EFFECT OF BIOFERTILIZATION ON SUGAR BEET YIELD AND ITS COMPONENTS

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ABSTRACT

Two field experiments were carried out at Sakha Agricultural Research Station, Kafer El-Sheikh Governorate, Egypt during the two successive seasons of 2006/2007 and 2007/2008.

These experiments were performed to study the effect of biofertilization with some nitrogen fixing bacteria, ***Azotobacter chrococcum, Bacillus polymyx*** and either in individual form or in mixture of them. or ***Azospirillum brasilense*** this inoculation was performed under different levels of N-fertilizer, 25%, 50% and 100% of the recommended dose as well as their interaction on sugar beet plants. obtained results proved that:

Application of N-mineral fertilizer led to significant increases in root dimensions (root length and diameter), tops and root yield, sucrose % of juice and sugar yield. Where using of 80 Kg N/fed raised the values of tops yield by 19.17 and 5.64 % in the 1st season corresponding by 8.64 and 11.62 % in the 2nd season compared with 20 and 40 Kg/N /fed. However, this root yield amounted by 47.8% and 23.9 % in the 1st season corresponding by 36.69% and 17.48 % in the 2nd season. Purity (%) of sugar beet root juice was insignificantly affected by the used N-level.

Obtained results also revealed that use of these bacteria gave significant increases in root dimensions including root length and diameter, TSS (%), sucrose %and purity of juice, tops and root and sugar yield. Generally, the mixture of three used bacteria gave the best results of all parameters under study. The highest values of top and root yield by bacterial mixture treatment were 15.87&37.8 tons/fed in the1st and 2nd season compared with 11.24 and 20.8 tons/fed, respectively

Regarding the interaction effect between the two examined factors N_2-fixing bacteria and N-mineral fertilizer on sugar beet yield and yield components. Data pointed out that this interaction caused significant response of root dimensions, where the bacterial mixture with 80 kg N/fed produced the maximum values of root length and diameter which represented 26.48 and 25.40 cm of length and 16.77 and 15.93 cm of diameter in the 1st and 2nd season, respectively. It could be remarked that the most effective treatment on purity (%) and sugar yield was the combination between the three bacterial strain with 80 kg/N/fed.

Key words: Biofertilization, sugar beet, yield and its components, *Azotobacter chrococcum, Bacillus polymyx Azospirillum brasilense*

INTRODUCTION

Sugar beet ranks the second sugar crop after sugar cane crop in the world as it provides about 40% of the world sugar production. The total acreage of sugar beet in Egypt has been increased from 17 thousand fed in 1982 to 258 thousand fed in 2008. High mineral nitrogen levels are being added to sugar beet in order to maximize its productivity in clay soils **(Abou-Zeid and Osman, 2005**).

Many workers have studied the effect of nitrogen fertilizer on sugar beet crop yield and quality. **Neamet Alla (2004)** reported that there was non significant effect on root length by applying 20, 40 and 60 kg N/fed. While, increasing N level from 90 to 140 kg/fed did not affect sucrose and TSS%. **Abou Zeid and Osman (2005)** and **Aly *et al* (2009)** found that the highest sugar yield was recorded due to the addition of 80 kg N/fed. On the other hand, no significant differences in TSS, sucrose and purity (%) were detected. **Leilah *et al* (2005)** found that adding 250 kg N/ha (600 kg N/fed) produced the highest values of length, diameter and fresh weight of roots, foliage fresh weight as well as root, top and sugar yields/ha under the newly reclaimed soil in Egypt. **Pytlarzkozicka (2005)** found that increase of nitrogen level from 90 to 180 kg/ha caused a significant increase in average root mass, leaves and dry matter yield, potassium and nitrogen in roots but it also lowered sugar content.

Abu El-Fotoh and Abou El-Magd (2006) found that the highest root yields of 34.26 and 33.89 ton/fed were obtained when urea fertilizer was applied at 80 kg/fed in the tested tow seasons. The reverse was true for top yield that was increased by increasing nitrogen application level. Significant effect on the quality of sugar beet juice such as sodium and potassium ions and also nitrogen and purity (%) was detected.

The excessive use of mineral fertilizers causes side-effects such as leaching out and hence polluting underground water, destroying benefit microorganisms and domestic insects, making the crop more susceptible to the attack of pests and diseases. Reducing of soil fertility and irreparable damage to the over all system cannot be neglected. Numerous efforts are being exercised everywhere to combat the adverse consequences of chemical farming.

Thus, the aim of this work was to study the effect of sugar beet inoculation with some N_2-fixing bacteria, i.e. *Azotobacter chroococcum, Bacillus polymyxa* and *Azospirillum brasilense* under different levels of nitrogen fertilizer on the root, sugar production and juice quality as well**.**

MATERIALS AND METHODS

Two field Experiments were carried out at Sakha Agricultural Research Station, Kafer El-Sheikh Governorate, Egypt during the two successive seasons of 2006/2007 and 2007/2008. These experiment were performs to find out the effect of biofertilization under three levels of nitrogen fertilizer and their interaction effect on sugar beet plants.

Materials:

Soil samples:

Soil physical and chemical properties of the experimental sites were determined according to **Jackson (1973**) and are showed in Table 1.

Table 1. Soil Physical and chemical properties of the experimental sites

Determined Paramemeters	Season	
	2006/2007	2007/2008
Mechanical analysis		
Sand%	26.07	28.82
Silt%	19.46	18.31
Clay%	54.47	52.87
Chemical analysis		
Available N (ppm)	16.72	17.20
Available P (ppm)	6.72	6.41
Available Ko (ppm)	290.18	28.40
pH	8.50	8.30
$CaCO_3$	3.60	4.05
EC dS/m	0.59	0.79
Cations and anions, meq / L		
Na^+	3.38	6.48
K^+	0.29	0.57
Ca^{++}	1.00	2.00
Mg^{++}	0.8	2.90
HCO_3^-	2.00	6.70
Cl^-	0.25	5.88
SO_4^{--}	3.23	0.20

Sugar beet seeds:

Seeds of sugar beet variety (multigerm) plemo were planted on 17and 10 October in 2006 and 2007, respectively. These seeds were kindly supplied by the Sugar Crops Research Institute, Agricultural Research Center (A.R.C), Giza, Egypt.

Mineral fertilizer used:

Nitrogen fertilizer as urea (46.5%**N**) was added in 25%, 50% and 100% of the recommended dose. The recommended N-fertilizer is 80 kg/fed. Phosphorus fertilization was applied as calcium superphosphate at 15 Kg P_2O_5 / fed during land preparation.

Bacterial strains used:

Bacterial strains used in this study were ***Azotobacter chroococcum***, ***Bacillus polymyxa*** and ***Azospirillum brasilense***. These strains were kindly taken from Dept. of Microbiology, Soil, Water and Environ. Res. Institute, Agricultural Research Center (ARC), Giza, Egypt

Methods:

II-1.2. Preparation of bacterial inoculation:

Each of bacterial strain used was grown on its specific medium ***Azotobacter chroococcum*** (A) was grown up to 3-7 days at 30ºC on liquid Ashbys medium **(Hegazi** and **Niemela, 1976).** ***Bacillus polymyxa*** (B) was grown up to 3 days at 30ºC on liquid Hino and Wilson medium**(Hino and Wilson, 1958**) and ***Azospirillum brasilense*** (c) was grown up to 3days at 30ºC on semi solid Döbereiner medium **(Döbereiner *et al.*, 1976).**

Seeds inoculation:

The individual bacterial strain was grown to maximum density equal to about (10^6 (10^9cells ml^{-1}) specific cultivation media mentioned above. Each inoculated seed of sugar beet received abundant number of bacterial cells using arabic gum (15%) as adhesive agent in the presence of peat moss as a carrier. The uncoated seeds were treated only with 15% arabic gum solution in the presence of peat moss to serve as control, and then the seeds were allowed to dry in open air before sowing.

Experimental design:

Soil used in the experiments in both seasons had received nitrogen fertilizer as urea (46.5%**N**) at ratios of 20, 40 and 80 kg N/fed which represent 25, 50 and 100%, of recommended does, respectively. These rations were added in two equal doses at one month after planting and at one month later. Phosphorus fertilization was applied as calcium superphosphate at 15 Kg P_2O_5 / fed during land preparation. Cultivation of sugar beet was at 17th October and 10th October at the first and second season, respectively. However, the harvesting stage was at 8th May at the1st season and 13th May at the 2nd season.

Each experiment included 15 treatments with three replicates using a split plot design. N-Fertilizer occupied the main plot while the bacterial inoculation was randomly allocated in the sub-plot. (ridge width was 50 cm and 25 cm between plants). The plot area was $14m^2$ (7x2 m) = 1/300 fed.

N-fertilizer treatments (main plots): were 20**,** 40 and 80kg N/fed.

While the Bacterial inoculation treatments (sub plots): were without bacterial inoculation (control), seeds inoculated with**. *Azotobacter chroococcum*** (A), Seeds inoculated with. ***Bacillus polymyxa (B)***, seeds inoculated with. ***Azospirillum brasilense (C)*** and seeds inoculated with mixture of all bacterial strains (A+B+C) in equal value.

Measurements:

Samples of three plants were collected at harvest (210 days) to estimate the following traits:

Root dimensions, Root length (cm) and Root diameter (cm).

Root quality: was measured by considering the total soluble solids (TSS %) that determined using Handle Refractometer.

1. Total soluble solids (TSS %) was determined using Handle Refract meter. Sucrose % was determined using Saccharometer apparatus according to the procedure outlined by **Le Doct (1927).** The Purity was calculated using the equation of

Purity (%) = Sucrose (%) x 100 / TSS %

Yield and yield components.

To determine yield and its components, the four rows of each plot were harvested, topped and weighed to determine top yield (ton/fed),

Root yield (ton/fed), and sugar yield (ton/fed) were calculated by multiplying root yield x sucrose (%). Sugar yield

Statistical analysis:

The obtained results were subjected for statistical analysis according to the procedure outlined by **Gomes and Gomes (1984).**

RESULTS AND DISCUSSIONS

1- Root dimensions:

Results illustrated in Table 2 pointed out that the values of root dimensions i.e. root length and diameter as affected by N-level and N-fixation by the treated bacterial strains at harvest in the two growing seasons.

Data collected in Table (2) distinctly clear positive response in the values of root dimensions in the two growing seasons. It could be noted that there was a continuous increment these values by increasing N–dose from 20 to 80 kg N/fed. This increase was significantly in both seasons whether for root length or root diameter. These findings are in accordance with those reported by **Neamat-Alla *et al.*, (2002)**, **Badr (2004) and Abou Zeid and Osman (2005)** and **Aly *et al* (2009)** who stated that root length and diameter at harvest were significantly increased by increasing N-fertilizer level

Table 2. Effect of nitrogen fertilizer levels and biofertilization and their interaction on root dimensions of sugar beet at harvest (2006/07 & 2007/08)

Nitrogen fertilizer dose	Microbiological treatment	Root length		Root diameter	
		2006/07	2007/08	2006/07	2007/08
20 Kg N/Fed.	**Control**	20.4	18.8	11.5	11.9
	Azotobacter(A)	20.7	20.4	12.9	12.3
	Bacillus (B)	21.0	18.6	13.8	11.5
	Azospirllum(C)	23.2	20.3	14.2	12.7
	A+B+C	23.6	21.1	15.1	13.6
Mean		21.7	19.8	13.5	12.4
40 Kg N/Fed	**Control**	18.7	17.8	13.4	10.4
	***Azotobacter*(A)**	22.0	21.7	13.5	13.1
	***Bacillus* (B)**	21.8	20.6	13.1	12.6
	***Azospirllum*(C)**	23.5	23.5	14.7	13.8
	A+B+C	24.1	22.8	16.1	14.2
Mean		22.0	21.3	14.2	12.8
80 Kg.N/Fad	**Control**	19.7	19.1	13.7	10.9
	***Azotobacter*(A)**	22..7	22.6	14.6	13.9
	***Bacillus* (B)**	22.0	21.2	13.2	14.8
	***Azospirllum*(C)**	23.8	24.2	15.1	14.1
	A+B+C	26.4	25.4	16.7	15.9
Mean		22.9	22.5	14.7	13.9
Control		19.6	18.5	13.4	11.1
Azotobacter(A)		21.8	21.6	13.7	13.1
Bacillus (B)		21.6	20.1	13.2	12.9
Azospirllum(C)		23.5	22.6	14.7	13.5
Ax B x C		24.7	23.1	15.8	14.6
LSD at 0.05					
Nitrogen fertilizer (N)		0.105	0.292	0.1136	0.147
Nitogen fixation (F)		0.103	0.338	0.193	0.231
N x F		0.165	0.543	0.309	0.371

The highest values of root dimensions in both seasons were found with the mixture of the three tested N-fixing bacteria, followed by *Azospirillum* then *Azotobacter* treatments. However, the lowest values of this trait were recorded with control. These positive effect of using bacteria attributed to nitrogen fixation and also to their capability for producing some hormones and growth promoting substances. These materials such as (IAA), (IBA), (GA) and (ABA) and making the other nutrients more available for sugar beet which in turn induces the proliferation of roots and root hairs and hence may increase nutrient absorbing surfaces and therefore enhance the plant growth. The influence of nitrogen fertilization on root dimensions has been reported by **Abou Zeid** and **Osman (2005)** and **Hilal, Saima (2005).**

Regarding the interaction effect between fertilizer N-level and biofertilization, the results obtained appeared that applying the highest dose of N-fertilizer, 80 Kg N/fed with the bacterial mixture gave significant increases of both root length and root diameter, specially in the 1st season which represented 26.476 and 16.767 cm, respectively.

2- Tops and root yields

Data given in Table 3 clear the influence of N-dose and biofertilization and their interactions on the values of root and tops yield in the two growing seasons. Results obtained revealed that increasing the applied dose of nitrogen fertilizer was accompanied by a distinct increment in the values of tops and root yield. This increment was statistically positive in both growing seasons. Application of 80 Kg N/fed raised the values of tops yield by 19.17 and 38.64% in the 1st and 2nd seasons, respectively. These values were compared with corresponding values of control to be 20 N /fed. However, the increment in root yield amounted by 47.8% and 36.89 % in the 1st and 2nd seasons over the same values of control, respectively. The influence of nitrogen fertilization on yields/fed has been reported by **Amin, Gehan (2005)** and **Shalaby *et al* (2003).**

Belonging the effect of biofertilization on yield of tops and roots of sugar beet crop, the collected results illustrated in Table 3 obviously showed that the combination between the three examined bacteria i.e. *Azotobacter, Bacillus and Azospirillum* produced the highest values of top yield (15.87 & 14.07 tons /fed) and root yield amounted by 26.08 & 37.80 in the 1st and 2nd seasons, respectively. These results are in a good line with those reported by **sultan *et al.,* (1999)**, **Ali (2003) and Badr (2004)** who showed that inoculation of sugar beet seed with nitrogen fixing bacteria significantly increased root yield per fed.

Once more, the results shown in Table 3 demonstrated that the interaction between the studied factors appeared a pronounced response, where this response was statistically analyzed in the 2nd season only for tops yield. Meanwhile the difference between the various combination of the studied factor was not enough to be significant with respect to its effect on root yield of both seasons. Regardless the significance effect, it could be noted that the combination treatment between the three tested bacterial strains and 80Kg N/fed attained the highest values of tops and roots yield in the two growing seasons. This indicated that biofertilization played a complementary role with mineral N fertilization where the highest sugar beet yield was recorded when sugar beet received 80 Kg N / fed along with treating seeds with N2-fixing bacterial strains.

Table (3): Effect of nitrogen fertilizer levels and biofertilization and their interaction on top and root yields of sugar beet.

Fertilizer nitrogen dose	Microbiological treatment	Top yield (tons/fad.)		Root yield (tons/fad.)	
		2006/07	2007/08	2006/07	2007/08
20 Kg. N/Fad.	Control	10.19	6.36	11.75	16.26
	Azotobacter (A)	10.78	8.48	18.88	25.35
	Bacillus (B)	11.34	7.67	15.47	19.59
	Azospirllum(C)	12.42	9.69	20.09	27.37
	A+B+C	13.41	11.81	18.96	32.21
Mean		**11.63**	**8.80**	**17.03**	**24.15**
40 Kg. N/Fad	Control	11.47	6.86	14.72	22.02
	Azotobacter(A)	11.62	11.51	22.93	26.86
	Bacillus (B)	12.66	10.10	17.30	24..84
	Azospirllum(C)	13.06	11.81	20.64	29.49
	A+B+C	16.79	14.34	25.94	37.47
Mean		**13.12**	**10.93**	**20.31**	**28.14**
80 Kg.N/Fad	Control	12.06	8.68	19.46	24.14
	Azotobacter(A)	13.06	11.71	22.31	33.58
	Bacillus (B)	12.63	11.21	25.12	28.48
	Azospirllum(C)	14.14	13.33	25.65	36.97
	A+B+C	17.40	16.05	33.32	42.22
Mean		**13.86**	**12.20**	**25.17**	**33.06**
Control		11.24	7.30	15.31	20.80
Azotobacter(A)		11.82	10.57	21.37	28.58
Bacillus (B)		12.21	9.66	19.30	24.30
Azospirllum(C)		13.27	11.61	22.13	31.27
A+ B + C		15.87	14.07	26.08	37.80
LSD at 0.05					
Nitrogen fertilizer (N)		0.280	0.136	1.103	0.221
Nitogen fixation (F)		0.498	0.196	1.130	0.527
N + F		NS	0.315	NS	NS

3. Juice quality (TSS % and sucrose %):

Data presented in Table 4 show the influence of N- fertilizer dose and N-fixation bacteria and their interactions on the values of TSS (%) and sucrose (%) of sugar beet roots. Results pointed out that N- fertilizer increased the values of TSS%, however this increase was significant in the 2nd season only. Moreover, the influence of N-level on sucrose (%) was statistically positive in the two seasons. On the other hand, it could be remarked that while application of 40 kg N/fed was enough to produce the highest values of sucrose (17.8 %) in the 1st season. This value it was 17.96 (%) when sugar beet plant were received 80 kg N/fed in the 2nd season. The influence of nitrogen fertilization on juice quality has been reported by **Azzazy (2004), Nafie (2004)** and **Amin, Gehan (2005)**.

Belonging to, the effect of biofertilization on TSS% and sucrose %, the available results revealed that the examined N-fixation bacterial strains attained a significant effect on TSS (%) as well as sucrose% in both growing seasons. However, *Azospirillum* treatment surpassed significantly the others microorganisms treatments with respect to their influence on TSS (%). It could be also noticed that the mixture of the three N_2-fixing bacteria produced the highest values of sucrose (18.51 and 18.96%) in the 1st and 2nd seasons, respectively.

Generally, there were significant effects as a result of use of N-fertilizer or N_2-fixing bacteria. These findings were not in harmony with those obtained by **Hassouna** and **Hassanein** (**2000**) and **Badr (2004**) who concluded that biological and mineral N-fertilization had slightly positive effect on Juice quality percentage.

Table 4. Effect of nitrogen fertilizer levels and biofertilization and their interaction on TSS % and sucrose % of sugar beet.

Fertilizer N-dose	Microbiological treatment	TSS %		sucrose %	
		2006/07	2007/08	2006/07	2007/0
20 Kg.N/Fad.	Control	19.633	20167	16.133	16.367
	Azotobacter(A)	19.933	20.833	17.00	17.300
	Bacillus (B)	19.767	20.000	16.00	16.400
	Azospirllum(C)	20.867	21.000	17.200	17.600
	A+B+C	20.633	21.667	18.167	18.467
Mean		20.167	20.733	16.900	17.227
40 Kg.N/Fad	Control	19.867	20.000	15.800	16.167
	Azotobacter(A)	19.733	21.000	17.133	17.467
	Bacillus (B)	19.733	2.267	16.267	16.600
	Azospirllum(C)	21.267	21.333	17.667	17.933
	A+B+C	21.267	22.333	18.533	19.00
Mean		20.373	20.987	17.80	17.433
80 Kg.N/Fad	Control	19.800	20.167	16.100	16.333
	Azotobacter(A)	20.967	21.833	17.833	18.10
	Bacillus (B)	21.467	21.333	17.033	17.467
	Azospirllum(C)	21.733	22.000	18.233	18.500
	A+B+C	21.600	22.833	18.833	19.433
Mean		21.113	21.633	17.607	17.967
Control		19.767	21.222	16.011	16.289
Azotobacter(A)		20.211	20.533	17.322	17.622
Bacillus (B)		20.322	21.444	16.433	16.822
Azospirllum(C)		21.289	22.278	17.700	18.011
A+B+C		21.167	20.111	18.511	18.967
LSD at 0.05					
Nitrogen fertilizer (N)		N.S	0.154	0.121	0.124
Nitogen fixation (F)		0.369	0.148	0.110	0.136
N x F		N.S	N.S	N.S	0.218

Given results indicated that the various combinations between N-level and biofertilization did not led to significant effects on TSS% for the two seasons and for the 1st season on sucrose (%). The mixture of the three N_2-

fixing bacteria plus 80 Kg N/fed produced the highest sucrose percentage to be 18.833 and 19.433% for the 1st and 2nd growing seasons, respectively. These results are in accordance with those obtained by **Abou Zeid** and **Osman (2005)** who concluded that biological and mineral N-fertilization had slightly positive effect on sucrose percentage of sugar beet root yield.

4-Purity (%) and sugar yield:

Results given in Table 5 reveal the values purity (%) and sugar yield of sugar beet in the two growing seasons as affected by fertilizer N-dose and N_2-fixing bacteria and their interactions

Date illustrated in Table 5 pointed out that Purity percentage of sugar beet root juice insignificantly affected by N-fertilizer or the interaction between N-fertilizer and bio-fertilizer in the two growing seasons. While, the relationship between sugar yield and nitrogen fertilizer was positive and significant in both seasons. This finding may be indicated that the used high level of nitrogen is still around the acceptable quantity that is because , it is well known there was a negative relationship between the excess amount of nitrogen and sugar beet juice quality. The influence of N-dose on purity (%) and sugar yield has been shown by **Nemat Alla *et al;* (2002); Ouda, Sohier (2002); Zaiat and Ibrahim (2002)**.

As for, the influence of N-fixing bacteria on both of purity (%) and sugar yield, the collected results indicated that the N-fixing bacteria gave significant increases. The lowest values of purity % in the two growing seasons were recorded by control treatment. It could be remarked that the most effective treatment on purity (%) was the mixture of the three used bacteria in the 2nd season and was Azospirillum treatment in the 1st season which represented 85.111 and 84.911, respectively. This result is in agood line with those obtained by **Abo El-Goud (2000)**

The available results in Table 5 cleared that sugar yield of sugar beet increased ascendingly by using the examined N_2-fixing bacteria, as well as effect of N_2-fixing bacteria on this trait was as similar as their effect on purity (%) ,where the combination between the three N_2-fixing bacteria over control treatment whether applied individually or in combination with each other. The effective role of N_2-fixing bacteria was demonstrated by **Zaiat *et al.*, (2002) and Hilal, Samia (2005).**

Despite the interaction between biofertilization and N- level was insignificant with respect to its influence on juice purity and sugar yield. In combination with the mixture of the three bacterial strains was the effective treatment which produced the highest values of purity (%) and sugar yield.

Table 5: Effect of nitrogen fertilizer levels and biofertilization and their interaction on purity (%) and sugar yield of sugar beet.

Fertilizer N-dose	Microbiological treatment	Purity %		Sugar yield tons/fad.	
		2006/07	**2007/08**	**2006/07**	**2007/08**
20 Kg.N/Fad.	**Control**	82.533	81.167	1.49	2.12
	Azotobacter(A)	84.433	83.000	2.71	3.64
	Bacillus (B)	82.633	81.967	2.08	2.63
	Azospirllum(C)	84.267	83.000	2.91	4.03
	A+B+C	85.233	85.200	2.92	5.05
Mean		83.820	82.866	**2.42**	**3.49**
40 Kg.N/Fad	**Control**	80.600	82.900	2.00	2.92
	Azotobacter(A)	84.800	83.167	3.35	3.90
	Bacillus (B)	85.133	82.833	2.38	3.40
	Azospirllum(C)	85.767	84.000	3.15	4.43
	A+B+C	84.167	85.033	4.17	6.05
Mean		84.093	83.581	**3.01**	**4.14**
80 Kg.N/Fad	**Control**	84.533	81.667	2.63	3.21
	Azotobacter(A)	84.900	82.900	3.39	5.04
	Bacillus (B)	82.800	81.833	3.57	4.08
	Azospirllum(C)	84.700	84.033	4.02	5.74
	A+B+C	84.667	85.100	5.39	6.97
Mean		84.320	83.107	**3.8**	**5.00**
Control		82.555	81.91	2.04	2.75
Azotobacter(A)		84.711	83.022	3.15	4.193
Bacillus (B)		83.522	82.211	2.67	3.37
Azospirllum(C)		84.911	83.677	3.36	5.647
Ax B x C		84.689	85.111	4.16	6.02
LSD at 0.05					
Nitrogen fertilizer (N)		N.S	N.S	1.196	0.221
Nitrogen fixation (F)		0.530	0.2571	1.131	0.527
N x F		N.S	N.S	NS	NS

4-Impurities percentages

Data obtained in Table 6 reveal that the influence of fertilizer N-dose and N_2-fixing bacteria and their interactions on the values of sugar beet root impurities i.e. N, K and sodium which play an important effect on sugar extraction that increasing impurities in sugar beet root lead to less sugar extraction.

Once more, the influence of N-fixing bacterial treatments produced significant influence on the value of nitrogen percentage. The lowest value of nitrogen percentage (1.4 %) was found with the combination between the three N_2-fixing bacterial treatment.

As for, the effect of the interaction between the studied factors, the collected data appeared a significant influence in N (%) in the 2nd season due to the combination between 40 Kg N/fad and *Azospirllum* treatment recorded the lowest N to be 1.3(%).

Table 6: Effect of nitrogen fertilizer levels and biofertilization on N %, K % and NA % of sugar beet roots.

Fertilizer N-dose	Microbiological treatment	Nitrogen (%)		Potassium (%)		Sodium (%)	
		2006/0	2007/0	2006/0	2007/0	2006/0	2007/0
20Kg.N/Fad	Control	1.5	1.4	1.8	1.3	0.70	0.40
	Azotbacter(A)	1.7	1.9	1.6	1.6	0.82	0.48
	Bacilus (B)	2.3	1.7	1.6	1.8	0.70	0.52
	Azspirllum(C)	1.2	1.7	1.5	1.7	0.74	0.54
	A+B+C	1.8	1.4	1.6	1.8	0.70	0.52
Mean		**1.7**	**1.6**	**1.6**	**1.6**	**0.7**	**0.50**
40	Control	2.6	1.6	1.7	1.8	0.86	0.42
	Azotobacter(A	1.9	1.4	1.9	1.1	0.78	0.44
	Bacillus (B)	2.0	1.6	1.7	1.7	0.72	0.52
	Azospirllum(C	1.9	1.3	1.6	2.0	0.68	0.40
	A+B+C	1.9	1.4	1.6	1.8	0.64	0.46
Mean		**2.1**	**1.5**	**1.7**	**1.7**	**0.8**	**0.45**
80	Control	2.9	1.8	1.6	1.7	0.70	0.54
	Azotobacter(A	2.7	1.9	1.8	1.8	0.66	0.62
	Bacillus (B)	1.4	1.4	1.9	1.9	0.76	0.68
	Azospirllum(C	2.2	1.9	1.8	1.2	0.66	0.46
	A+B+C	1.2	1.4	1.8	1.3	0.78	0.62
Mean		**2.1**	**1.7**	**1.8**	**1.6**	**0.70**	**0.59**
Control		2.4	1.6	1.7	1.6	0.76	0.46
Azotobacter(A)		2.1	1.7	1.8	1.5	0.76	0.52
Bacillus (B)		1.9	1.6	1.7	1.8	0.73	0.58
Azospirllum (C)		1.7	1.6	1.6	1.6	0.70	0.47
Ax B x C		1.6	1.4	1.7	1.6	0.74	0.54
LSD at 0.05							
Nitrogen fertilizer (N)		NS	0.029	NS	NS	NS	NS
Nitrogen fixation (F)		NS	0.09	NS	NS	NS	NS
N x F		NS	0.09	NS	NS	NS	NS

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تأثير التسميد الحيوي علي محصول بنجر السكر ومكوناته

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أقيمت تجربتان حقليتان فى محطة البحوث الزراعية بسخا بمحافظه كفر الشيخ خلال موسمى الزراعة (٢٠٠٦-٢٠٠٧) (٢٠٠٧-٢٠٠٨).

وكان هدف الدراسة معرفه تاثير التلقيح ببعض البكتيريا المثبته للنيتروجين الجوى (آزوتوبكتر كروكوم - باسليس بلوميكسا- آزوسبريليم برازلينس) تحت مستويات مختلفة من التسميد المعدنى الأزوتى (٢٥-٥٠-١٠٠%) من الجرعه الموصى بها (٨٠كجم /ن/فدان).

أدت النتائج إلي زياده الأضافه من السماد المعدنى من ٢٥% الى١٠٠% لزياده معنويه لمعظم الصفات تحت الدراسه مثل طول وقطر الجذر، محصول الجذور والعرش والسكر، وكذلك % للسكروز. بأستخدام (٨٠/كجم/ن/فدان) زاد محصول العرش بنسبه ١٩.٧% و ٥.٦٤% فى الموسم الاول وكذلك ٨.٦٤ % و١١.٦٢% فى الموسم الثانى وذلك بالمقارنه بالتسميد بـ٢٠-٤٠كجم ن/ف.

.بينما كانت نسبه الزياده فى محصول الجذور ٤٧.٨% و٢٣.٩% فى الموسم الاول ٣٦.٧% و١٧.٥% فى الموسم الثانى علي التوالي.

لم يكن هناك أى تاثير معنوى لزياده مستويات النيتروجين المعدنى على النسبة المئوية للنقاوة. وبالنسبه للتأثير البكتريا المثبته للآزوت الجوى آوضحت النتائج المتحصل عليها أن أستخدام الخليط من الثلاث سلالات البكتيريه (ازوتوبكتر كروكوم - باسليس بلوميكسا- ازوسبريليم برازلينس) مع ٨٠ كجم/ن/فدان آدت الى حدوث زياده معنويه فى صفات طول وقطر الجذور، (TSS%) و % السكروز و% للنقاوة ومحصول العرش والجذوز والسكر وبصفه عامه وجد أن أضافه مخلوط هذه البكتريا أعطى أعلى قيم لجميع الصفات تحت الدراسه. وكانت أعلي القيم لمحصول العرش والجذور بلغت ١٥.٨٧-٣٧.٨طن/ف فى الموسم الاول و(١١.٢٤-٢٠.٨ طن /ف) فى الموسم الثانى على الترتيب.

وبالنسبه لتأثير التفاعل بين البكتريا والسماد المعدنى على المحصول ومكوناته كان معنويا لمعظم الصفات عند أضافه مخلوط البكتريا مع ٨٠كجم/ن/ف) سجلت هذه المعامله آعلى القيم فى طول وقطر الجذور حيث بلغت ٢٦.٤٨ سم ٢٥.٤سم بالموسم الاول ،(١٥.٩- ١٦.٧٧سم) بالموسم الثانى على الترتيب حيث سجلت كأفضل معامله فى % للنقاوه ومحصول السكر.