من ٦٠ الي ١٠٠ كجم ن/فدان إلي زيادة معنوية في طول وقطر الجذر ونسبة الجذر/للعرش للنبات والنسبة المئوية للبوتاسيوم والالفا امينو نيتروجين والسكروز والسكر المستخلص والسكر المفقود في المولاس ومحصول الجذور والعرش والسكر، في حين انخفضت النسبة المئوية للنقاوة وذلك في كلا الموسمين.

أدت زيادة عدد مرات رش الخميرة إلي زيادة معنوية في طول وقطر الجذر ونسبة الجذر/للعرش للنبات والنسبة المئوية للصوديوم والبوتاسيوم والالفا امينو نيتروجين والسكروز والسكر المستخلص والسكر المفقود في المولاس ومحصول الجذور والعرش والسكر، في حين انخفضت النسبة المئوية للنقاوة وذلك في كلا الموسمين.

كان هناك تاثير معنوي للتفاعل بين عوامل الدراسة علي كلامن من محصول العرش ونسبة السكر وكذلك محصول السكر وذلك خلال الموسم الاول من الزراعه.

مما سبق توصى الدراسة بإمكانية استخدام الخميرة رشاً ثلاث مرات مع التسميد بمستوي ١٠٠ كجم ن/فدان لتحقيق اعلي محصول للعرش والسكر وكذلك أعلي قيم للنسبة المئوية للسكروز. وذلك تحت ظروف هذا البحث.