EFFECT OF BIOFERTILIZATION AND SEEDING RATE ON YIELD AND QUALITY OF FOUR SUGARCANE VARIETIES

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Abstract

Two field trials were carried out at Mattana Agricultural Research Station, Qena Governorate in two successive growing seasons (2004/2005 and 2005/2006) to evaluate the performance of four sugar cane varieties (G.T 54-9, ph.8013, G95-19 and F.161) under three biofertilization treatments (*Cerealin*, *Azotobacter* and *Azospirillum*) and three seeding rates, i.e. 8400, 12600 and 16800 of 3- budded cane cuttings arranged in 1, 1.5 and 2 rows, respectively. A split-split plot design with three replications was used in both seasons, the three biofertilizers treatments were allocated in main plots, while the three seeding rates were distributed in the sub plots and the four varieties were randomly distributed in the 2nd order plots.

The results indicated that bacterial inoculation of sugarcane significantly improved stalk height, purity percentage and sugar recovery, number of millable cane/fed cane yield in both seasons. However, bacterial inoculation significantly improved stalk diameter and sucrose in the second season only. Inoculation with *Azotobacter* gave the highest values of cane and sugar yields and sugar recovery %.

Planting sugarcane using 16800 cane setts/fed in two rows attained significantly higher stalk height, purity percentage, number of millable cane/fed and cane yield in both seasons. Whereas, sucrose and sugar yield were insignificantly affected by seed rate in both seasons. However, seed rate significantly affected stalk diameter and sugar recovery% in the second season only.The results indicated that the tested sugarcane varieties differed significantly in all traits under study. G.T 54-9 variety recorded the highest sucrose and purity percentages and sugar recovery%. while, P.h 8013 variety surpassed all varieties in cane and sugar yields. The effect of the 1st order and 2nd interactions on all studied traits were insignificant in both seasons.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is the world's most important sugar crop. Because of its long growing season and high maximum growth rate, sugarcane has large nutrient requirements of which nitrogen is the most important (Fageria *et al*, 1997). Biofertilization has long been served to decrease the environmental pollution caused by the high doses of N fertilizer of sugarcane fields. Biofertilizers which provide up to 80% of the host plant's nitrogen requirement promote rooting and improve sugarcane growth by direct effects on metabolic processes, in addition to their role in N_2 fixation. Biofertilizers also have an important role in the utilization of N by sugarcane through higher biological N fixation and increasing the availability and uptake of N. The economical advantages of biofertilizers in sugarcane N nutrition were reported by many workers. Thakur and Singh (1996) studied the effect of bio-fertilizers (*Azotobacter chroococcum* and *Azospirillum brazilense),* they found that there was an increase in cane and sugar yields compared with nitrogen fertilizers alone and cane juice quality was significantly improved with bio-fertilizers. Osman (2000) showed that inoculating sugarcane with bio-fertilizers affected significantly stalk height, stalk diameter, number of millable canes (thousand/fed), net cane yield and sugar yield (ton/fed). Also, El Geddawy *et al* (2003) found that inoculating sugarcane by *Azotobacter* or *Azospirillum* produced significantly the highest values of cane and sugar yields and sugar recovery%.

Seeding rate plays a distinct role in defining the number of shoots emerged and mortality. Concerning the influence of seeding rate, El-Shafai (1996) showed that planting sugarcane with two rows of cane sets (50400 buds/fed) significantly increased stalk height but decreased its diameter compared with planting 1.5 rows (37800) buds/fed). Zahoor *et al.* (1997) planted sugarcane at a density of 30000, 40000 or 50000 sets/ha. They showed that sugar yield was highest with 40000 sets/ha, while juice quality (pol, purity and sugar content) were not affected by plant density. Bull *et al.* (2000) mentioned that the theory behind high density planting (HDP) is based on the fact that current crops intercept less than 60% of the solar radiation available during the season. They added that HDP significantly increases light interception in the period prior to canopy closure and can also make better use of available water and nutrient resources during this period suggesting that close rows have the potential to increase crop yield of cane per hectare. However, Avtar *et al.* (2001) grew sugarcane at seeding rates of 50000 and 75000 three-budded seeding sets/ha. They revealed that higher cane yield was obtained at a seeding rate of 50000 compared to 75000 three-budded sets/ha. Shahid *et al.* (2001) studied the effect of different planting densities (100, 150, 200 and 250 thousand buds/ha) on yield of sugarcane. They found that increasing planting rate gave higher cane yield. El-Sogheir and Mohamed (2003) and Ahmed (2005) studied the effect of two seed rates of 1.5 and 2.0 rows of cane cuttings. They found that planting sugarcane using 16800 cane setts/fed. in two drills attained significantly higher number of millable stalk/m^2, cane and sugar yields compared with 12600 cuttings/fed. Higher values of stalk height, number of millable canes/m2 and purity percentage were significantly obtained by planting 2 drills. On the contrary, thicker stalks were produced in case of using 16800 cane setts/fed.

In Egypt, Yousef *et al.* (1998) observed wide variation in sucrose, purity and sugar yield among varieties. Moreover, Yousef *et al.* (2000) revealed that sugarcane varieties differed significantly in millable cane length, diameter and cane yield. Ahmed (2000) evaluated five sugarcane genotypes (G.85-37, G.84-47, F.153, G.75-368 and G.87-55) compared with the commercial variety G.T. 54-9. He found that the tested cane varieties were significantly different in cane and sugar yields. Mohamed and Ahmed (2002) obtained significant differences among the studied cane varieties in stalk height, diameter and net cane and sugar yields. Ahmed (2003-a) revealed that the promising sugarcane varieties G.95-19, G.95-21 and ph.8013 differed markedly in millable cane height, diameter, sucrose% and sugar yield. He mentioned that the differences among varieties could be to the relative importance of gene make-up.

MATERIALS AND METHODS

Two field trials were carried out at Mattana Agricultural Research Station, Qena Governorate in two successive seasons (2004/2005 and 2005/2006) to find out the response of four sugar cane varieties(G.T 54-9, ph.8013, G95-19 and F.161) to three bio-fertilizer sources (*Cerealin, Azotobacter* and *Azospirillum*) at the rate of 1.5kg/fed per each and three cutting seeding rates, 8400, 12600 and 16800 of 3- budded cane cuttings and arranged in 1, 1.5 and 2 rows, respectively. A split-split plot design with three replications was used in both seasons, where the three biofertilizers were allocated in main the plots, while the three seeding rates were distributed in the sub plots and the four varieties were randomly distributed in the sub-sub plots. Plot area was 42m^2 (including 7 rows of 1m apart and 6m in length). Soil mechanical analyses of the experimental site showed that 29.4% sand, 10.4% silt and 59.6% clay. The soil texture is clay loamy. Som chemical parameters of soil were 74, 11.7 and 210 ppm of N, P and K respectively, pH was 7.6. Planting took place in the 2nd week of March, while harvesting was done at age of twelve months, in both seasons. Urea (46%N) was applied in two equal doses by rate 210Kg/fed. The first dose was applied after two months from planting and the second one was added one month later. Other agricultural practices were practiced as recommended by Sugar Crops Research Institute.

The recorded data:

At harvest, twenty millable canes from each plot were randomly collected to determine the following traits:

1. Stalk height (cm) was measured from soil surface up to the top visible dewlap.
2. Stalk diameter (cm) was measured at the middle part of the stalk.
3. Sucrose percentage in cane juice was determined using Saccharemeter according to A.O.A.C. (1995).
4. Purity percentage was calculated according to the following equation:
   Purity % = (sucrose % / Brix %) x100.
   Where: Brix percentage (total soluble solids %) in juice was

determined using Brix Hydrometer standarized at 20 °c).

5. Number of millable canes (thousand/fed) were counted.
6. Sugar recovery percentage was calculated as follows:

   Sugar recovery % = Richness% x Purity%

   Where: Richness = (Sucrose in 100g x factor)/100.

   Factor = 100- [fiber % + physical impurities% + percent water free from sugar].
7. Cane yield (ton/fed). The millable canes of the three guarded rows from each treatment were harvested, topped, cleaned, weighed and cane yield (tons/fed) was determined.
8. Sugar yield (tons/fed) was calculated as follows:

   Sugar yield (tons/fed) = cane yield (tons/fed) x sugar recovery%.

The recorded data were statistically analyzed according to Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

1- Stalk height:

The results in Table (1) cleared that biofertilizers had a significant effect on stalk height in both seasons. Inoculating sugarcane cuttings with *Azotobacter* gave the highest mean value of stalk height (282.4, 285.9cm) over *Cerealin* (271.4, 272.5cm) or *Azospirillum* (264.2, 263.1cm) in both seasons. This result is in accordance with that reported by Osman (2000).

The seeding rate had a significant effect on stalk height in both seasons. Increase of seeding rate to 37800 buds/fed (1.5 rows of cane cuttings) and 50400 buds/fed (2.0 rows of cane cuttings) led to an increase in stalk height in both seasons, compared with planting 25200 buds/fed (1.0 row of cane cuttings). The increase in plant height accompanying the increase of seeding rate could be attributed to the fact that increasing planting density led to an increase in competition among plants for solar radiation leading to the elongation of internodes. This result is in harmony with that reported by El-Shafai (1996), El-Sogheir and Mohamed (2003). The results showed that the tested sugarcane varieties differed significantly in stalk height. It was noticed that G.T. 54-9 variety attained the highest value of stalk height over the other varieties in the two seasons. While, G. 95-19 variety recorded the lowest value of this trait. The differences among cane varieties could be due to their gene make-up effect. This result is in line with those found by Yousef *et al.* (2000), Mohamed and Ahmed (2002) and Ahmed (2003-a).

The first and second order interactions between studied factors were insignificant with respect to stalk height in both seasons.

Table 1. Stalk height (cm) of the four sugarcane varieties as affected by biofertilizers and seeding rates.

Bio-Fertilizers	Seeding rates (Buds/fed)	Season 2004/2005					Season 2005/2006				
		Varieties									
		Gt.54-9	Ph. 8013	G.95-19	F161	Mean	Gt.54-9	Ph. 8013	G.95-19	F161	Mean
Cerealin	25 200	284.5	267.3	245.6	255.6	263.3	289.6	266.7	249.4	253.7	264.9
	37 800	289.6	278.4	254.7	267.1	272.5	297.2	275.7	256.5	261.4	272.7
	54 400	297.5	284.5	259.8	272.3	278.5	299.7	282.6	261.7	275.5	279.9
	Mean	290.5	276.7	253.4	265.0	271.4	295.5	275.0	255.9	263.5	272.5
Azotobacter	25 200	293.4	282.6	255.3	264.8	274.0	302.5	284.5	253.7	269.7	277.6
	37 800	306.7	291.5	263.8	271.2	283.3	310.4	290.4	267.3	274.5	285.6
	54 400	313.5	298.2	269.4	278.3	289.9	317.2	303.4	274.6	282.6	294.5
	Mean	304.5	290.7	262.8	271.4	282.4	310.0	292.7	265.2	275.6	285.9
Azospirillum	25 200	272.8	261.4	242.1	247.5	256.0	276.5	259.5	240.5	245.6	255.5
	37 800	281.5	272.8	252.0	253.3	264.9	282.8	272.5	248.6	251.7	263.9
	54 400	287.1	280.7	257.5	261.5	271.7	291.5	278.3	251.4	258.4	269.9
	Mean	280.5	271.6	250.5	254.1	264.2	283.6	270.1	246.8	251.9	263.1
Mean		291.8	279.7	255.6	263.5	272.6	296.4	279.3	256.0	263.7	273.8

L.S.D. at 5% level for:		
Bio-fertilizer (A)	5.97	6.30
Seeding rate (B	5.92	5.30
Sugarcane varieties(C)	8.43	8.44
(A) x (B)	N.S	N.S
(A) x (C)	N.S	N.S
(B) x (C)	N.S	N.S
(A) x (B) x (C)	N.S	N.S

2- Stalk diameter:

Data presented in Table (2) showed that the stalk diameter was significantly affected by biofertilizer in the second season only. *Azotobacter* treatment was the superior bacterium, it gave the highest mean values (2.76, 2.79cm) over that inoculated with *Cerealin* or *Azospirillum* in both seasons. This result may be due to that *Azotobacter* could improve sugarcane growth by direct effects on metabolic processes, in addition to its role in N_2 fixation. This result is in accordance with those reported by Osman (2000). Planting cane with 25200 buds/fed revealed that appreciably and positively influenced stalk diameter compared with planting 37800 and 54400buds/fed in both seasons. However, this effect was significant in the second season only. The thinner stalk observed in case of planting double rows is mainly due to the increase in plant population density leading in turn to an increase in competition among grown cane plants for light, water and nutrients. This result is in line with that obtained by Ei-

Shafai (1996) and El-Sogheir and Mohamed (2003). The data showed significant differences in stalk diameter among the evaluated sugarcane varieties in the two seasons. The results pointed out that Ph.8013 variety was characterized by the thickest cane stalk. These are mainly due to the differences in the genetic constitution of the tested varieties. This results is in agreement with those reported by Yousef *et al.* (2000), Mohamed and Ahmed (2002) and Ahmed (2003-a).

Table 2. Stalk diameter (cm) of the four sugarcane varieties as affected by biofertilizers and seeding rates.

Bio-Fertilizers	Seeding rates (Buds/fed)	Season 2004/2005					Season 2005/2006				
		Varieties									
		Gt.54-9	Ph. 8013	G.95-19	F161	Mean	Gt.54-9	Ph. 8013	G.95-19	F161	Mean
Cerealin	25 200	2.78	3.05	2.58	2.60	2.75	2.72	3.07	2.56	2.62	2.74
	37 800	2.69	2.87	2.54	2.52	2.66	2.62	2.75	4.48	2.54	2.59
	54 400	2.62	2.81	2.50	2.52	2.61	2.55	2.69	1.41	2.51	2.53
	Mean	2.70	2.91	2.54	2.55	2.67	2.63	2.84	2.48	2.56	2.63
Azotob-acter	25 200	2.93	3.26	2.65	2.71	2.89	2.91	3.31	2.68	2.75	2.91
	37 800	2.78	3.04	2.54	2.58	2.74	2.77	3.17	2.61	2.62	2.79
	54 400	2.67	2.92	2.52	2.52	2.66	2.64	2.91	2.55	2.54	2.66
	Mean	2.79	3.07	2.57	2.60	2.76	2.77	3.13	2.61	2.64	2.79
Azospir-illum	25 200	2.68	2.92	2.52	2.52	2.66	2.61	2.75	2.44	2.50	2.57
	37 800	2.57	2.81	2.49	2.45	2.58	2.53	2.62	2.50	2.43	2.49
	54 400	2.54	2.74	2.43	2.43	2.54	2.51	2.57	2.37	2.38	2.45
	Mean	2.60	2.82	2.48	2.47	2.59	2.55	2.65	2.40	2.44	2.51
Mean		2.70	2.94	2.53	2.59	2.68	2.65	2.87	2.50	2.54	2.64

L.S.D. at 5% level for:		
Bio-fertilizer (A)	N.S.	0.11
Seeding rate (B	N.S.	0.09
Sugarcane varieties(C)	0.19	0.12
(A) x (B)	N.S	N.S
(A) x (C)	N.S	N.S
(B) x (C)	N.S	N.S
(A) x (B) x (C)	N.S	N.S

Stalk diameter were not significantly affected by the first and second orders interactions in both seasons.

3- Sucrose percentage:

Table (3) illustrate the effect of inoculation with biofertilizer on sugar percentage. Data showed that the sugar percentage was significantly affected by biofertilizer in the second season only. Inoculation sugarcane cuttings with *Azotobacter* bacteria recorded the highest sucrose percentage (18.72%, 18.61%) in both seasons. However this increase in sucrose percentage did not reach the level of significant in the first season. These results are in line with those outlined by Thakur and Singh (1996). On the other hand, sucrose percentage was not significantly affected by the used seeding rates in both seasons. This agreement with those reported by Zahoor *et al.* (1997) and Ahmed (2005). However the evaluated sugarcane varieties revealed different significantly in sucrose percentage in both seasons. The variety G.T. 54-9 surpassed the other varieties and markedly recorded the highest sucrose percentage (19.01%) and (18.79%) in the first and second seasons respectively. While F.161 variety was inferior to the other two varieties in sucrose percentage (17.58% and 17.35%) in the first and second seasons respectively. The variation among sugarcane varieties in sucrose percentage could be attributed to their genetic structures. Differences among cane varieties in sucrose percentage were reported by Yousef *et al.* (1998) and Ahmed (2003-a).

The first and second order interactions between factors under study were insignificant with respect sucrose percentage in both seasons.

Table 3. Sucrose percentage of the four sugarcane varieties as affected by bio fertilizers and seeding rates.

Bio-Fertilizers	Seeding rates (Buds/fed)	Season 2004/2005					Season 2005/2006				
		Varieties									
		Gt.54-9	Ph. 8013	G.95-19	F161	Mean	Gt.54-9	Ph. 8013	G.95-19	F161	Mean
Cerealin	25 200	19.15	18.82	17.91	17.55	18.36	19.21	18.85	18.21	17.51	18.45
	37 800	18.85	18.73	17.67	18.32	18.39	18.72	18.65	18.11	17.28	18.19
	54 400	18.71	18.50	17.42	17.20	17.96	18.36	18.51	17.87	17.18	17.98
	Mean	18.90	18.68	17.67	17.69	18.24	18.76	18.67	18.06	17.32	18.21
Azotob-acter	25 200	19.73	19.17	18.15	17.83	18.72	19.56	19.11	18.87	17.77	18.83
	37 800	19.46	18.68	18.85	18.51	18.87	19.18	18.87	18.61	18.02	18.67
	.54 400	19.15	18.92	18.80	17.35	18.56	18.85	18.65	18.55	17.22	18.32
	Mean	19.45	18.92	18.60	17.90	18.72	19.20	18.88	18.68	17.67	18.61
Azospir-illum	25 200	18.83	18.98	17.50	17.27	18.14	18.92	18.08	17.85	17.22	18.02
	37 800	18.65	18.25	17.18	17.15	17.81	18.35	17.91	17.38	17.02	17.67
	54 400	18.57	18.11	17.10	17.11	17.72	17.92	17.52	17.21	16.95	17.40
	Mean	18.68	18.45	17.26	17.18	17.89	18.40	17.84	17.48	17.06	17.69
Mean		19.01	18.68	17.84	17.58	18.28	18.97	18.46	18.07	17.35	18.17

L.S.D. at 5% level for:		
Bio-fertilizer (A)	N.S.	0.57
Seeding rate (B	N.S.	N.S.
Sugarcane varieties(C)	0.72	0.60
(A) x (B)	N.S	N.S
(A) x (C)	N.S	N.S
(B) x (C)	N.S	N.S
(A) x (B) x (C)	N.S	N.S

4- Purity percentage:

The purity percentage was significantly affected by inoculating of sugarcane cuttings in both seasons. Inoculation with *Azotobacter* gave the highest mean values of purity percentages in the both seasons (80.85%, 81.92%) compared with *Cerealin* or *Azospirillum*. Similar results were obtained by Thakur and Singh (1996). Data illustrated in Table (4) revealed that significant differences in juice purity percentage. Results indicated that planting sugarcane using 8400 (1.0 row), 12600 (1.2 rows) or 16800 (2.0 rows) of cane cuttings/fed had significant effect on purity percentage in the both seasons. However, planting sugarcane using 1.0 drill recorded higher purity percentage compared with 1.5 and 2.0 drills of cane cuttings in both seasons. This result is in accordance with that reported by Zahoor *et al.* (1997) and Ahmed (2005).

Table 4. Purity percentage of the four sugarcane varieties as affected by bio fertilizers and seeding rates.

Bio-Fertilizers	Seeding rates (Buds/fed)	Season 2004/2005					Season 2005/2006				
		Varieties									
		Gt.54-9	Ph. 8013	G.95-19	F161	Mean	Gt.54-9	Ph. 8013	G.95-19	F161	Mean
Cerealin	25 200	84.87	80.25	83.72	73.70	80.64	84.65	79.87	84.41	76.20	81.28
	37 800	82.42	79.60	81.82	71.92	78.94	85.17	78.11	83.50	74.35	80.28
	54 400	83.35	78.77	79.75	71.17	78.26	84.72	77.75	82.81	73.65	79.58
	Mean	83.55	79.54	81.76	72.26	79.28	84.85	78.58	83.36	74.73	80.38
Azotob-Acter	25 200	83.73	81.50	85.54	75.80	81.64	84.12	82.62	86.23	78.18	82.79
	37 800	86.11	80.17	84.22	74.41	81.23	86.76	81.11	85.11	75.23	82.05
	54 400	82.57	79.85	82.81	73.44	79.67	85.15	79.85	84.10	74.55	80.91
	Mean	84.14	80.51	84.19	74.55	80.85	85.34	81.19	85.15	75.99	81.92
Azospir-Illum	25 200	85.18	79.31	83.31	72.81	80.15	82.93	78.66	82.62	75.51	79.93
	37 800	84.21	78.82	82.20	74.53	79.19	83.24	77.81	81.41	72.68	78.79
	54 400	83.11	78.70	80.10	70.75	78.17	83.07	77.12	80.65	71.40	78.06
	Mean	84.17	78.94	81.87	71.70	79.17	83.08	77.86	81.56	73.20	78.93
Mean		83.95	79.66	82.60	72.84	79.77	84.42	79.21	83.35	74.64	80.41

L.S.D. at 5% level for:		
Bio-fertilizer (A)	0.69	0.74
Seeding rate (B	0.57	0.63
Sugarcane varieties(C)	1.06	1.11
(A) x (B)	N.S	N.S
(A) x (C)	N.S	N.S
(B) x (C)	N.S	N.S
(A) x (B) x (C)	N.S	N.S

Data in Table (4) point out that the evaluated sugarcane varieties differed significantly in juice purity percentage in both seasons. Sugarcane variety G.T.54-9 attained the highest mean value of purity percentage (83.95%, 84.42% in both seasons. respectively) compared with the other varieties. This result may be due to higher sucrose percentage recorded by this variety (Table 3). Meantime, variety F.161 recorded the lowest value of this trait in the two seasons. These results are in agreement with that mentioned by Yousef *et al.* (1998).

The first and second order interactions between factors under study were insignificant with respect purity percentage in both seasons.

5- Sucrose recovery percentage:

A significant effect on sugar recovery percentage by biofertilizer in both seasons. Inoculation of sugarcane cuttings with *Azotobacter* treatment gave the highest values of sugar recovery percentage in both seasons compared with *Cerealin* or *Azospirillum*. This result is in line with those outlined by Thakur and Singh (1996) and El Geddawy *et al* (2003).

Table 5. Sucrose recovery percentage of the four sugarcane varieties as affected biofertilizers and seeding rates.

Bio-Fertilizers	Seeding rates (Buds/fed)	Season 2004/2005					Season 2005/2006				
		Varieties									
		Gt.54-9	Ph. 8013	G.95-19	F161	Mean	Gt.54-9	Ph. 8013	G.95-19	F161	Mean
Cerealin	25 200	13.15	12.39	12.13	10.49	12.04	13.16	12.33	12.46	10.80	12.19
	37 800	12.58	12.21	11.70	10.67	11.79	12.90	11.95	12.26	10.40	11.88
	54 400	12.61	11.96	11.26	9.93	11.44	12.60	11.79	11.90	10.26	11.64
	Mean	12.78	12.19	11.70	10.36	11.76	12.89	12.03	12.21	10.49	11.90
Azotob-Acter	25 200	13.37	12.82	12.58	10.94	12.43	13.13	12.94	13.18	11.25	12.67
	37 800	13.56	12.26	12.85	11.17	12.46	13.47	12.56	12.82	10.98	12.46
	54 400	12.80	12.38	12.61	10.31	12.03	13.01	12.21	12.63	10.41	12.06
	Mean	13.24	12.49	12.68	10.81	12.30	13.26	12.57	12.88	10.88	12.40
Azospir-Illum	25 200	13.00	12.33	11.80	10.18	11.83	12.70	11.65	11.94	10.53	11.71
	37 800	12.71	11.77	11.45	9.93	11.47	12.38	11.43	11.45	10.01	11.32
	54 400	12.51	11.69	11.08	9.81	11.27	12.05	11.07	11.24	9.81	11.04
	Mean	12.74	11.93	11.44	9.97	11.52	12.38	11.39	11.54	10.12	11.36
Mean		12.92	12.20	11.94	10.38	11.86	12.84	11.99	12.21	10.49	11.89

L.S.D. at 5% level for:		
Bio-fertilizer (A)	0.51	0.32
Seeding rate (B	N.S.	0.81
Sugarcane varieties(C)	0.44	0.40
(A) x (B)	N.S	N.S
(A) x (C)	N.S	N.S
(B) x (C)	N.S	N.S
(A) x (B) x (C)	N.S	N.S

Data in Table (5) showed that sugar recovery percentage was significantly affected by the studied seeding rates in the second season only. Planting sugarcane using the lowest seeding rate (25200 buds/fed) gave the highest mean value of this trait. The lowest sugar recovery percentage was obtained from sugarcane planted with (50400 buds/fed). This result is in accordance with those reported by Ahmed (2005).

Results obtained in Table (5) that the Evaluated sugarcane varieties revealed differed significantly in sugar recovery percentage in the two seasons. Sugarcane variety G.T.54-9 attained the highest value of sugar recovery percentage (12.92%, 12.84% in both seasons. respectively) while, variety F.161 recorded the lowest value. This result is probably due to higher values of sucrose and purity percentages recorded by G.T.54-9 and lower one of F.161 variety (Table 3, 4). These results are in line with those outlined by Ahmed (2003-a).

Sugar recovery percentage were not significantly affected by the first and second its interactions in both seasons.

6- Number of millable cane/fed:

Data in Table (6) show significant for biofertilizers on number of millable cane/fed in both seasons. Where was significant increase in this trait resulted from using *Azotobacter* compared with *Cerealin* or *Azospirillum*. The number of millable cane/fed was significantly affected by the studied seeding rates. Growing sugarcane using two rows (16800 cane cuttings/fed) attained markedly higher number of millable cane/fed compared with 1.0 and 1.5 rows (8400 and 12600 cane cuttings/fed) in both seasons. This result is probably due to higher planting bud density (50400 buds/fed) in case of 2.0 rows as compared with 1.0 and 1.5 rows (25200 and 37800 buds/fed). Similar results were obtained by Osman (2000) and El-Sogheir and Mohamed (2003). The evaluated sugarcane varieties showed different significantly in number of millable cane/fed in both seasons. Sugarcane variety Ph.8013 exhibited a significant superiority over the other varieties. The relative advantage of Ph.8013 variety in respect with cane number is due to that millable cane number is mainly affected by genetic make-up. While the lowest value of this trait was recorded by G.95-19 variety. This finding is in according with those by Yousef *et al.* (2000).

The first and second order interactions between factors under study were insignificant with respect number of millable cane/fed in both seasons.

Table 6. Number of millable cane/fed of the four sugarcane varieties as affected by biofertilizers and seeding rates.

Bio-Fertilizers	Seeding rates (Buds/fed)	Season 2004/2005					Season 2005/2006				
		varieties									
		Gt.54-9	Ph. 8013	G.95-19	F161	Mean	Gt.54-9	Ph. 8013	G.95-19	F161	Mean
Cerealin	25 200	46751	50411	41518	44317	45749	46789	51655	42810	43832	46271
	37 800	48077	51742	42718	45711	47062	49520	52714	43123	45116	47618
	54 400	49852	52551	43830	46411	48161	50671	53435	44168	46270	48636
	Mean	48227	51568	42689	45479	46991	48993	52601	43367	45072	47508
Azotob-Acter	25 200	48542	51722	42633	45541	47109	49622	52815	43115	45156	47677
	37 800	50357	53460	43417	46375	48402	51365	54127	43870	47168	49132
	54 400	52508	55312	45105	48505	50357	51844	55826	45711	48865	50561
	Mean	50469	53498	43718	46807	48623	50943	54256	44232	47063	49123
Azospir-Illum	25 200	44883	48552	40811	42850	44274	44650	48914	40721	41917	44050
	37 800	45865	50351	42131	43655	45500	48150	51365	41835	42865	46058
	54 400	47750	51865	43641	45321	47144	48356	51893	43115	44723	47021
	Mean	46166	50256	42194	43942	45639	47052	50724	41890	43175	45710
Mean		48287	51774	42867	45409	47084	48996	52527	43163	45103	47448

L.S.D. at 5% level for:	2004/2005	2005/2006
Bio-fertilizer (A)	824.97	881.80
Seeding rate (B	804.17	876.00
Sugarcane varieties(C)	810.83	1103.30
(A) x (B)	N.S	N.S
(A) x (C)	N.S	N.S
(B) x (C)	N.S	N.S
(A) x (B) x (C)	N.S	N.S

7- Cane yield (ton/fed):

The cane yield showed significant influence by biofertilizer treatments in the both seasons, Table (7). In general, sugarcane cuttings inoculated with *Azotobacter* resulted in increasing the cane yield over that inoculated with *Cerealin* or *Azospirillum.* This result could be attributed to the increased of both height stalk and diameter (Tables 1 and 2) similar effect was observed in the number of millable cane/fed (Table 6) consequently sugarcane yield. This result is in accordance with those reported by Thakur and Singh (1996), Osman (2000) and El Geddawy *et al* (2003). The significant differences in cane yield/fed due to the used seeding rates where increasing seeding rates to 37800 and to 50400 buds/fed led to a gradual increase in cane yield in the first season, corresponding in the second season. This result could by attributed to the increase in stalk height (Table 1) and number of millable cane/fed (Table 6) as seeding rate was increased. This finding was explained by Bull *et al.* (2000). who mentioned that dense population would increase light interception in the period prior to canopy closure and also make better use of available water and nutrients during this period, this result is also in agreement with that reported by Bull *et al.* (2000), Avtor *et al.* (2001), Shahid *et al.* (2001) and Ahmed (2005).

Table 7. Cane yield (ton/fed) of the four sugarcane varieties as affected by biofertilizers and seeding rates.

Bio-Fertilizers	Seeding rates (Buds/fed)	Season 2004/2005					Season 2005/2006				
		Varieties									
		Gt.54-9	Ph. 8013	G.95-19	F161	Mean	Gt.54-9	Ph. 8013	G.95-19	F161	Mean
Cerealin	25 200	41.58	45.62	39.72	37.30	41.06	43.17	46.17	35.52	39.50	41.10
	37 800	44.97	47.18	41.65	39.60	43.35	45.22	47.82	40.91	41.37	43.83
	54 400	46.42	48.41	42.71	41.85	44.85	47.40	49.32	41.87	43.12	45.43
	Mean	44.32	47.07	41.36	39.58	43.08	45.26	47.77	41.43	39.33	43.45
Azotobacter	25 200	45.72	48.35	41.86	41.92	44.46	46.21	49.60	40.75	42.35	44.73
	37 800	47.85	51.64	42.80	43.91	46.55	48.62	51.25	43.15	44.70	46.93
	54 400	50.27	53.82	43.45	46.52	48.52	51.73	54.71	45.60	47.51	49.89
	Mean	47.95	51.27	42.70	44.12	46.51	48.85	51.85	44.17	43.85	47.18
Azospirillum	25 200	40.31	44.76	37.35	36.55	39.74	41.75	45.30	36.70	36.82	40.14
	37 800	42.61	46.32	40.55	38.36	41.96	43.15	46.81	40.20	40.21	42.59
	54 400	43.80	48.50	41.82	41.70	43.96	45.35	47.80	41.11	42.65	44.23
	Mean	42.24	46.53	39.91	38.87	41.89	43.42	46.64	39.34	39.89	42.32
Mean		44.84	48.29	41.32	40.86	43.83	45.84	48.75	42.65	40.03	44.32

L.S.D. at 5% level for:	Season 2004/2005	Season 2005/2006
Bio-fertilizer (A)	0.97	1.33
Seeding rate (B	0.86	0.83
Sugarcane varieties(C)	1.10	1.29
(A) x (B)	N.S	N.S
(A) x (C)	N.S	N.S
(B) x (C)	N.S	N.S
(A) x (B) x (C)	N.S	N.S

Data presented in Table (7) showed also that sugarcane varieties differed significantly in cane yield in both seasons. Sugarcane variety Ph.8013 surpassed the other varieties in mean values of cane yield/fed (48.29, 48.75 ton/fed in both seasons respectively). This result may be due to that variety had the highest stalk diameter (Table 2). Moreover, it could be noted that the superiority of Ph.8013 and G.T.54-9 cane varieties over the other varieties with respect to cane yield/fed is mainly due to their stalk thickness, consequently it could be assured that this trait is attributed with gene make-up effect. Meanwhile, F.161 variety produced the lowest cane yield/fed in the both seasons. This result is in line with those outlined by Ahmed (2000), Yousef *et al.* (2000) and Mohamed and Ahmed (2002).

The first and second order interactions between factors under study were insignificant with respect cane yield in both seasons.

8- Sugar yield:

The results in Table (8) illustrated that sugar yield (ton/fed) was significantly affected by biofertilization in both seasons. There was a significant increase in sugar with *Azotobacter* treatment compared with *Cerealin* or *Azospirillum* treatments in both seasons. These results are in line with those outlined by Thakur and Singh (1996), Osman (2000) and El Geddawy *et al* (2003). In the meanwhile, sugar yield was not significantly affected by the used seeding rates in both seasons. However, increasing rates from 25200 to 50400 buds/fed led to a gradual increase in sugar yield in both seasons. This result is probably due to increase in cane yield as seeding rate was increased. The evaluated sugarcane varieties showed differed significantly in sugar yield/fed in the two seasons. Sugarcane variety Ph.8013 produced the highest mean values of sugar yield/fed (5.90, 5.88 ton/fed in both seasons. respectively) compared with the other two cane varieties. This result may be due to that variety had the highest cane yield/fed. Meanwhile, F.161 variety produced the lowest sugar yield/fed in the two seasons. These results are in line with that showed by Ahmed (2000), Mohamed and Ahmed (2002) and Ahmed (2003-a).

Sugar yield were not significantly affected by the first and second its interactions in both seasons.

Table 8. Sugar yield (ton/fed) of the four sugarcane varieties as affected by biofertilizers and seeding rates.

Bio-Fertilizer	Seeding rate (Buds/fed)	Season 2004/2005					Season 2005/2006				
		Varieties									
		Gt.54-9	Ph. 8013	G.95-19	F161	Mean	Gt.54-9	Ph. 8013	G.95-19	F161	Mean
Cerealin	25 200	5.46	5.66	4.81	3.92	4.96	5.69	5.70	4.44	4.27	5.02
	37 800	5.65	5.75	4.88	4.21	5.12	5.82	5.72	5.00	4.30	5.21
	54 400	5.85	5.80	4.82	4.14	5.15	5.97	5.81	4.98	4.42	5.29
	Mean	5.65	5.74	4.84	4.09	5.08	5.83	5.74	4.81	4.33	5.18
Azotob-acter	25 200	6.10	6.21	5.25	4.59	5.54	6.16	6.42	5.39	4.78	5.69
	37 800	6.50	6.34	5.49	4.91	5.81	6.55	6.43	5.54	4.91	5.86
	54 400	6.44	6.67	5.50	4.79	5.85	6.71	6.68	5.77	4.93	6.02
	Mean	6.35	6.41	5.41	4.77	5.73	6.47	6.51	5.57	4.87	5.86
Azospir-illum	25 200	5.26	5.53	4.41	3.73	4.73	5.31	5.28	4.38	3.86	4.71
	37 800	5.40	5.46	4.65	3.81	4.83	5.35	5.34	4.60	4.03	4.82
	54 400	5.47	5.67	4.64	4.09	4.97	5.47	5.29	4.62	4.19	4.89
	Mean	5.38	5.55	4.57	3.87	4.84	5.38	5.31	4.53	4.03	4.81
Mean		5.79	5.90	4.94	4.24	5.22	5.85	5.88	4.97	4.41	5.28

L.S.D. at 5% level for:		
Bio-fertilizer (A)	0.21	0.22
Seeding rate (B)	N.S	N.S
Sugarcane varieties(C)	0.24	0.24
(A) x (B)	N.S	N.S
(A) x (C)	N.S	N.S
(B) x (C)	N.S	N.S
(A) x (B) x (C)	N.S	N.S

The insignificantly of the first and second seasons and its interactions between factors under study in all growth and yield attributes clearly indicate that the tested varieties responded in similar magnitudes to biofertilization and seeding rates. However, Ph. 8013 was the superior variety in sugar yield and all of its attributes. Probably due to having thick stalks with a medium stalk length. The superiority of *Azotobacter* inoculums might refer to efficient N fixation which could be attributed to a more harbouring by the bacteria on sugarcane roots.

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تأثير التسميد الحيوى ومعدل التقاوى على المحصول والجودة لأربعة اصناف من قصب السكر

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أقيمت تجربتان حقليتان بمحطة بحوث المطاعنة الزراعية بمحافظة قنا فى موسمى ٢٠٠٤/٢٠٠٥ و٢٠٠٥/٢٠٠٦ لتقييم أربعة أصناف من قصب السكر هى جيزة– تايوان ٥٤–٩ ، بى أتش ٨٠١٣ ، جيزة ٩٥–١٩ و أف ١٦١ كقصب غرس ربيعى. تحت تأثير ثلاث من اللقاحات البكتيرية كأسمدة حيوية هى سيريالين، أزوتوباكتر ، أزوسبيرللم. وثلاث معدلات من التقاوى (٨٤٠٠ و ١٢٦٠٠و ١٦٨٠٠ عقلة/فدان ،بكل منها ثلاث براعم وتم وضعها فى الخطوط كصف، صف ونصف، وصفين من العقل)وكان التصميم المستخدم هو القطع المنشقة مرتين فى ثلاث مكررات ، حيث تم وضع معاملات التسميد الحيوى فى القطع الرئيسية ومعدلات التقاوى فى القطع الشقية الأولى. بينما وزعت الأصناف عشوائيا فى القطع الشقية الثانية.

أوضحت النتائج وجود فروق معنوية فى استخدام التسميد الحيوى البكتيرى حيث تفوق السماد الحيوى أزوتوباكتر وأعطى قيم متوسطات عالية لجميع الصفات مقارنة بالسيريالين والأزوسبيرللم.

أدت زيادة معدلات التقاوى من ٨٤٠٠ الى ١٢٦٠٠ و ١٦٨٠٠ عقلة/فدان الى زيادة معنوية فى طول الساق وعدد العيدان القابلة للعصير وحاصل العيدان فى كلا الموسمين. بينما لم يكن لمعدلات التقاوى المستخدمة تأثير معنوى على النسبة المئوية للسكروز وحاصل السكر فى كلا الموسمين. وكان لها تأثير معنوى على قطر الساق والسكر الناتج فى الموسم الثانى فقط.

أوضحت النتائج أن أصناف قصب السكر التى تم تقييمها قد تباينت معنويا فى إرتفاع وقطر الساق، عدد العيدان القابلة للعصير وحاصل العيدان والنسبة المئوية للسكروز، النسبة المئوية لنقاوة العصير، النسبة المئوية للسكر الناتج، والسكر فى كلا الموسمين وتفوق الصنف بى أتش فى حاصلى العيدان والسكر ثم الصنف جيزة– تايوان ٥٤–٩.

لم يلاحظ تداخل فعل معنوى من عوامل الدراسة على جميع صفات الحاصل والجودة خلال موسمى الدراسة .