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Effect of Bio and Inoroganic Fertilization on Growth and Yield of Some Sugar Cane Varieties

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ABSTRACT

Field experiment was carried out at Mallawi Agriculture Research Station, Minia Governorate, (latitude of 28° N, latitude of 30° E and latitude of 49 m above sea level) Egypt, during the two successive seasons (2016/2017and 2017/2018). To study the effect of addition of bio fertilizer (*Azotobacter chroccocum*) and different levels of inorganic nitrogen fertilizer (Three rates of N fertilizer 100%,75% and 50% of recommended dose RD) on stalk diameter, stalk length, stalk weight, total soluble solids purity, sucrose, sugar recovery sugar yield and cane yield of three sugar cane varieties (G.99-103, G.47-2003 and G.T.54-9) strip plot design with three reps. The results indicated that sugar cane varieties and bio fertilizer (*Azotobacter chroccocum*) with different levels of inorganic nitrogen fertilizer exhibit significant effects on all studied traits in both seasons. The variety G.99-103 recorded the highest values of stalk diameter, stalk length, stalk weight and N%, N uptake plant, N uptake fed.$^{-1}$, millable cane (ton fed^{-1}) and sugar yield (ton fed^{-1}) in both seasons, while G.T.54-9 variety recorded the highest values of total soluble solids, purity%, sucrose and sugar recovery %. The addition 75% N (160 kg N fed^{-1}) + *Azotobacter chroccocum* gave the highest values in all studied characters except purity % in both seasons. The interactions between sugar cane varieties and bio fertilizer (*Azotobacter chroccocum*) with different levels of inorganic nitrogen fertilizer significantly affected on the studied traits in both seasons. Under the conditions of present work, the results suggest that planting G.99-103 variety with 160 kg N fed^{-1} + *Azotobacter chroccocum* is highly recommended to obtain the highest cane and sugar yields.

***Keywords*:** Biofertilizer, *Azotobacter*, Cane yield, Sugarcane

Introduction

Sugar cane is the main sugar crop in Upper Egypt. About 90 percent of the yield is used for sugar extraction (Essaam *et al*., 2020). The role of sugar cane variety is considered the main factor in governing the expected sugar yield. It is well to known that, the commercial variety G.T.54-9 occupies most of sugar cane area in Egypt. Recently, Sugar Crops Research Institute produced some promising varieties of sugar cane among them G.2003-47 and G.99-103, many studies were designed to select among the produced varieties in yield and its components, as well as, juice quality parameters among them El-Shafai and Ismail (2006), Yousif *et al.* (2015), and Ahmed (2017). (Ibraheem, Abd Elateef 2016 and Ali, 2019). Zaki (2017) indicated that the examined sugarcane varieties differed significantly Promising varieties G.99-103 recorded the highest values of number of millable cane m^{-2}, millable cane height, diameter and cane yield, while G.T. 54-9 surpassed the other varieties respect to brix, sucrose, sugar recovery percentages and sugar yield in plant cane.

Nitrogen is one of the most important nutrients to increase plant growth and yield and due to its role in chemical compounds such as proteins, nucleic acids and many other components, (Berger *et al.,* 2013). The sustainable production of sugarcane could be recovered by practicing the inoculation of bio fertilizers particularly the *Azotobacter* bio fertilizer. Non symbiotic N_2 fixing bio fertilizer which fix atmospheric N_2 to its available forms as nitrate form besides N_2 fixation *Azotobacter* synthesizes and secretes considerable amounts of biologically active substances like B vitamins, nicotinic acid, pantothenic acid, biotin, heteroxins and gibberelins etc, *Azotobacter* also produces traces of indole acetic acid, folic acid and gibberllin like substances sufficient to cause change in plant physiology, which enhance root growth of plants (Dada *et al.,* 2020; Ambesh *et al.,* 2017 and Wani, 2016). Bio fertilization has been used as an alternative to chemical fertilizers to increase soil fertility and crop production in sustainable agriculture (Das and Pradhas, 2016 and WU *et al.,* 2005). This will be a useful

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shelter to solve problems of low soil fertility and crop productivity. Nitrogen bio fertilizers, especially *Azotobacter* have a greater potential for application in non-leguminous crop. The genus *Azotobacter* belongs to family Azotobacteriaceae including gram negative, free-living asmybiotic nitrogen fixing (up to 10 - 20 kg N ha^{-1}) diazotroph (Kader *et al.,* 2002). *Azotobacter* is the genus of great interest in agricultural application due to their free nitrogen fixing ability. Few studies have found out bio fertilizer use for sugar cane, in spite of the fact that a symbiotic nitrogen fixed by bacteria replaces 60 % of the nitrogen needed cultivar (corresponding to kg N ha-1) and its harvested in more than 90 countries worldwide (Araujo *et al.,* 2020 and Serna-cock *et al*., 2011). Nemeat *et al.,* (2015) Showed that juice parameters of sugar beet roots in terms of sucrose and Purity percentages significantly affected by application methods of bio fertilization. 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 bio fertilization leads to direct improving in plant metabolism which reflected on storage materials in terms of sucrose consequently improving purity %.The influence of bio fertilization on juice quality of sugar beet roots.

The objective of this investigation was studding the positive effects of inoculation of *Azotobacter* bio fertilizer and chemical nitrogen fertilizer on growth and yield parameters in sugarcane var. (G.T.54-9, G.47-2003 and G 99-103) under field conditions.

Materials and Methods

1. Microbial strains:

Isolates of *A. chroococcum* were isolated from rhizosphere soil of sugarcane plant collected from several locations of El-Minia Governorate. Twenty isolates of *A. chroococcum* was isolated at random from rhizosphere of different varieties of sugar cane at the different stages of Minia governorate. After purification, the isolates were tested towards their efficiency for nitrogen fixation by growing in Ashby's modified N-deficient broth (Abdel-Malek and Ishac, 1968) for *Azotobacter* isolates. The nitrogen fixing capability of the isolates was achieved using the ambient assay of nitrogenase activity according to (Postage 1972).

2. Determination of bacteria:

In vivo studies the experiment count of *A. chroococcum* and total count of bacteria was estimated at 50 days after cultivation in rhizosphere soils of sugarcane plants. To determine numbers of *A. chroococcum* dilution frequency method and (Haskin's 1934) were used to determination numbers of *A. chroococcum* also total count of bacteria as described by (Allen 1959). At 50, 75and 100 days after cultivation the bacterial population dynamics in the rhizosphere of the plants Furthermore, the nitrogenase enzyme activity in rhizosphere of plant was measured as acetylene reduction activity (ARA) by GC analysis according to (Somasegaran and Hoben, 1994). The most probable number MPN ($\times 10^6$ cfu/g dry soil) was measured in specific *Azotobacter* species were Ashby's medium the same periods in both seasons (Cochran, 1950).

3. The field experiment:

Field experiment was carried out at Mallawi Agricultural Research Station, Minia Governorate, Egypt in the two successive seasons of 2016/2017 and 2017/2018 on sugar cane plants to study the effect of *A. chroococcum* culture and nitrogen fertilization for three varieties (G.T.54-9, G.47-2003, G99-103) of sugarcane. The experiment was conducted in a clay loam soil in strip plot design with randomize complete blocks Design (RCBD) with three replicates. The vertical plots were occupied with three varieties, while the horizontal plots were devoted to the four levels of nitrogen fertilizer mixed with bio fertilizer using (*Azotobacter chroococcum*) culture.

Treatments:

1. G.T.54-9 2. G.47-2003 3. G.99-103.

Four levels of nitrogen fertilizer mixed with bio fertilizer using (*Azotobacter chroococcum*) culture.

1. Control 100% N (210 kg N fed^{-1}).
2. 50 % N (105 kg N fed^{-1}) + *Azotobacter chroococcum* .
3. 75% N (160 kg N fed^{-1}) + *Azotobacter chroococcum* .

4. 100% N (210 kg N fed^{-1}) + *Azotobacter chroococcum* .

Each plot comprised 4 rows with seven meters in length and one meter in width, the plot area was 28 m^2 (1/150 fed^{-1}) the dry method of sugar cane planting was used. Sugar cane varieties were planted in spring season on the middle of March in both seasons. Nitrogen fertilizer was added as urea (46**%** N) at the rate of 210 kg nitrogen fed^{-1} recommended nitrogen (RD). Nitrogen fertilizer was split into two equal doses which were added after 60 days from planting and 30 days later. Phosphorus and potassium fertilizer were added at the rate of 60 kg P_2O_5 and 50 kg K_2O fed^{-1} in the form of calcium super phosphate (15 % P_2O5) and potassium sulphate (48**%** K_2O) respectively. Phosphorus was added during land preparation, while potassium was applied after two months after planting. bio fertilizer (*A. chroococcum*) was added twice. The first inoculated by dipping the stalk-cutting in cell suspension of *A. chroococcum* (1×10^6cell ml^{-1}) for 60 min before planting and the second inoculated after 30 days from planting and directly irrigation was done. Some physical and chemical properties of the experimental soil is shown in Table 1.

Table 1: Some physical and chemical properties of the experimental soil

Property	Values
Particle size distribution (%):	
Sand	10.20
Silt	29.95
Clay	59.85
Texture grade	Clay loam
$CaCO_3$	0.90
Saturation percent (S.P %)	41.00
pH (soil paste)	8.12
E.C (dS m^{-1}, at 25°C)	0.58
Soluble cations and anions (meq L^{-1}):	
Ca^{++}	1.60
Mg^{++}	2.30
Na^{+}	1.50
K^{+}	0.24
$CO^{=}_3$	0.00
HCO^{-}_3	2.88
Cl^{-}	2.12
$SO^{=}_4$	0.64
Total soluble- N (mg kg^{-1})	25.40
Available- P (mg kg^{-1})	13.80
Available-K (mg kg^{-1})	315.20

4. Data recorded:

At harvest, twenty plants from the two middle guarded ridges of each treatment were taken at random to determine the following data:

-Stalk height (cm) was measured from soil surface to the top point of visible dewlap.

-Stalk diameter (cm) was measured at the middle part of stalk.

-Stalk weight (kg).

Total soluble solids (TSS %): It was determined using "Brix hydrometer" according to (A.O.A.C. 1995).

-Sucrose percentage was determined using saccharometer according to A.O.A.C. (1995).

-Purity percentage: It was calculated using the following formula according to Satisha *et al.,* (1996).

Juice Purity % = (Sucrose % ÷ TSS %) × 100.

-Sugar recovery percentage (%): It was calculated according to the following formula described by Yadav and Sharma (1980).

Sugar recovery (%) = [Sucrose % - 0.4 (Brix % - Sucrose %)] × 0.37.

-Cane yield (ton fed^{-1}): the mill able canes of two guarded rows of all plots were harvested, topped, cleaned, weighed and cane yield ton fed^{-1} was determined.

-Sugar yield ton fed^{-1}: It was estimated according to the following equation:
Sugar yield ton fed^{-1} = Cane yield (ton fed^{-1}) × Sugar recovery (%).

5. Nitrogen and nitrogen uptake analysis:

Concentration of N and N uptake were analyzed from matured stalks. Five clean sample stalks from each plot were collected randomly. The finely ground and dried tissues were wet digested using sulphuric-perchloric acid mixture (1:1) as described by A.O.A.C (2000). Total nitrogen percentage was determined by Kjeldahl method according to Jackson (1967).

6. Statistical analysis:

Collected data were subjected to analysis of variance (ANOVA) in each season was performed. The measured variables were analyzed using MSTATC. Differences among treatments were evaluated by LSD test at 5% according to procedure out lined by (Elias and Karim 1984 and Gomez and Gomez 1984).

Results and Discussion

The results in (Table 2) represent the nitrogenase activity of 20 *Azotobacter* isolates. It is clear that the best isolated with the highest recorded values was the isolate (Azt. 1) with sugar cane which attained (39.79 and 40.65 n moles / C_2H_4 / 1ml culture/ hr.) in the first and second season, respectively.

Table 2: Nitrogenase activity of *A. chroococcum* isolates

Nitrogenase activity n moles/C_2H_4/1 ml culture/hr of		
No.	**First season**	**Second season**
	N_2-ase	**N_2-ase**
***A. chroococcum* 1**	39.79	40.65
***A. chroococcum* 2**	19.70	20.5
***A. chroococcum* 3**	14.82	16.0
***A. chroococcum* 4**	12.69	13.45
***A. chroococcum* 5**	12.67	23.88
***A. chroococcum* 6**	20.4	22.0
***A. chroococcum* 7**	22.01	23.89
***A. chroococcum* 8**	11.69	12.89
***A. chroococcum* 9**	33.03	35.0
***A. chroococcum* 10**	8. 12	9.44
***A. chroococcum* 11**	15.65	16.42
***A. chroococcum* 12**	22.63	23.98
***A. chroococcum* 13**	10.32	11.65
***A. chroococcum* 14**	13.84	14.5
***A. chroococcum* 15**	17.14	18.21
***A. chroococcum* 16**	22.87	23.2
***A. chroococcum* 17**	13.69	14.3
***A. chroococcum* 18**	34.89	35.4
***A. chroococcum* 19**	26.87	27.98
***A. chroococcum* 20**	16.64	18.0

The results in (Table 3) clearly indicated that counts of *Azotobacter* were much higher in rhizosphere samples soil of any of the tested varieties of sugar cane. The results also showed that the count of ***Azotobacter*** affected with the age of sugar cane varieties tested that decreased at the late stages at the ages of 100 days after planting. The highest numbers were found in samples of rhizosphere of all variety G.T.54-9, G.47-2003 and G99-103 with 75% N (160 kg N fed^{-1}) + *A. chroococcum* (20.4 and

21.0), (20.9 and 20.8) and (21.6 and 21.9 × 10^4) in the first and second season at 75 days after planting, respectively.

The results in (Table 4) indicated that the total counts of bacteria were higher in rhizosphere samples soil of all plants of sugar cane varieties under study. It was shown that after three different stages of plant growth ranged from 50 to 100 days after sowing, the total count of bacteria increased at the ages started from 50 to 75 days after sowing, while decreased in all varieties of sugar cane plants at 100 days. The highest numbers were observed in samples of rhizosphere variety G.T.54-9, G.47-2003 and G99-103 75% N (160 kg N fed^{-1}) + *A. chroococcum* by (15.3 and 15.6), (15.1 and 15.7) and (15.2 and 15.5 × 10^6) in the two growing seasons at age of 75 days after planting, respectively.

Table 3: Numbers of *Azotobacter* ×10^4 (M.P.N. /g) in the rhizosphere of different varieties of sugar cane plant

Treatments	First season			Second season		
	50 days	75 days	100 days	50 days	75 days	100 days
G.T.54-9 100% N RD	4.3	5.3	3.6	4.5	5.5	3.8
G.T.54-9 50 % N RD + *A. chroococcum*	12.7	16.7	9.7	13	16.8	10.1
G.T.54-9 75 % N RD + *A. chroococcum*	14.4	20.4	11.4	14.5	21	11.9
G.T.54-9 100 % N RD + *A. chroococcum*	5.3	6.3	9.0	5.5	6.5	9.3
G.47-2003 100% N RD	4.4	5.4	3.3	4.7	5.7	3.6
G.47-2003 50 % N RD + *A. chroococcum*	14.4	18.4	9.2	14.8	18.6	9.8
G.47-2003 75 % N RD + *A. chroococcum*	15.4	20.9	11.3	15.7	20.8	11.7
G.47-2003 100 % N RD + *A. chroococcum*	7.1	8.1	10.5	7.5	8.5	10.9
G99-103 100% N RD	6.3	7.3	3.8	6.8	7.7	4.2
G99-103 50 % N RD + *A. chroococcum*	13.6	18.6	10.8	13.9	18.9	11.4
G99-103 75 % N RD + *A. chroococcum*	14.6	21.6	11.5	14.9	21.9	11.9
G99-103 100 % N RD + *A. chroococcum*	9.2	10.1	9.1	9.7	10.5	9.5

Table 4: Total count of bacteria ×10^6 (CFU) /g dry soil in the rhizosphere of different varieties of sugar cane plants

Treatments	First season			Second season		
	50 days	75 days	100 days	50 days	75 days	100 days
G.T.54-9 100% N RD	5.0	5.7	4.7	5.3	5.9	5.1
G.T.54-9 50 % N RD + *A. chroococcum*	11.0	13.0	10.7	11.4	13.3	10.9
G.T.54-9 75 % N RD + *A. chroococcum*	13.3	15.3	12.3	13.5	15.6	12.6
G.T.54-9 100 % N RD + *A. chroococcum*	11.6	12.6	11.0	11.9	12.8	11.3
G.47-2003 100% N RD	5.1	5.9	4.9	5.4	6.2	5.1
G.47-2003 50 % N RD + *A. chroococcum*	11.8	12.8	10.9	12.1	13	11.2
G.47-2003 75 % N RD + *A. chroococcum*	13.1	15.1	13.1	13.4	15.7	13.4
G.47-2003 100 % N RD + *A. chroococcum*	11.9	12.9	11.8	12.2	13.1	12
G99-103 100% N RD	5.2	5.5	4.5	5.6	6.0	4.7
G99-103 50 % N RD + *A. chroococcum*	12. 1	13.0	10.5	12.4	13.4	10.7
G99-103 75 % N RD + *A. chroococcum*	13.8	15.2	13.2	14.0	15.5	13.4
G99-103 100 % N RD + *A. chroococcum*	12.5	13.5	11. 1	12.9	14.0	11.4

1. Stalk length, diameter and weight of sugar cane plant:

1.1. Varietal effect:

Data in Table (5) showed that sugar cane varieties differed significantly in the three traits in both seasons. G99-103 surpassed the other two varieties G.T.54-9 and G.47-2003 by 14.62 and 16.44 % in stalk length, 23.94 and 25.63 % in stalk diameter and 15.71 and 28.57 % in stalk weight in the 1st season,

respectively. The same trend in 2nd season was recorded for these varieties. These results may be attributed to the gene make up. This result is in agreement with those obtained by Yasser (2008), Yousif *et al.*, (2015), Zaki, (2017) and Abu- Ellail *et al.,* (2018).

1.2. Bio and inorganic fertilizer effect on stalk length, diameter and weight of sugar cane plant:

Results in Table (5) revealed that these treatments affected significantly the previous traits in both seasons. The results showed that the previous traits were increased by increasing mixing bio fertilizer with 50% N level to 75% N level then values of these traits of sugar cane plants decreased in both seasons with increasing mixing bio fertilizer with 100 % N level. These findings are in accordance with those obtained by Chandrasekar *et al*., (2005) who revealed that application of chemical nitrogen with nitrogen fixing bacteria at all levels resulted increase in growth, yield the control (without bio fertilizers). These results are in agreement with those obtained by (Hari and Srinivasan 2005) and (Shankaraiah and Kalyanamurthy 2005).

Table 5: Effect of bio and inorganic fertilizer on stalk length, diameter and weight of some sugarcane varieties and their interactions in 2016/2017 and 2017/2018 seasons

Bio and inorganic fertilizer	Stalk length (cm)							
	First season				Second season			
	Varieties							
	G.T.54-9	G.47-2003	G99-103	Mean	G.T.54-9	G.47-2003	G99-103	Mean
100% N RD	254.33	226.00	278.67	253.00	264.00	233.67	285.33	261.00
50 % N RD+ *A. chroococcum*	248.00	218.67	274.33	247.00	254.00	222.33	280.33	252.22
75 % N RD+ *A. chroococcum*	246.67	299.64	308.33	284.89	256.67	306.00	313.67	292.11
100% N RD + *A. chroococcum*	248.00	231.33	306.33	261.89	258.00	235.00	311.00	268.00
Mean	249.25	243.92	291.92	261.69	258.17	249.25	297.58	268.33
LSD $_{0.05}$	19.20				19.24			
LSD $_{0.05}$	21.08				18.76			
LSD $_{0.05}$	28.22				30.10			
	Stalk Diameter (cm)							
100% N RD	2.81	2.64	3.56	3.00	2.87	2.69	3.60	3.05
50 % N RD+ *A. chroococcum*	2.51	2.57	3.45	2.85	2.56	2.60	3.48	2.88
75 % N RD+ *A. chroococcum*	2.76	2.63	3.62	3.00	2.81	2.67	3.63	3.06
100% N RD + *A. chroococcum*	2.72	2.71	3.58	3.02	2.76	2.75	3.65	3.04
Mean	2.70	2.64	3.55	2.97	2.75	2.68	3.59	3.01
LSD $_{0.05}$	0.04				0.03			
LSD $_{0.05}$	0.04				0.05			
LSD $_{0.05}$	0.01				0.02			
	Stalk weight (kg)							
100% N RD	1.17	1.00	1.44	1.20	1.19	1.03	1.49	1.24
50 % N RD+ *A. chroococcum*	1.01	0.89	1.17	1.03	1.03	0.92	1.20	1.05
75 % N RD+ *A. chroococcum*	1.34	1.11	1.55	1.33	1.37	1.15	1.60	1.37
100% N RD + *A. chroococcum*	1.18	1.02	1.43	1.21	1.20	1.03	1.47	1.23
Mean	1.18	1.00	1.40	1.19	1.20	1.03	1.44	1.22
LSD $_{0.05}$	0.14				0.15			
LSD $_{0.05}$	0.09				0.11			
LSD $_{0.05}$	NS				NS			

1.3. Interactions effect:

Effect of Interaction between varieties and treatments of N level mixed with bio fertilizer of *A. chroococcum* had significant effects on the previous traits. Fertilizing the tested verities with 75% N

with bio fertilizer surpassed the other treatments in both seasons. Also, it was noticed that applying 100% N RD alone recorded higher values of these traits in both seasons over that of 50% N + bio fertilizer. These results may be attributed that Nitrogen element has a positive and active role in growth traits (length, diameter and weight) of sugar cane plants besides increasing the photosynthesis produced by solar energy conversion. These results coincide with that obtained by (Satwant 2012). Many studies illustrated that inoculation with only one beneficial microorganism generally increases plant growth and decreases pathogenic agent (Raimam *et al.,* 2007).

2. Sucrose%, total soluble solids and purity percentages:

2.1. Varietal effect:

Results in Table (6) showed that varieties of sugarcane differed significantly in total soluble solids , sucrose and purity% traits in both seasons. Variety G.T.54-9 surpassed in sucrose, by 10.58 and 8.40 % over G.47-2003 and G99-103 in the 1st season, respectively and 8.30 and 10.55% in the second season. Also, this superior was recorded for purity percentage where it was 8.46 and 2.84 % over the G.47-2003 and G99-103 in the 1st season, respectively and 8.06 and 0.83% in the 2nd season, respectively. Regarding to total soluble solids %, G.T.54-9 and G.47-2003 varieties surpassed G99-103 variety in both seasons but the difference between two varieties did not reach the level of significance. This result in quality may be due to the gene make up for varieties. Those findings coincide with that obtained by Yasser. (2008) and Abu-ellail *et al.,* (2020).

2.2. Bio and inorganic fertilizer Effect:

Results presented in Table (6) revealed that bio and inorganic fertilizer significantly affected quality traits in both seasons. Treatment (3) recorded the highest values of total soluble solids and sucrose % in both seasons followed treatment (2) then treatment (1) while treatment (4) recorded the lowest value of total soluble solids and sucrose in both seasons. It is noticed that the difference between treatments (2) and (3) did not reach level of significance in both seasons. This result may be attributed the active role of bio and inorganic fertilizer the increase of fertilization led to inverse effect on quality traits concerning purity %, it was noticed that treatment (4) recorded the highest values of purity% compared to the other treatments in both seasons. This result did not reach the level of significance between bio fertilizer with 50, 75% of Nitrogen fertilizer this result is in agreement with those obtained by Ishwaq Peerzada *et al.,* (2009) *Azotobacter* is the genus of great interest in agricultural application due to their free nitrogen fixing ability. Here, emphasis is given on the role of polysaccharide in sustainable agriculture stalk and also to the survival in its own environments. Substances like amino acid produced by *Azotobacter* are involved in many processes that explain plant-grown promotion. Biochemical analysis of chlorophyll, nitrogen, phosphorous, potassium and protein content was higher in *Azotobacter* inoculated plants as compared to un inoculated control plants (Kravchenko *et al*., 2002).

2.3. Interactions effect:

Results in Table (6) showed that under bio fertilizer with 50 or 75 % of N fertilizer level, all varieties recorded the highest values of quality traits in both season. Generally, G.T.54-9 variety surpassed the other two varieties G.47-2003 and G99-103 in quality traits (total soluble solids, sucrose and purity %) when it was fertilized by bio fertilizer with 75% of N inorganic fertilizer in both season except total soluble solids % in the 1st seasons, where the interaction between varieties and treatments was insignificant. These results are in agreement with that obtained by Nemeat *et al.,* (2015), This observation may be due to foliar application of PGPR lead to direct improvement 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.The highest yield of the yield has been reported in treatment *Azotobacter* N100% RD which significant than the other additional plant growth promoting benefits apart from the diazotrophic action of the *Azotobacter* inoculation in sugarcane. Similar results have been quoted by application of bio fertilizers (*Azotobacter* and *Azospirillum*) along with 100% urea treatment highest yields of millet, (Echinochloa frumentacea (Roxb.) were obtained compared to control (Chandrasekar *et al.,* 2005).

Table 6: Effect of bio and inorganic fertilizer on total soluble solids, sucrose and purity % of some sugarcane varieties and their interactions in 2016/2017 and 2017/2018 seasons

Bio and inorganic fertilizer	Total Soluble Solids							
	First season				Second season			
	Varieties							
	G.T.54-9	G.47-2003	G99-103	Mean	G.T.54-9	G.47-2003	G99-103	Mean
100% N RD	20.43	21.00	18.97	20.13	21.73	21.07	19.43	20.74
50 % N RD + *A. chroococcum*	20.43	20.87	19.20	20.17	21.77	21.27	19.70	20.91
75 % N RD + *A. chroococcum*	20.77	20.83	19.27	20.29	21.73	21.77	19.73	21.08
100% N RD + *A. chroococcum*	20.20	19.13	18.90	19.08	19.83	20.73	19.27	19.94
Mean	20.47	20.46	19.08	20.00	21.27	21.21	19.53	20.67
LSD $_{0.05}$		0.15				0.14		
LSD $_{0.05}$		0.15				0.12		
LSD $_{0.05}$		0.25				0.25		
	Sucrose %							
100% N RD	17.10	16.07	15.67	16.28	17.50	16.37	16.07	16.64
50 % N RD + *A. chroococcum*	17.57	15.97	15.73	16.42	17.87	16.27	16.10	16.74
75 % N RD + *A. chroococcum*	17.77	16.07	15.83	16.56	18.17	16.37	16.13	16.89
100% N RD + *A. chroococcum*	17.13	15.60	14.97	15.90	17.33	16.00	15.10	16.14
Mean	17.39	15.93	15.55	16.29	17.72	16.25	15.85	16.61
LSD $_{0.05}$		0.19				0.18		
LSD $_{0.05}$		0.14				0.15		
LSD $_{0.05}$		0.30				0.32		
	Juice purity%							
100% N RD	82.84	75.24	82.61	80.23	82.92	75.31	82.71	80.31
50 % N RD + *A. chroococcum*	83.95	74.32	81.65	79.97	83.47	74.40	81.73	80.04
75 % N RD + *A. chroococcum*	83.37	75.23	81.66	80.09	84.10	75.31	81.76	80.94
100% N RD + *A. chroococcum*	83.53	80.73	78.27	80.84	83.61	80.82	78.38	80.18
Mean	83.42	76.38	81.05	80.28	83.08	76.39	82.39	80.37
LSD $_{0.05}$		1.07				1.08		
LSD $_{0.05}$		0.67				0.66		
LSD $_{0.05}$		1.76				1.73		

3. Nitrogen %, N uptake plant^{-1} and N uptake fed^{-1}

3.1. Varietal effect:

Results in Table (7) indicated that the studied varieties significantly affected nitrogen %, N uptake plant^{-1} and N uptake fed^{-1} traits in both seasons except N% trait in the 1st season. G.99-103 variety recorded the highest values of N uptake plant^{-1} and N uptake fed^{-1} followed by G.T.54-9 variety while the lowest values of these traits were obtained by G.47-2003 variety.

3.2 Bio and inorganic fertilizer effect:

Results in Table (7) showed that application of Bio and inorganic fertilizer of nitrogen increased gradually in values of these traits until the 3 treatment (75% N + bio fertilizer) then decreased the values of these trails in both seasons. Results recorded the lowest values of these traits when using 50% N + bio fertilizer in both seasons. These results may be attributed that nitrogen element has a role in enhancing the vegetative growth of plants and reflecting in yield in the final where it was increases by increasing N mixed bio fertilizer until 75% N mixed bio fertilizer level, only. These are in agreement with that obtained by (Kravchenko *et al.,* 2002) Biochemical analysis of chlorophyll, nitrogen, phosphorous, potassium and protein content was higher in *Azotobacter* inoculated plants as compared to un inoculated control plants.

3.3. Interactions effects:

The interaction between varieties and treatments of nitrogen fertilizer alone or mixed by bio fertilizer significantly affected the previous traits in both seasons. It was noticed from the table that under any variety of sugarcane, treatment 75% N mixed with bio fertilizer recorded the maximum value of the previous traits followed by 100% N + bio fertilizer and 50% N + bio fertilizer. Generally, G99-103 variety surpassed the highest value for these traits when fertilizer by 75% N+ bio fertilizer in both seasons which recorded (2.64, 2.69%) N%, (0.04, 0.04%) N uptake plant^{-1} and (166.8, 171.8%) N uptake fed^{-1} in the 1st and 2nd season, respectively. These findings are in agreement with that obtained by (Berger *et al.,* 2013) N is one of the most important nutrients to increase plant growth and yield, due to its role in chemical compounds such as proteins, nucleic acids and many other components, it is necessary for all kinds of life throughout the world.

Table 7: Effect of bio and inorganic fertilizer on N%, N uptake plant^{-1} and N uptake fed^{-1} of some sugarcane varieties and their interactions in 2016/2017 and 2017/2018 seasons

Bio and inorganic fertilizer	Nitrogen%							
	First season				Second season			
	Varieties							
	G.T.54-9	G.47-2003	G99-103	Mean	G.T.54-9	G.47-2003	G99-103	Mean
100% N RD	2.24	2.22	2.21	2. 34	2.29	2.27	2.26	2.39
50 % N RD+ *A. chroococcum*	2.35	2.36	2.32	2.23	2.40	2.41	2.37	2.28
75 % N RD+ *A. chroococcum*	2.45	2.34	2.64	2.45	2.50	2.39	2.69	2.50
100% N RD + *A. chroococcum*	2.33	2.36	2.37	2.35	2.38	2.41	2.42	2.40
Mean	2.34	2.33	2.35	2.34	2.39	2.38	2.40	2.39
LSD $_{0.05}$	NS				0.02			
LSD $_{0.05}$	0.03				0.06			
LSD $_{0.05}$	0.05				0.08			
	Uptake plant^{-1}							
100% N RD	0.026	0.022	0.031	0.026	0.031	0.027	0.036	0.031
50 % N RD + *A. chroococcum*	0.022	0.021	0.028	0.024	0.027	0.026	0.033	0.029
75 % N RD +*A. chroococcum*	0.028	0.026	0.036	0.030	0.033	0.032	0.041	0.035
100% N RD + *A. chroococcum*	0.027	0.025	0.035	0.029	0.032	0.030	0.040	0.034
Mean	0.026	0.023	0.033	0.027	0.031	0.028	0.038	0.031
LSD $_{0.05}$	0.002				0.005			
LSD $_{0.05}$	0.001				0.003			
LSD $_{0.05}$	0.002				0.003			
	Uptake fed^{-1}							
100% N RD	127.47	103.73	137.12	122.79	132.41	108.71	142.11	127.71
50 % N RD+ *A. chroococcum*	113.74	98.85	124.10	112.23	118.72	103.81	129.12	117.21
75 % N RD+ *A. chroococcum*	140.38	124.15	166.84	143.79	145.32	129.12	171.81	148.72
100% N RD + *A. chroococcum*	128.13	117.01	151.67	132.27	133.12	122.03	156.65	137.27
Mean	127.43	110.95	144.93	127.77	131.41	115.95	149.91	132.42
LSD $_{0.05}$	8.04				8.09			
LSD $_{0.05}$	6.40				6.45			
LSD 0$_{.05}$	6.55				6.88			

4. Cane yield ton fed^{-1}, Sugar recovery and sugar yield ton fed^{-1} traits:

4.1. Varietal effect:

Results in Table (8) illustrated that varieties of sugarcane differed significantly in cane yield (ton fed^{-1}), sugar recovery (%) and sugar yield (ton fed^{-1}) traits. The data present indicated that significant increasing of the three varieties by cane yield ton fed^{-1}, sugar recovery and sugar yield ton fed^{-1} traits.

It could be demonstrated from the results that variety G.99-103 recorded the highest values of cane yield (64.18 and 65.34 ton) and sugar yield (6.18 and 16.84 ton), while variety G.T.54-9 recorded the highest values of sugar recovery (11.64 and 11.64 %), respectively treatment.

4.2. Bio and inorganic fertilizer Effect:

Results by Table (8) the effect bio and inorganic fertilizer of nitrogen. Results had recorded positive influence inoculation with *Azotobacter chroccocum* on cane yield ton fed^{-1}, sugar recovery and sugar yield ton fed^{-1}. The higher values had of 75% N RD + bio fertilizer. (57.29 and 58.43 ton) cane yield ton fed^{-1}, (10.99 and 11.09 %) sugar recovery and (6.42 and 6.39 ton) sugar yield ton fed^{-1}, respectively, these results were agreed with Shaban and Helmy (2006) who stated that nitrogen uptake was increased significantly by the application of different nitrogen rates and *Azotobacter* as compared to the control.

Table 8: Effect of bio and inorganic fertilizer on cane yield ton fed^{-1}, sugar recovery and sugar yield ton fed^{-1} of some sugarcane varieties and their interactions in 2016/2017 and 2017/2018 seasons

Bio and inorganic fertilizer	Cane yield ton fed^{-1}							
	First season				Second season			
	Varieties							
	G.T.54-9	G.47-2003	G99-103	Mean	G.T.54-9	G.47-2003	G99-103	Mean
100% N RD	53.50	46.00	64.87	54.79	54.50	47.77	66.23	56.17
50 % N RD + *A. chroococcum*	43.60	41.07	54.23	46.30	44.83	42.20	55.70	47.58
75 % N RD +*A. chroococcum*	51.93	48.77	69.13	57.29	53.03	50.30	69.87	58.43
100% N RD + *A. chroococcum*	53.60	49.80	68.47	56.61	55.07	50.67	69.57	57.73
Mean	50.66	46.30	64.18	53.75	51.89	47.73	65.34	54.98
LSD $_{0.05}$		1.31				1.42		
LSD $_{0.05}$		3.45				3.57		
LSD $_{0.05}$		NS				NS		
	Sugar recovery %							
100% N RD	11.61	10.24	10.61	10.82	11.73	10.31	10.68	10.91
50 % N RD + *A. chroococcum*	12.01	10.29	10.63	10.98	12.11	10.35	10.70	11.05
75 % N RD + *A. chroococcum*	11.94	10.38	10.66	10.99	12.07	10.46	10.72	11.09
100% N RD + *A. chroococcum*	11.02	10.68	9.76	10.49	11.20	10.72	9.81	10.57
Mean	11.64	10.40	10.42	10.82	11.78	10.46	10.48	10.91
LSD $_{0.05}$		0.31				0.32		
LSD $_{0.05}$		0.19				0.22		
LSD $_{0.05}$		0.50				0.52		
	Sugar yield ton fed^{-1}							
100% N RD	6.18	4.86	7.01	6.01	6.40	4.93	7.10	6.13
50 % N RD + *A. chroococcum*	5.31	4.30	5.91	5.17	5.43	4.37	5.96	5.25
75 % N RD + *A. chroococcum*	6.30	5.23	7.73	6.42	6.40	5.27	7.49	6.39
100% N RD + *A. chroococcum*	6.04	5.35	7.34	6.24	6.16	5.41	6.82	6.13
Mean	5.96	4.93	7.02	5.97	6.10	4.99	6.84	5.98
LSD $_{0.05}$		0.66				0.42		
LSD $_{0.05}$		0.71				0.55		
LSD $_{0.05}$		NS				NS		

4.3. Interactions effect:

Interactions between of varieties and Bio and inorganic fertilizer by regard to cane yield ton fed^{-1}, SR% and sugar yield ton fed^{-1} are scored in Table (8). Interaction between the varieties and levels of nitrogen fertilizer mixed with bio fertilizer by maximum increase significant difference observed in var. G99- 103 with (75% N RD + *A. chroococcum*.) by SR. While increase was un- significant with yield ton fed^{-1}, and yield of sugar ton fed^{-1} in the 1st season. Sugar cane variety G.99-103 attained the highest sugar yield in the two growing seasons. The increase in cane yield may be attributed to increasing quality traits as a result in fertilizing plants by nitrogen and bio fertilizer which improving and building plant organic through synthesis of protein and its integral part of the chlorophll molecules. Also,

nitrogen important to the synthesis of sucrose and the reactions involving the utilization of sucrose as an energy source for plant growth and cell maintenance. So, the final product (sugar yield) became higher with helping the gene make up of varieties of sugarcane. Varietal influence on sugar yield had been recorded by Ibraheem Abd Elateef *et al.,* (2016).

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