

## RESPONSE OF SWEET SORGHUM (*SORGHUM BICOLOR* L.) TO MINERAL NITROGEN AND BIOFERTILIZATION

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### Abstract

Two field experiments were carried out on a clay loamy soil at the experimental field of the Agricultural Research Station Sabaheia, Alexandria during 2001 and 2002 seasons, to study the effect of three levels of a mineral nitrogen fertilizer (40, 60 and 80 kg N/fed in urea form) and three levels of biofertilizer (0, 800 and 1600 g cereal/fed) on sweet sorghum var. Collier. The experiments design was a split plot with four replications.

The results showed that leaf area (cm<sup>2</sup>), stalk yield (ton/fed), juice yield (ton/fed), total soluble solids % and sucrose % were significantly responded to the mineral nitrogen fertilizer in both seasons and plant length, stalk diameter, purity % and extraction percentage in the 1<sup>st</sup> season.

Cereal application significantly increased stalk diameter, leaf area (cm<sup>2</sup>), stalk yield (ton/fed), juice yield (ton/fed), sucrose %, purity % in both seasons while total soluble solids % was significantly affected by cereal in the 1<sup>st</sup> season and plant length in the 2<sup>nd</sup> season.

Interaction effect between nitrogen and cereal fertilizers significantly increased sucrose % and purity % in both seasons and juice yield and stalk yield in the 1<sup>st</sup> season. Otherwise, stalk length, diameter, leaf area and extraction % were insignificantly affected by interaction between nitrogen and cereal fertilizers.

This study recommends the application of nitrogen fertilizer at 80 kg N/fed and/or 1600 g cereal/fed to yield the highest value of stalk yield of sweet sorghum.

### INTRODUCTION

*Sorghum bicolor* L. is a tropical and subtropical African annual summer growing grain crop. Sweet sorghum is considered one of sorghum types which was cultivated in Egypt as a summer forage crop on small scale. It is characterized by having high sucrose and low reducing sugars and starch content. These characters make it suitable for jaggery and syrup production. The syrup produced from sweet sorghum is a concentrated juice with an attractive color and good sweet taste that is liked by the

Egyptian people. Also, it is free from jelly like consistency and free from crystals and sediments.

Nitrogen fertilizer has a vital role in increasing sweet sorghum production. Biofertilization of nitrogen is an important cultural practice for viable economic production and protecting the environmental components from pollution.

Sarig *et al* (1985) showed that inoculation of sorghum with *Azospirillum* increased stem diameter and developed root systems. Balasubramanian *et al* (1986) found no difference in yield between 60 kg N/ha with *A. brasilense* and 80 kg N/ha without inoculation. It was concluded that inoculation with *A. brasilense* could reduce the fertilizer requirements by 20 kg N/ha. Panwar *et al* (1990) showed that sorghum seed inoculation with *A. brasilense* increased growth and leaf area. Hussein (1992) noticed that inoculation of two sweet sorghum varieties with *A. brasilense* increased plant height, fresh stalk yield, juice extraction, T.S.S %, sucrose percentage and juice yield. Hassouna *et al* (1993) showed that inoculation with *Azospirillum* on sweet sorghum increased fresh weight of stalk and sucrose in the juice. Almodares *et al* (1996) revealed that sucrose content and purity were the highest when 100 kg N/ha was applied. Higher nitrogen rates increased stalk yield but decreased purity. Taha *et al* (1999) stated that plant height, stalk diameter, stalk yield, brix percentage, juice yield and syrup yield increased with increasing nitrogen rates. Ihtisham and Jan (2001) stated that all nitrogen levels positively affected leaf area, stem thickness and plant height. Nanda *et al* (2001) cleared that N fertilizer with *Azotobacter* gave sorghum yield more than with *Azospirillum* and no fertilizer. Moreover, they found that 60 kg N/ha + *Azospirillum* inoculation increased forage yield by 11.10 % compared to 80 kg N/ha. Eskander (2003) showed that stalk height, stalk weight, leaf area and juice yield were significantly affected by nitrogen fertilizer while stalk diameter was not affected. El-Zeny (2004) found that inoculation with *Bacillus polymyxa* on sweet sorghum increased plant height, leaf area, stripped stalks yield, juice extraction percentage and juice yield. Increasing nitrogen levels from zero up to 90 kg N/ha also significantly increased plant height, stalk diameter, leaf area, stripped stalks yield, juice extraction, juice yield, sucrose percentage and purity percentage. Saleh (2004) found that yield and yield components as well as juice quality were significantly increased by application of 100 kg N/fed or 75 kg N/fed with *Azotobacter* or *Azospirillum* inoculation, respectively. El-Shafai, *et al.* (2005) recorded significant differences in stalk height, stalk diameter, stripped stalks as affected by the applied mineral and/or bio-N fertilizers. Applying 60 kg N/fed was enough to obtain the highest percentages of total soluble solids and sucrose. Inoculating seeds of Honey variety with Nitrobin + 60 kg N/fed gave the highest purity %. The highest stripped

stalk yield/fed was produced by inoculating seeds with Nitrobin + 80 kg N/fed. Ismail *et al.* (2005) reported that application of 90 kg N/fed increased leaf area index, stalk height and diameter, stalk yield, sucrose and purity percentages. The aim of this investigation is to assess the response of sweet sorghum to mineral nitrogen and biofertilizers.

## MATERIALS AND METHODS

Two field experiments were conducted during 2001 and 2002 seasons at Agricultural Research Station Sabaheia, Alexandria Governorate to study the effect of mineral and biofertilizers of nitrogen and their interaction on growth, juice quality and yield of sweet sorghum (*Sorghum bicolor* L. Moench). The physical and chemical analyses of the soil of the experimental site are given in Table 1.

Table 1. Physical and chemical soil characteristics of the experimental field.

Season	Physical properties				Chemical properties				
	Clay	Silt	Sand	Texture	E.C. m.mhos (cm)	Organic matter%	CaCO <sub>3</sub> %	Total N %	pH
2001	45.63	40.80	13.57	Clay loam	2.40	1.08	17.85	0.06	8.20
2002	47.12	42.24	10.62	Clay loam	2.61	2.44	14.64	1.24	7.84
Chemical properties									
Season	Cations (meq/L)				Anions (meq/L)				P (ppm)
	Ca <sup>++</sup>	Mg <sup>++</sup>	Na <sup>+</sup>	K <sup>+</sup>	CO <sub>3</sub> <sup>--</sup>	HCO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>--</sup>	
2001	13.80	5.63	19.4	1.45	0.0	2.13	22.3	13.35	1.70
2002	12.21	8.90	14.3	1.20	0.0	4.24	17.0	11.50	3.55

Sweet sorghum variety Collier was sown on 9 May and 10 June in 2001 and 2002 seasons, respectively. Split plot design with four replications was used. Each trial included 9 treatments represented the combination between three levels of mineral fertilizer (40, 60 and 80 kg N/fed in the form of Urea (46 % N) which arranged at random in the main plots while three levels of biofertilizers (Cerealin) of 0, 800 and 1600 g cerealin/fed were allocated in the sub plots. Sweet sorghum seeds were inoculated by biofertilizer in a shadow place pre-planting and immediately sown and irrigated. The biofertilizer used was a mixture of growth promoting N fixing bacteria of *Azotobacter*, *Azospirillum* and *Klubiella*, registered under the name of cerealin and was provided by the Biofertilization Unit, Soil, Water and Environment Research Institute, Agricultural Research Center. Plot area was 10.50 square meters (3.5 in length, 3 m in width with 5 ridges, 60 cm apart and 25 cm between plants. The first and the fifth ridges were left as borders. Phosphorus fertilizer at 15.5 kg P<sub>2</sub>O<sub>5</sub> /fed was added during land preparation in the form of calcuim super phosphate. Potassium fertilizer in the form of potassium sulphate (48 % K<sub>2</sub>O) was applied at 48 kg K<sub>2</sub>O /fed. Potassium and nitrogen fertilizers were applied in two equal doses, one before the first

irrigation at about 21 days from planting and the other before the second irrigation at about 35 days from planting. Sweet sorghum harvesting was performed at 112 days from planting (dough ripening stage). The following data were recorded:

Growth, yield and juice technological characters were determined from the three middle ridges. Sample size was 10 plants/plot.

Plant height (cm), stalk diameter (cm), leaf area (cm<sup>2</sup>) according to Montgomery (1911), stalk yield (tons/fed), juice yield (tons/fed), juice extraction % which estimated from the formula: Juice extraction % = [(juice yield/stalk yield) x 100], total soluble solids (TSS%), sucrose %, purity % which estimated from the formula: purity% = [(sucrose % / TSS %) x100].

Data were subjected to statistical analysis according to the method as described by Snedecor and Cochran (1981). Using LSD test at level 5 % of significance to compared the treatment means.

## RESULTS AND DISCUSSION

### 1. Plant height (cm):

Data presented in Table (2) showed that plant height was significantly increased by increasing N from 40 to 60 and 80 kg /fed in 2002 season. The increase was 5.64 and 13.93 % compared with the application of 40 kg N/fed. The increase in plant height might be due to the role of nitrogen in stimulating the meristematic activity and cell elongation of plants. These results coincide with the findings of **Taha et al (1999)**, **Ihtisham and Jan (2001)**, **Eskander (2003)**, **El-Zeny (2004)** and **El-Shafai, et al. (2005)**.

Table 2. Effect of nitrogen and cereal levels on plant height (cm) during 2001 and 2002 seasons.

Nitrogen level (kg N/fed)	Cereal level (g/fed)							
	2001 season				2002 season			
	0	800	1600	Mean	0	800	1600	Mean
40	187.31	195.61	199.43	194.12	190.04	179.87	190.20	186.70
60	194.91	201.73	209.74	202.33	192.44	195.21	204.04	197.23
80	199.68	208.12	211.46	206.42	200.55	208.23	207.16	205.31
Mean	193.97	201.87	206.88	200.95	194.34	194.44	200.47	196.42

LSD

N level (N)	N.S	8.71
Cereal level (C)	N.S	6.28
N x C	N.S	N.S

Cerealin fertilization levels increased plant height in 2002 season. Plant height was 194.30, 194.10 and 200.47 cm due to the application of 0, 800 and 1600 g cerealin/fed, respectively. This result was insignificant when cerealin was applied at 800 g/fed while adding cerealin at the rate of 1600 g/fed gave a significant increase by 3.15 % compared with control (untreated). Increasing plant height may be attributed to the role of biofertilizer in N- fixation in soil, which increases vegetative growth. This result is in agreement with those reported by Hussein (1992) and El-Zeny (2004).

The interaction effect between nitrogen and cerealin fertilizer was not significant with regard to the plant height in both seasons.

## 2. Stalk diameter (cm):

Data presented in Table 3 showed that nitrogen fertilizer significantly increased stalk diameter in the second season only. The stalk diameter was increased by 2.97 and 5.47 % when N fertilizer was increased from 40 to 60 and 80 kg N/fed, respectively. This result is mainly due to the role of nitrogen fertilizer in stimulating the meristematic growth activity of cells. Similar findings were obtained by Taha *et al* (1999), Eskander (2003), Ismail *et al* (2005) and El-Shafai, *et al.* (2005).

Regarding to cerealin fertilizer effect, it is noticed that stalk diameter was significantly affected by cerealin in both seasons. Stalk diameter was 2.21, 2.34 and 2.45 cm for 0, 800 and 1600 g cerealin/fed, respectively, in the 1<sup>st</sup> season, corresponding to, 2.10, 2.20 and 2.27 cm/plant in the 2<sup>nd</sup> season, respectively. These results produced increases 5.73 and 10.71% in the 1<sup>st</sup> season, corresponding, 4.75 and 8.08% in the 2<sup>nd</sup> season, respectively. The gradually increasing of this trait due to increase meristematic activity of inoculated plants and consequently increased stalk diameter. This result is in harmony with those obtained by Sarig *et al* (1985) and Hussein (1992).

The results revealed that there was no effect for the interaction between nitrogen fertilizer and cerealin in both seasons.

Table 3. Effect of nitrogen and cerealin levels on stalk diameter (cm)(g/m<sup>2</sup>) during 2001 and 2002 seasons.

Nitrogen level (kg N/fed)	Cerealin level (g/fed)							
	2001 season				2002 season			
	0	800	1600	Mean	0	800	1600	Mean
40	2.11	2.23	2.32	2.22	2.04	2.14	2.22	2.13
60	2.23	2.35	2.48	2.35	2.10	2.21	2.28	2.20
80	2.29	2.43	2.54	2.42	2.17	2.26	2.32	2.25
Mean	2.21	2.34	2.45	2.33	2.10	2.20	2.27	2.19

LSD

N level (N)

N.S

0.01

Cerealin (C)

0.18

0.02

Nx C

N.S

N.S

**3. Leaf area per plant (cm<sup>2</sup>):**

Table 4 indicated that there were significant differences among nitrogen levels in the leaf area/plant in both seasons. In 2001 season, the leaf area/plant was 654.11, 685.00 and 715.11 cm<sup>2</sup> for the application of 40, 60 and 80 kg N/fed, respectively. In the second season, the increase in leaf area was 29.28 and 45.30 cm<sup>2</sup>/plant, respectively, when N levels were increased up to 60 and 80 kg N/fed. This result reflects the important role of nitrogen in building photosynthetic area of sweet sorghum plants. Similar results were obtained by Eskander (2003), El-Zeny (2004) and Ismail *et al* (2005).

Regarding cereal in application, the leaf area/plant was significantly increased by increasing cereal in from 800 up to 1600 g/fed in both seasons. The increases were 135.19 and 53.72 cm<sup>2</sup> in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively. This result may be attributed to biological action of bacteria in producing metabolites that could be useful to soil and plants for better performance. This result is in agreement with those obtained by Panwar *et al* (1990), Hussein (1992) and El-Zeny (2004).

Interaction nitrogen x cereal in fertilizers was significant in the 1<sup>st</sup> season where the treatment 80 kg N/fed with 1600 g cereal in recorded the highest leaf area (815.61 cm<sup>2</sup>) compared with the other interactions.

Table 4. Effect of nitrogen and cereal in levels on leaf area (cm<sup>2</sup>) during 2001 and 2002 seasons.

Nitrogen level (kg N/fed)	Cereal in level (g/fed)							
	2001 season				2002 season			
	0	800	1600	Mean	0	800	1600	Mean
40	521.66	720.33	720.33	654.11	528.46	734.81	798.66	687.31
60	681.53	594.76	778.72	685.00	571.50	767.97	810.30	716.59
80	735.73	594.00	815.61	715.11	586.00	778.43	833.40	732.61
Mean	646.31	636.36	771.55	684.74	561.99	760.40	814.12	712.17

LSD

N level (N)	31.78	23.03
Cereal in (C)	22.34	43.62
N x C	38.71	N.S

**4. Stalk yield (tons/fed):**

Results in Table 5 revealed that the application of nitrogen fertilizer at the rates of 40, 60 and 80 kg N/fed increased significantly stalk yield of sweet sorghum during 2001 and 2002 seasons. The increase in stalk yield was 5.46 and 8.47 % in the 1<sup>st</sup> season, corresponding to 7.67 and 8.30 % in the 2<sup>nd</sup> season, respectively, as N rates increased from 40 kg N/fed up to 60 and 80 kg N/fed. This result confirms the

favorable impact of nitrogen on green meristematic regions and their active growth. Also, nitrogen plays an important role in synthesis, distributing and accumulating the important substances responsible for growth and reflected greatly on stalk components, i.e. stalk height, stalk diameter and leaf area as mentioned before. This result is in harmony with those obtained by Taha *et al* (1999), Eskander (2003), El-Zeny (2004), Ismail *et al* (2005) and El-Shafai, *et al* (2005).

Concerning cerealizer fertilizer, results revealed that cerealizer application at the rates of 800 and 1600 g /fed significantly increased stalk yield of sweet sorghum by 1.55 and 2.6 tons/fed (12.84 and 21.59 %) in 2001 season as well as 1.37 and 2.75 tons/fed (11.98 and 23.97 %) in 2002 season as compared with the control. These results demonstrated clearly that the stalk yield of sweet sorghum plants responded to cerealizer fertilizer. This result may be due to that biofertilizer enrich the nutrient status of roots zone and consequently favors root absorption of elements plant growth and accumulation in stripped stalks of inoculated sweet sorghum plants and hence increased height, diameter of stalks and therefore improved their stalks yield /fed. Similar results were obtained by Hussein (1992) and El-Zeny (2004).

Interaction of nitrogen fertilizer x cerealizer affected significantly stalk yield in the first season only. The highest stalk yield (15.29 tons/fed) was obtained by adding 80 kg N/fed +1600 g cerealizer/fed while application 40 kg N/fed with non biofertilizer recorded the lowest stalk yield (11.64 tons/fed).

Table 5. Effect of nitrogen and cerealizer levels on stalk yield (tons/fed) during 2001 and 2002 seasons.

Nitrogen level (kg N/fed)	Cerealizer level (g/fed)							
	2001 season				2002 season			
	0	800	1600	Mean	0	800	1600	Mean
40	11.64	13.00	13.85	12.83	10.85	12.37	13.42	12.21
60	12.12	13.68	14.79	13.53	11.67	13.20	14.58	13.15
80	12.37	14.09	15.29	13.92	11.94	13.02	14.72	13.23
Mean	12.04	13.59	14.64	13.43	11.49	12.86	14.24	12.86

LSD

N level (N)	0.25	0.04
Cerealizer (C)	0.12	0.09
N x C	0.23	N.S

### 5. Juice yield (tons/fed):

Data presented in Table 6 showed significant differences among nitrogen levels in juice yield in both seasons. Juice yield were (3.74, 4.03 and 4.12 tons/fed) and (3.36, 3.70 and 3.81 tons/fed) by the application of 40, 60 and 80 kg N/fed, in 2001 and 2002 seasons, respectively. This increase may be due to the direct effect of nitrogen on the vegetative growth of plants and photosynthesis activity as well as consequently increasing juice yields as the final product. This result is in harmony with

those obtained by Taha *et al* (1999), Eskander (2003), El-Zeny (2004) and Ismail *et al* (2005).

Concerning the biofertilizer effect, it is noticed that increasing the rate of cereal in up to 1600 g/fed significantly increased juice yield in both seasons. The increase was 13.45 and 24.54 % in 1<sup>st</sup> season, corresponding to 13.13 and 23.99 % in 2<sup>nd</sup> season, respectively. This increase in juice yield may be due to the role of biofertilizer in N- fixation in soil, which increases vegetative growth, chemical contents as T.S.S % and sucrose % and consequently, the final product (juice yield). This result is in accordance with those reported by Hussein (1992) and El-Zeny (2004).

Statistical analyses showed that juice yield was significantly affected by the interaction between nitrogen and cereal in the 1<sup>st</sup> season only. The highest juice yield (4.57 tons/fed) was obtained from the application of 1600 g cereal/fed with 80 kg N/fed compared with the other interactions.

Table 6. Effect of nitrogen and cereal levels on juice yield (tons/fed) during 2001 and 2002 seasons.

Nitrogen level (kg N/fed)	Cereal level (g/fed)							
	2001 season				2002 season			
	0	800	1600	Mean	0	800	1600	Mean
40	3.36	3.75	4.11	3.74	2.97	3.40	3.70	3.36
60	3.56	4.07	4.47	4.03	3.31	3.71	4.07	3.70
80	3.64	4.16	4.57	4.12	3.39	3.83	4.22	3.81
Mean	3.52	3.99	4.38	3.97	3.22	3.65	4.00	3.62

LSD

N level (N)	0.21	0.14
Cereal (C)	0.07	0.15
N x C	0.13	N.S

## 6. Juice extraction percentage:

Data presented in Table 7 indicated that juice extraction percent was significantly affected by increasing the rates of nitrogen fertilizer in the 2<sup>nd</sup> season only. Application of 80 kg N/fed surpassed by 1.34 and 0.43 % in juice extraction % more than application of 40 and 60 kg N/fed, respectively. This increase may be attributed to the important role of N in building up, photosynthesis process and water content in cell, which result in increasing juice extraction % in the plants. Similar results were recorded by Eskander (2003) and El-Zeny (2004).

Concerning cereal levels, it is obvious from data presented that juice extraction percentage was not significantly differed in both seasons.

Interaction between nitrogen and cereal in fertilizers did not significantly affect juice extraction percentage in both seasons.

Table 7. Effect of nitrogen and cereal in levels on juice extraction% during 2001 and 2002 seasons.

Nitrogen level (kg N/fed)	Cereal in level (g/fed)							
	2001 season				2002 season			
	0	800	1600	Mean	0	800	1600	Mean
40	27.91	27.19	25.98	27.03	26.87	27.13	26.99	27.00
60	28.62	29.02	29.80	29.15	27.66	28.04	28.02	27.91
80	28.80	28.81	29.29	28.97	29.72	26.99	28.30	28.34
Mean	28.44	28.34	28.36	28.38	28.08	27.39	27.77	27.75

LSD

N level (N)	N.S	0.81
Cereal in (C)	N.S	N.S
N x C	N.S	N.S

### 7. Total soluble solids percentage (TSS %) :

Data presented in Table 8 indicated that nitrogen levels exhibited a significant effect on total soluble solids percentage in both seasons. Increasing nitrogen fertilizer level from 40 up to 60 kg N/fed increased significantly TSS % in sweet sorghum juice by 0.85 and 1.93 in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively. Further increase in nitrogen fertilizer level from 60 up to 80 kg N/fed increased TSS % by 0.62 and 0.36 in 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively, but these increases were insignificant. This result might be explained by the direct effect of nitrogen in increasing photosynthesis activity and subsequently carbohydrate synthesis and its accumulation which is reflected on the total soluble solids. This result is similar to those obtained by Almodares (1996), Taha *et al.* (1999), Eskander (2003), El-Zeny (2004) and El-Shafai, *et al.* (2005).

Table 8. Effect of nitrogen and cereal in levels on total soluble solids percentage during 2001 and 2002 seasons.

Nitrogen level (kg N/fed)	Cereal in level (g/fed)							
	2001 season				2002 season			
	0	800	1600	Mean	0	800	1600	Mean
40	14.95	15.17	15.40	15.17	13.25	12.55	13.50	13.10
60	15.75	16.09	16.22	16.02	14.63	14.88	15.57	15.03
80	16.28	16.64	17.00	16.64	15.06	15.41	15.71	15.39
Mean	15.66	15.97	16.21	15.94	14.31	14.28	14.93	14.51

LSD

N level (N)	0.69	0.63
Cereal in (C)	0.48	N.S
N x C	N.S	0.99

In regard to cereal levels, Data showed that cereal significantly affected T.S.S % in the 1<sup>st</sup> season only. Application 1600 g /fed recorded high value of T.S.S (16.21 %) compared to the other two levels of cereal. This increase may be due to the role of biofertilizer in increasing available nutrients for growth of plants and subsequently increasing juice quality. These results are in accordance with those reported by Hussein (1992) and El-Zeny (2004).

Interaction nitrogen x cereal fertilizers significantly affected total soluble solids in the second season only. The highest T.S.S % (15.71) was obtained by the application of 80 kg N/fed + 1600 g cereal/fed.

#### **8. Sucrose percentage:**

Results in Table 9 revealed that nitrogen fertilizer levels had significant effects on sweet sorghum plants with respect to sucrose percentage in both seasons. Increasing nitrogen levels from 40 up to 60 kg N/fed increased significantly sucrose percentage by 1.0 and 0.65 in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively. Otherwise, when N levels increased up to 80 kg N/fed, the increases were insignificant where recorded 0.22 and 0.33. In the beginning, the increase may be attributed to the role of nitrogen in vegetative growth of sorghum plants where it improves the photosynthesis efficiency and increased the amount of synthesized metabolites by plant and consequently improve the quantity and quality traits such as TSS and purity, then decreased by increasing N level where the increase in N fertilizer help to accumulate alpha amino nitrogen and impurities in plant which decrease juice quality. Similar results were obtained by Almodares *et al* (1996), Taha *et al* (1999), Eskander (2003), El-Zeny (2004), Ismail *et al* (2005) and El-Shafai, *et al* (2005).

Concerning cereal effect, results revealed that increasing cereal levels up to 1600 g/fed increased significantly sucrose percentage in sorghum juice in both seasons. Application of 1600 g cereal/fed gave the highest value of sucrose (8.06 and 7.47 %). The increases were 0.63 and 0.31 in the 1<sup>st</sup> season and 1.19 and 0.41 in the 2<sup>nd</sup> seasons, respectively compared with untreated and 800 g cereal/fed. This result is similar to those obtained by Hussein (1992) and Hassouna *et al* (1993).

Interaction of nitrogen x cereal affected significantly sucrose percentage in both seasons. Application of 80 kg N/fed with 1600 g cereal/fed gave 8.79 and 7.91 % of sucrose in 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively while application of nitrogen at the rate of 40 kg N/fed with non biofertilizer recorded the lowest sucrose % (6.80 and 5.73 %) in the 1<sup>st</sup> and 2<sup>nd</sup> seasons, respectively. These results revealed the importance of mineral and biofertilizers of nitrogen for juice quality of plants.

Table 9. Effect of nitrogen and cerealin levels on sucrose percentage during 2001 and 2002 seasons.

Nitrogen level (kg N/fed)	Cereal in level (g/fed)							
	2001 season				2002 season			
	0	800	1600	Mean	0	800	1600	Mean
40	6.80	7.01	7.21	7.01	5.73	6.48	6.97	6.39
60	7.59	8.26	8.19	8.01	6.60	6.98	7.53	7.04
80	7.90	7.99	8.79	8.23	6.50	7.71	7.91	7.37
Mean	7.43	7.75	8.06	7.75	6.28	7.06	7.47	6.93

LSD

N level (N)	0.24	0.40
Cereal in (C)	0.08	0.37
N x C	0.16	0.64

### 9. Purity percentage:

The results in Table 10 revealed that nitrogen levels exhibited a significant effect on purity percentage in the 2<sup>nd</sup> season only. Increasing N levels up to 80 kg/fed decreased purity %. Otherwise, The highest purity 46.44 percentage was obtained by the application of 40 kg N/fed. This result may be attributed to the decrease of total soluble solids in juice. Generally, the purity behaves the inverse effect with TSS % in juice. This result agreed with those reported by Almodares *et al* (1996), Eskander (2003) and Ismail *et al* (2005).

Also, it is clear from Table 10 that the purity percentage was significantly increased by increasing cereal in rates from 0 to 1600 g/fed. Application of 1600 g cereal in/fed increased purity percentage of stalk juice by about 1.74 and 2.37 in the 1<sup>st</sup> season, corresponding 6.44 and 1.93 in the 2<sup>nd</sup> season higher than 0 and 800 g cereal in/fed, respectively. These results coincide with those obtained by Hussein (1992) and El-Zeny (2004).

Regarding the interaction effect, results indicated that the interaction between nitrogen fertilizer x cereal in for purity percentage was significant in both seasons. Application of 1600 g cereal in/fed with 80 and 40 kg N/fed in the 1<sup>st</sup> and 2<sup>nd</sup> seasons gave the highest purity percentage compared with the other interactions.

Table 10. Effect of nitrogen and cereal levels on purity percentage during 2001 and 2002 seasons.

Nitrogen level (kg N/fed)	Cereal level (g/fed)							
	2001 season				2002 season			
	0	800	1600	Mean	0	800	1600	Mean
40	45.14	45.44	46.21	45.60	41.02	48.41	49.89	46.44
60	47.66	48.81	48.50	48.32	41.11	45.72	44.77	43.87
80	48.04	44.71	51.35	48.03	41.59	43.12	48.38	44.36
Mean	46.95	46.32	48.69	47.32	41.24	45.75	47.68	44.89

LSD

N level (N)	M.S	1.12
Cereal (C)	1.15	1.66
Nx C	0.25	2.88

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## استجابة الذرة السكرية للتسميد النتروجيني المعدنى والحيوى

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أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بالصباحية بالأسكندرية موسمى ٢٠٠١ و ٢٠٠٢ لدراسة تأثير التسميد بالنتروجين المعدنى (يوريا ٤٦% نتروجين) والسريالين على محصول الذرة السكرية وقد استخدم تصميم القطع المنشقة فى أربعة مكرارات. اشتملت التجربة على ثلاث مستويات من التسميد النتروجينى المعدنى فى القطع الرئيسية (٤٠، ٦٠ و ٨٠ كجم ن/فدان) وثلاث مستويات من السريالين (بدون تلقیح، ٨٠٠ و ١٦٠٠ جم/فدان) وضعت فى القطع الشقية.

أوضحت النتائج استجابة صفات طول و مساحة الأوراق للنبات و محصول السيقان و محصول العصير والنسبة المئوية لكلا من المواد الصلبة الكلية الذائبة و السكروز بالعصير معنوياً بمعاملات التسميد النتروجينى المعدنى فى الموسمين بينما تأثرت صفات طول و قطر النبات والنسبة المئوية لكلا من استخلاص العصير و النقاوة فى الموسم الثانى وقد سجلت أعلى القيم لهذه الصفات من المعاملة ٨٠ كجم نتروجين/فدان.

تأثرت صفات قطر و مساحة الأوراق و محصول السيقان و محصول العصير والنسبة المئوية للسكروز والنسبة المئوية للنقاوة معنوياً بمستويات السريالين فى الموسمين بينما تأثرت صفة النسبة المئوية للمواد الصلبة الكلية الذائبة بالعصير فى الموسم الأول و طول النبات فى الموسم الثانى فقط وكانت أعلى قيمة فى تلك الصفات من استخدام مستوى ١٦٠٠ جم سريالين للفدان.

كان التفاعل بين التسميد النتروجينى و السريالين معنوياً على صفات النسبة المئوية للسكروز والنقاوة فى الموسمين بينما تأثرت صفات مساحة الأوراق و محصول السيقان و محصول العصير فى الموسم الأول وقد سجلت أعلى القيم لهذه الصفات من المعاملة ٨٠ كجم نتروجين + ١٦٠٠ جم سريالين للفدان.

يوصى هذا البحث باستخدام التسميد النتروجينى بمعدل ٨٠ كجم ن/فدان و/أو ١٦٠٠ جم سريالين/فدان للحصول على أعلى محصول سيقان.