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INTEGRATED EFFECT OF MINERAL NITROGEN AND BIOFERTILIZER ON THREE SWEET SORGHUM VARIETIES PLANT (*Sorghum bicolor* L. Moench).

Abdelaal, Kh.A.A.[١];Shimaa A.Badawy[٢]; Ranya M.Abdel Aziz[٣] and Shahrzad M.M. Neana[٣]

[1]Agricultural Botany Dept., Fac. Agric., Kafrelshiekh University, Egypt.

[2]Agronomy Dept., Fac. Agric., Kafrelshiekh University, Egypt.

[3] Sugar Crops Research Institute, Agricultural Research Center Giza, Egypt.

ABSTRACT

Two field experiments were conducted during 2013 and 2014 growing seasons at Nubaria Region, Alexandria Governorate, Egypt in order to study the integrated effect of mineral nitrogen and biofertilizer (85 kg N/fed as recommended dose (control), 65 kg N/fed + ٦٠٠ g Cerealin as biofertilizer and 45 kg N/fed + ٦٠٠ g Cerealin) on three sweet sorghum varieties *i.e*., Sorgo, Brandes and Planter.

Results showed that Planter variety recorded the highest values of morphological characters *i.e.* stalk height, stalk diameter, leaf area, stripped, and juice yields as well as chlorophyll a and b concentrations compared with Sorgo and Brandes in both seasons. On the other hand, in both seasons syrup yield was significantly increased in Brands variety compared with other two varieties. In both seasons Planter variety gave the highest values of physiological characters *i.e*., sucrose%, pH value, total soluble solids%, purity% and extracted juice%, while, Sorgo variety recorded the highest value in reducing sugar.

The treatment of 65 kg N/fed + ٦٠٠ g Cerealin gave the greatest concentrations of chlorophyll a and b in both seasons also gave the greatest values of stalk height, diameter and leaf area in the first season only, while, stripped stalks and juice yields recorded the highest values in both seasons. In the first season there was no significant difference in juice yield at the rate of 85 kg N/fed compared with 65 kg N/fed ٦٠٠ g Cerealin, while, in the second season both treatments did not significantly differed in stripped stalks yield. Nitrogete fertilizer at rate of 65 kg N/fed + 600 g Cerealin gave the highest values of sucrose%, purity% and juice extraction% in both seasons. The interactions between Planter variety and 65 kg N/fed + ٦٠٠ g Cerealin gave the greatest values in stripped stalks, juice and syrup yields followed by Brandes and Sorgo in both seasons.

Keywords: *Sorghum bicolor* L., Sorghum, integrated effect, growth characters nitrogen, chlorophyll, biofertilizer, cerealin.

INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench) belongs to the sorghum genus, family Poaceae. Sorghum is one of the most important multipurpose cereal crop, contains grain, forage and syrup. Sweet sorghum is cultivated mainly for its syrup, which is called Black honey and ethanol production. Sweet sorghum gave ethanol concentration higher than cassava (Nadir, 2009).

Sweet sorghum is a C4 plant; this plant wide temperature variability. With its anatomical features and C4 metabolism, the plant can efficiently use CO_2 under a wide range of both temperature and moisture stresses, and is able to grow in wide geographic regions and under different environmental conditions.

Sweet sorghum is predicted to be one of the major sources for syrup production in the near future if the sorghum syrup quality improved. Good sorghum syrup is light colored and mild and has a characteristic of flavor, Osman *et al*. (2005) and Mohamed *et al*. (2006). According to CCSC (2010), the production of sucrose was about 1,000991 tons, while the consumption was nearly 2,000765 tons and the self-sufficiency was approximately 72%. There are about 12181 fed cultivated with sugar cane for syrup production. However, improving syrup quality of sweet sorghum would save sugar cane for sugar production as an attempt to minimize the gap between the production and consumption of sucrose. Sweet sorghum is adapted wildly to different climatic and soil conditions. It is a short term crop where it matures after about 120 days from sowing. Its water and fertilizer requirements are much less, resulting in lower cultivation cost compared to sugar cane.

Sweet sorghum is a high-biomass and sugar-yielding C4 plant containing approximately equal quantities of soluble glucose and sucrose, and insoluble carbohydrates (cellulose and hemicellulose), (Mohamed *et al*., 2006). Sweet sorghum productivity and quality are affected greatly by many factors. Variety selection is one of the most important decisions in the production of sweet sorghum syrup. There is a great variation among sorghum varieties in stalk height, diameter, number of internodes, syrup production and yield and its components, (Miller and Creelman, 1982, Chawdhury and Rahman, 1990 and Mohamed *et al*., 2006). Nour El Hoda *et al*., (1994) and Mohamed *et al*., (2006) reported that stripped stalk yield, was the effective parameter on juice and syrup yield, in addition to the chemical characteristics which in turn affect syrup quality of sweet sorghum varieties. In this respect, Abd El-Lattief, (2011) indicated that the effect of cultivars on the measurements were significant except for apparent purity in the first and second seasons. Cv Honey had the highest stalk height, stalk diameter, number of internodes per stalk, stalk yield and forage (leaves) yield in two seasons, respectively. Yadav *et al*., (2007) indicated that application of 75 kg/ha N (urea), 25 kg/ha N (castor residuum) and inoculation by *Azospirillum* increased the raw protein and quality of forage sorghum. Ahamed *et al*., (2007) stated that there were significant differences due to N sources in growth, yield and yield components in sorghum plant. The effect of nitrogen fertilizer on LAI and stem growth of sorghum was significant (Van, Oosterom *et al.*, 2010). Ihtisham and Jam (2001) found that nitrogen levels positively affected leaf area, stem thickness and length, brix% as well as stalk, juice and syrup yields. Forage yield of sorghum increased with inoculation of seeds by *Azotobacter* and *Azospirillum* (Singh *et al*., 2005). Maha, El Zeny (2004), Ismail *et al*., (2007), Moustafa, Zeinab *et al*., (2006) and Aly *et al*., (2008) stated that application of mineral nitrogen 50, 75 and 100% of the recommended dose (80 kg/fed) and/or biofertilizer *Bacillus polymyxa, Azotobacter or Azospirillum* recorded significant differences in leaf area, leaf area index, plant length and diameter, TSS%, sucrose%, purity%, juice and syrup extraction%, stripped stalk, juice and syrup yields as compared with control (untreated with nitrogen) due to applied nitrogen 75% and/or biofertilizer were enough to obtain the highest values. El-Geddawy, Dalia *el al*., (2014) show the effect of six sweet sorghum varieties on sweet sorghum juice of some chemical and physical properties, they found that sweet sorghum SS.301 and Planter varieties as well as Brandes variety surpassed significant most of the studied varieties in respect to chemical properties of juice in terms of TSS % and purity %. Honey variety produced the highest juice extraction values with significant difference over Planter, Brandes and SS.301 varieties and with no significance difference with Sorgo and Rex varieties. Application of nitrogen fixing bacteria and cattle manure led to a decrease in the use of chemical fertilizers and has provided high quality products free of harmful agrochemicals (Mahfouz and Sharaf Eldin, 2007). Ahmed *et al*., (2013) found that the highest value of chlorophyll content was recorded by the treatment of bio-fertilizer plus two third of recommended dose of nitrogen fertilizer. Mir *et al*., (2015) indicated that the highest chlorophyll a and chlorophyll b were achieved from combine biofertilizers + chelated nano fertilizers (Fe + k) treatments application. El-Geddawy, Yara (2014) found that the highest amount of juice was obtained from honey with 60 kg N/fed followed by Brandes with 80 kg N/fed, while the highest amount of syrup was obtained from Brandes with 80 kg N/fed followed by Honey with 80 kg N /fed. Also added that TSS% increased with increasing N fertilizer in both varieties, the highest sucrose% was produced in Honey variety and also found the Brandes variety attained the highest purity% (48.4 % and 46.46 %) with 60 and 80 kg N/fed. Yield and composition of sweet sorghum are affected by variety.

Selection of the grown variety is one of the most important decisions in the production of sweet sorghum syrup. A good variety should be of a high content of total soluble solids in the juice and adapted to the growing season in the area. This is considered an important task for grower and syrup manufacturer.

Therefore, the objectives of this investigation were to study the effect of mineral and bio nitrogen fertilizers on growth, yield and its components of three sweet sorghum varieties.

MATERIALS AND METHODS

Two field experiments were conducted during the two growing seasons of 2013 and 2014 at Nubaria Region, Alexandria Governorate, Egypt. Three treatments of mineral nitrogen and biofertilizer were examined on three sweet sorghum varieties *i.e*., Sorgo, Brandes and Planter. The treatments were 85 kg N/fed as recommended dose (control), 65 kg N/fed + ٦٠٠ g Cerealin biofertilizer and 45 kg N/fed + ٦٠٠ g Cerealin biofertilizer.

Sorghum grains were obtained from Sugar Crops Research Institute, Agriculture Research Center. The used biofertilizer is a mixture of growth promoting nitrogen fixing bacteria of *Azotobacter*, *Azospirillum* and Klubsiella, registered under the name of Cerealin and were provided by the Biofertilization Unit, Soil, Water and Environment Research Institute, Agricultural Research Center, Giza, Egypt.

The experimental design was a split plot design with four replications, where sorghum varieties arranged in the main plots and nitrogen mineral and bio fertilizers in the sub plots. Plot area was 27.0 m^2 consists of 5 rows, 6 m long and 90 cm apart. Sowing date was 1^{st} and 4^{th} of May in both seasons respectively and harvesting after four months from sowing in both seasons. The previous crop was wheat. Nitrogen treatments were added in the two equal doses; the 1^{st} one was added after one month from sowing and the 2^{nd} 15 days later. Phosphours in the form of superphosphate (15.5% P_2O_5) was added at the rate of 30 kg P_2O_5/fed during seed bed preparation. Potassium fertilizer was added in the form of potassium sulfate (48 % K_2O/fed) at the rate of 48 kg K_2O/fed in two equal doses with nitrogen fertilizer. Grains were inoculated before sowing with biofertilizer in a shadow place and immediately sown and irrigated.

Some physical and chemical properties of the experimental site were analyzed according to Jakson (1967) are presented in Table (1).

Table.1 Physical and chemical properties of the experimental soil.

Partial size distribution %			Soil Texture	pH**	E.C*. dS/m	$CaCO_3$ %	Organic matter%	Availability (ppm)						
Clay	Silt	Sand						N	P	K	B	Fe	Zn	Mn
3.3	4.0	92.7	Sandy	7.75	1.75	10.25	0.83	5.45	3.11	126.0	0.33	4.15	3.05	3.10

*** In the soil paste extract.**
**** In soil water suspension 1:2.5**

Harvesting was took place at the dought stage (content of grains are firm and easily crushed between thumb and index fingers), the plants were harvested after 4 months from sowing. A sample of twenty stalks was taken at random to determine certain morphological characters, yield and its components.

Morphological characters:

Stalk length (cm) was measured from land level till point visible dewlap. Stalk diameter (cm) was measured at the middle part of the fourth internodes from stalk bottom. Leaf area (cm^2) was calculated using the formula outlined by Montogomery (1911), where unit leaf area = leaf area (leaf length x leaf maximum width (approximately at leaf middle x 0.72) x No. of leaves/plant.

Chlorophyll concentration:

Chlorophyll (chl.) concentration as mg/g fresh weight of one gram fresh leaves after 60 days from sowing was extracted with 5 ml N,N-dimethyl-formamid for overnight at 5°c then estimated chlorophyll a and chlorophyll b spectrophotometerically at 663 and 647 nm as described by Moran and Porath (1982). The concentrations were calculated in the following equations:

$$\text{Chl. a} = 12.76\ A663 - 2.79\ A647$$
$$\text{Chl. b} = 20.76\ A647 - 4.62\ A663.$$

Yield and its components:

Yield, stripped stalk, juice and syrup and juice extracted (tons/fed.) were determined according to Mohamed (1997).

For juice quality, sucrose, reducing sugars % were determined according to the methods described by AOAC (2005). PH value was measured according to Collins *et al*. (1987) by using Beckman pH meter.

Total soluble solids (TSS %) was determined by hand refractometer.

Purity% was determined by the following equation:-

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

Juice extraction% which estimated from the formula:- Juice and syrup extraction % = juice or syrup yield x 100/stripped stalk yields.

Statistical analysis

Data were statistically analyzed according to Gomez and Gomez (1984). Duncan's Multiple Range test was used.

Data of chlorophyll a and b represent the mean ± SD. Student's t-test was used to determine whether significant difference ($P<0.05$) existed between mean values according to O'Mahony (1986).

RESULTS AND DISCUSSION

Morphological characters

Results in Table 2 indicated that varieties significantly differed in morphological characters under study. Planter variety was significantly better than Brandes and Sorgo in both seasons. The highest values for stalk length, diameter and leaf area scored for Planter variety followed by Brandes as compared with Sorgo. These results might be due to the fact that the organic matter formed by photosynthesis for Planter variety was highest than the Brandes and Sorgo and the structure of gene make-up. (Nour El-Hoda *et. al.*, 1994 and Mohamed *et. al.*, 2006). These results are in agreement with those reported by Ismail *et al*. (2007); Aly *et al*. (2008); El-Geddawy, Dalia *et al*. (2014) and El-Geddawy, Yara (2014).

Results in Table 2 showed that application of nitrogen mixture fertilizer at the rate of 65 kg N/fed + 600 g Cerealin was more effective than 85 kg N/fed (control) and 45 kg N/fed + 600 g Cerealin where, it gave the highest values for stalk height, diameter and leaf area in the first season, while the rate of 85 kg N/fed (control) gave the highest values of stalk height, diameter and leaf area in the second season compared with 65 kg N/fed + 600 g Cerealin and 45 kg N/fed + 600 g Cerealin respectively. The increase in morphological characters *i.e*. stalk length, diameter, leaf area might be due to the role of nitrogen in stimulating the meristematic activity, cell division, elongation of plants and confirms the favorable impact of nitrogen on meristematic regions, their active growth and enrich the nutrient status of roots zone. These results are in harmony with those obtained by Mohamed *et al*. (2006); Ismail *et al*. (2007); Aly *et al*. (2008); El-Geddawy, Dalia *et al*. (2014) and El-Geddawy, Yara, (2014). Biofertilizer plays an important role in nitrogen fixation in soil, which increases available nutrients for growth of plants (Collins *et al*., 1977).

Table 2: Effect of varietal differences and fertilizer levels on morphological characters in the tow growing seasons 2013 and 2014.

Treatments Varieties	2013 season			2014 season		
	Stalk height (cm)	**Stalk diameter (cm)**	**Leaf area (cm^2)**	**Stalk height (cm)**	**Stalk diameter (cm)**	**Leaf area (cm^2)**
Sorgo	193.4 c	2.18 c	646.9 c	191.01 c	2.1 c	618.8 c
Brandes	202.4 b	2.33 b	663.3 b	200.38 b	2.16 b	674.1 b
Planter	206.5 a	2.45 a	709.9 a	205.42 a	2.23 a	742.9 a
F-value	**	**	**	**	**	**
Fertilizer levels						
45 kg N/fed. + 600 g Cerealin	194.4 c	2.26 c	661.2 c	192.52 c	2.08 c	657.3 c
65 kg N/fed. + 600 g Cerealin	203.2 b	2.38 a	683.9 a	200.47 b	2.14 b	681.1 b
85 kg N/fed.	204.9 a	2.32 b	675.0 b	203.82 a	2.21 a	697.3 a
F-value	**	**	**	**	**	**
Interaction	**	Ns	**	**	Ns	Ns

***Significant at 0.05 level **Significant at 0.01 level N.S.Not significant**
Means followed by the same letter are not significantly different, according to DMRT

Chlorophyll concentrations:

Results in Fig. 1 illustrated that the greatest concentrations of chl. a and b were recorded for Planter variety followed by Brandes as compared with Sorgo variety in both seasons. Also application of nitrogen mixture fertilizer at the rate of 65 kg N/fed + 600 g Cerealin, gave the highest concentrations of chl. a and b in Planter variety in both seasons. Patra *et al*. (2012) reported that total chlorophyll content in maize leaf was increased by inoculation of biofertilizers. These results may be due to the fact that the organic matter formed by photosynthesis for Planter variety was highest than the Brandes and Sorgo and the structure of gene make-up. Similar results were obtained by Mahfouz and Sharaf Eldin, (2007); Yadav *et al*. (2010); Ahmed *et al*., (2013) and Mir *et al*., (2015).

Yield characters:

Results in Table 3 cleared that varieties significantly differed in yield characters (stripped stalks, juice and syrup). Planter variety was significantly better than Brandes and Sorgo in both seasons. The greatest values for stripped stalks and juice recorded for Planter variety followed by Brandes as compared with Sorgo variety, while the highest value of syrup was obtained of Brandes in the two seasons. These results may be due to the fact that the organic matter formed by photosynthesis for Planter variety was highest than the Brandes and Sorgo and the structure of gene make-up. (Nour El-Hoda *et. al.*, 1994 and Mohamed *et. al.*, 2006). These results are in agreement with those reported by Ismail *et al*. (2007); Aly *et al*. (2008); El-Geddawy, Dalia *et al*. (2014).

Fig. 1: Effect of varietal differences and fertilizer levels on chlorophyll a and b concentrations (mg/g fresh weight) of sorghum varieties (Sorgo, Brandes, Planter) during the two growing seasons 2013 and 2014. N1 (45 kg N/fed + 600 g Cerealin), N2 (65 kg N/fed + 600 g Cerealin) and N3 (85 kg N/fed as recommended dose).

Results in Table 3 indicated that the highest values of stripped stalks and juice recorded by application of nitrogen mixture fertilizer at the rate of 65 kg N/fed + 600 g Cerealin, while the rate of 85 kg N/fed (control) significantly increased syrup in both seasons compared with 45 kg N/fed + 600 g Cerealin.

The effect of nitrogen fertilizer may be due to the effect on nutrient availability in the soil, also the increases in the studied traits may be due to splitting nitrogen fertilizer in two equal doses may be attributed to minimize the loss of nitrogen by leaching besides saving suitable amount of nitrogen as plant need during the different stages of life which led to increase of yield, (Nemeat, 2001 and Sharief *et al.*, 2004). These results are in accordance with those obtained by Abd El-Lattief, (2011). The application of nitrogen mixture fertilizer compare with control increased forage yield (108 and 71% respectively) Seied *et al*. (2013). These results were agreed with these obtained by Eidi zadeh *et al*., (2010) they found that application of chemical and bio-fertilizers increased plant height, LAI, dry matter production compared with chemical fertilizers on corn plant.

Biofertilizer plays an important role in nitrogen fixation in soil, which increases available nutrients for growth of plants and subsequently increasing the final product of yields, (Collins *et al*., 1977). These results are agreement with Mohamed *et al*. (2006); Ismail *et al*. (2007) and Aly *et al*. (2008).

Table 3: Effect of varietal differences and fertilizer levels on stripped stalks, juice and syrup yields (ton/fed) in the tow growing seasons 2013 and 2014.

Sweet sorghum	**2013 season**			**2014 season**		
Treatments Varieties	Stripped stalks	Juice	Syrup	Stripped stalks	Juice	Syrup
Sorgo	13.21 c	2.60 c	0.485 b	12.71c	2.04 c	0.364 b
Brandes	14.43 b	2.96 b	0.601 a	14.1 b	2.55 b	0.573 a
Planter	15.57 a	3.33 a	0.223 c	15.16 a	2.98 a	0.327 c
F-value	**	**	**	**	**	**
Fertilizer levels						
45 kg N/fed. + 600 g Cerealin	13.80 c	2.75 b	0.424 c	13.38 b	2.1 c	0.405 c
65 kg N/fed. + 600 g Cerealin	14.80 a	3.08 a	0.438 b	14.3 a	2.78 a	0.423 b
85 kg N/fed.	14.57 b	3.06 a	0.448 a	14.28 a	2.68 b	0.436 a
F-value	**	**	**	**	**	**
Interaction	**	**	**	**	**	**

***Significant at 0.05 level** ****Significant at 0.01 level** **N.S. Not significant**
Means followed by the same letter are not significantly different, according to DMRT

Yield components: Quality% and Extracted juice %

Data in Tables 4 and 5 indicated that varieties significantly differed in yield components. Planter variety was significantly better than others in both seasons. Sucrose%, pH value, Total soluble solids%, purity% and Juice extraction % were the highest values, whereas, the lowest was reducing sugars% in both season. These results are in agreement with those recorded by El-Geddawy, Dalia *et al*., (2014) and El-Geddawy, Yara (2014).

Data in Tables 4 and 5 showed that there were significant differences among mineral nitrogen and biofertilizer levels for quality% and extracted juice% in both seasons. The treatment with 65 kg N/fed + 600 g Cerealin was the best treatment than 45 kg N/fed + 600 g Cerealin and 85 kg N/fed without biofertilizer where, it gave the highest values for sucrose%, purity% and juice extraction%, the increase, may be due to the role of nitrogen in building up, photosynthesis process and water content in cell, which resulted in increasing quality and extracted juice % in plants. On the other hand there were significantly increases in reducing sugars%, pH value and TSS% with application the rate of 85 kg N/fed . Total soluble solids might be explained by the direct effect of nitrogen in increasing photosynthesis activity and synthesis of carbohydrate as well as its accumulation which is reflected on total soluble solids%, El-Geddawy, Dalia *et al*., (2014) and El-Geddawy, Yara (2014). The application of nitrogen improves protein contents and quality of sorghum (Ayub, *et al*., 1999 and Almodares *et al*., 2009).

Table 4: Effect of varietal differences and fertilizer levels on yield components in 2013 season.

Treatments / Varieties	Quality%			Extracted juice %		
	Sucrose %	**Reducing sugars**	**pH value**	**Total soluble solids%**	**Purity%**	**Juice extraction %**
Sorgo	8.56 c	10.10 a	1.29 c	14.41 c	59.37 ab	19.69 c
Brandes	8.75 b	9.31 b	2.47 b	14.81 b	59.05 b	20.45 b
Planter	9.16 a	8.65 c	2.75 a	15.37 a	59.58 a	21.41 a
F-value	**	**	**	**	*	**
Fertilizer levels						
45 kg N/fed. + 600 g Cerealin	8.11 c	9.21 c	2.01 c	14.64 c	55.42 c	19.89 b
65 kg N/fed. + 600 g Cerealin	9.30 a	9.36 b	2.18 b	14.87 b	62.53 a	20.74 a
85 kg N/fed.	9.06 b	9.49 a	2.32 a	15.08 a	60.04 b	20.93 a
F-value	**	**	**	**	**	**
Interaction	**	**	**	**	**	**

***Significant at 0.05 level   **Significant at 0.01 level   N.S. Not significant**
Means followed by the same letter are not significantly different, according to DMRT

Table 5: Effect of varietal differences and fertilizer levels on yield components in 2014 season.

Sweet sorghum	Quality%			Extracted juice %		
Treatments / Varieties	Sucrose %	Reducing sugars	pH value	Total soluble solids%	Purity%	Juice extraction %
Sorgo	7.39 c	11.36 a	1.44 c	13.46 b	54.86 c	15.92 c
Brandes	8.18 b	10.61 b	2.16 b	13.27 c	61.63 b	18.04 b
Planter	8.56 a	9.9 c	2.86 a	13.73 a	62.32 a	19.63 a
F-value	**	**	**	**	**	**
Fertilizer levels						
45 kg N/fed. + 600 g Cerealin	7.51 c	10.29 c	1.92 c	13.15 c	57.08 c	15.48 c
65 kg N/fed. + 600 g Cerealin	8.48 a	10.65 b	2.22 b	13.51 b	62.72 a	19.39 a
85 kg N/fed.	8.14 b	10.94 a	2.33 a	13.8 a	59.00 b	18.73 b
F-value	**	**	**	**	**	**
Interaction	**	**	**	**	**	**

*** Significant at 0.05 level ** Significant at 0.01 level N.S. Not significant**

Means followed by the same letter are not significantly different, according to DMRT

Biofertilizer has an important role in nitrogen fixation in soil, which increase in quality and extracted juice% may be due to the role in increasing available nutrients for vegetative growth, chemical contents and consequently increased extracted juice%. The increase in total soluble solids% and purity% might be mainly due to increase in sucrose% and reducing sugars% of quality% with nitrogen fertilizer. Purity% followed inverse relation with TSS% in juice (Krauss, 2000 and Ihtisham and Jam 2001). These results are in harmony with those obtained by Mohamed *et al*., (2006); Ismail *et al*., (2007); Aly *et al*., (2008); CCSC (2010); El-Geddawy, Dalia *et al*., (2014) and El-Geddawy, Yara (2014).

Interaction effects

Data in Table 6 indicated that the interaction between Planter variety and mineral nitrogen level at 65 kg N/fed + 600 g Cerealin (N2) were the best effects as compared with other interactions which showed significant increases in stripped stalks, juice yield (ton/fed) and sucrose% in both seasons as well as purity% in the first season only. On the other hand the interaction between Brandes variety and mineral nitrogen level at 85 kg N/fed (N3) recorded significant increase in syrup yield in both seasons.

Table 6: Effect of interaction between varieties and mineral and bio nitrogen fertilizer on stripped stalks, juice yield (ton/fed), syrup and sucrose% as well as Purity% in 2013 and 2014 seasons.

Interaction	Stripped stalks			Juice		
	2013					
	N1	N2	N3	N1	N2	N3
Sorgo	12.87 h	13.44 f	13.33 g	2.45 e	2.72 c	2.65 d
Brandes	13.88 e	14.78 c	14.64 d	2.71 c	3.09 b	3.06 b
Planter	14.64 d	16.33 a	15.73 b	3.09 b	3.44 a	3.47 a
	2014					
	N1	N2	N3	N1	N2	N3
Sorgo	12.04 i	13.11 g	12.98 h	1.34 g	2.44 e	2.34 f
Brandes	13.44 f	14.33 e	14.53 d	2.30 f	2.72 c	2.62 d
Planter	14.67 c	15.46 a	15.34 b	2.66 cd	3.19 a	3.087 b
Interaction	**Syrup**					
	2013			**2014**		
	N1	**N2**	**N3**	**N1**	**N2**	**N3**
Sorgo	0.476 f	0.487 e	0.492 d	0.347 f	0.364 e	0.381 d
Brandes	0.582 c	0.606 b	0.616 a	0.556 c	0.572 b	0.591 a
Planter	0.214 i	0.222 h	0.234g	0.312 i	0.332 h	0.336 g
Interaction	**Sucrose %**			**Purity %**		
	2013					
	N1	**N2**	**N3**	**N1**	**N2**	**N3**
Sorgo	7.93 h	9.02 d	8.72 e	55.82 e	62.56 b	59.73 d
Brandes	8.08 g	9.05 cd	9.12 c	55.17 f	61.22 c	60.77 c
Planter	8.33 f	9.83 a	9.33 b	55.28 f	63.83 a	59.63 d
	2014					
	N1	N2	N3	N1	N2	N3
Sorgo	6.81 g	7.63 f	7.74 e	51.92 h	56.81 f	55.85 g
Brandes	7.65 f	8.83 b	8.06 d	59.19 e	66.28 a	59.41 e
Planter	8.06 d	8.97 a	8.64 c	60.15 d	65.09 b	61.74 c

CONCLUSIONS

In conclusion, our results showed that there were significant differences between cultivars in stalk height and diameter, leaf area, chlorophyll concentrations, sucrose%, TSS%, yields of stripped stalk and juice scored for Planter variety followed by Brandes as compared with Sorgo. Application of nitrogen mixture fertilizer at rate of 65 kg N/fed + 600 g Cerealin was more effective than 85 kg N/fed as compared to 45 kg N/fed + 600 g Cerealin where, it gave the highest values of stalk diameter, leaf area and chlorophyll concentrations as well as yields of stripped stalk and juice (ton/fed). Based on these results to obtain the highest stalk and yields, it is recommended to planting three sweet sorghum varieties Planter, Brandes and Sorgo respectively as well as application of nitrogen at rate of 65 kg N/fed (NH_4NO_3, 33.5% N) in two equal doses + 600 g Cerealin.

REFERENCES

Abd El-Lattief, E.A., (2011). Nitrogen Management Effect on the Production of Two Sweet Sorghum Cultivars under Arid Regions Conditions. Asian Journal of Crop Science, 3: 77-84.

Ahmed, M.A.; Amal, M.Z. and M.S. Hassanein (2007). Response of green sorghum to different nitrogen sources. Res. J. Agric. Boil. Sci., 3:1002-1008.

Ahmed, S. H.; A. H. Gendy; A. A. M. Hussein; M. Said-Al AHL and F.Y. Hanaa (2013). Effect of some nitrogen sources, bio-fertilizers and their interaction on the growth, seed yield and chemical composition of Guar plants. Life Science Journal 10(3): 389-402.

Aly, M.H.; Amal, M.K. and Samia, Hassan (2008).The usage of biofertilizer to minimize the mineral fertilizer for sweet sorghum, Egypt, J. Appl. Sci., 23 (2B):486-499.

Almodares, A.; M. Jafarinia and M.R. Hadi (2009). The effects of nitrogen fertilizer on chemical compositions in corn and sweet sorghum, American-Eurasian J. Agric. & Environ. Sci., 6 (4): 441-446.

A.O.A.C., (2005). Association of Official Analytical Chemists. Official Methods of analysis, 26th Ed., A.O.A.C. International, Washington, D.C., USA.

Ayub, M., A. Tanveer; K. Mahmud; A. Ali and M. Azam (1999). Effect of nitrogen and phosphorus on the fodder yield and quality of two sorghum cultivars (*Sorghum blcolor* L.). Pakistan Journal of Biological Sciences, 2: 247-250.

CCSC (2010). Sugar Crops Council. Annual Report, Ministry of Agriculture, Egypt. (In Arabic).

Chawdhury, M.K. and M. Rahman (1990). Potash requirement of sugar cane in Gangetic River Plain Soil Bangladesh. J. Ind. Soc. of Soil Sci. 38 (4): 688-691.

Collins, J.I.; I.E. Mc Carty and J.D. Peavy (1977). Quality of sorghum syrup produced in Tennessee Dep. of Food Tech. and Sci. Tennessee Farm and Home Sci. Report, USA Act. Dec. 104: 12-15.

Collins, J.L.; C.B. Ebah; I.M. Mc Carty and J.R. Mount (1987). Clarification of sorghum juice for syrup by using Bentonite and Heat. Tennessee Form and Home Sci., Spring, (142): 16-20.

Eidi zadeh, K. h.; A. M. Damghani; H. Sabahi and S. S. Zadeh (2010). Effects of application of biological fertilizers in corporation of chemical fertilizers on growth of Shooshtar *Zea mays* cultivar. J. of Agro. 2: 292-301. (Abstract in English)

El-Geddawy, Yara, I. H., (2014). Evaluation the use of sweet sorghum dough stage for manufacture of some functional food products. M.Sc. Thesis, Food Science and Technol. Ain Shams Univ.

El-Geddawy, Dalia,I.H, N.M.M.Awad and Sahar, M. I. Moustafa (2014). Lighting spot around yield and technological characteristics of some sweet sorghum varieties. Int. J. Curr. Microbiol. App. Sci (2014) 3(4): 843-850.

El-Sheikh, S.R.E.; A.H.S.A. El-Labbody and A.M.H. Osman (2011). Response of three sweet sorghum varieties to potassium mineral and bio-fertilization, Egypt. J. Agric. Res., 89 (3):1019-1027.

Gomez, K.A. and A.A. Gomez (1984). Statistical procedures for Agricultural Research. John Wiley and Sons, Inc., New York.

Ihtisham, U. and A. Jam (2001). Effect of different nitrogen levels and time of irrigation on sorghum yield on line J. of Biological. Sci. 1 (5): 348-349.

Ismail, A.M.A.; S. A. Mohamed; Samia, Y.M. and Nahed, O.Z., (2007). Response of sorghum to mineral and bio nitrogen. Egypt. J. Agric. Res. 85 (2): 573-586.

Jakson, M., (1967). Soil Chem. Analys. Prentice Hall Inc Englewood Cliff NJ USA.

Krauss, A., (2000). Role of potassium in the system of sugar beet fertilization. International Potash Institute IPI Optimizing Crop Nutrition.

Maha, El Zeny. M., (2004). Response of sweet sorghum to appropriate fertilizer regimes. Ph.D. Thesis, Fac. Agric., Moshtohor, (Benha branch), Zagazig Univ.

Mahfouz, S.A. and M. A. Sharaf Eldin (2007). Effect of mineral vs. biofertilizer on growth, yield, and essential oil content of fennel *(Foeniculum vulgare* Mill). International Agrophysics. 21(4): 361-366.

Miller, R.W. and S.D. Creelman (1982). Sorghum a new fuel. 35th Annals. Corn and Sorghum Res. Conf. pp 219-232.

Mir, S.; A. Sirousmehr and E. Shirmohammadi (2015). Effect of nano and biological fertilizers on carbohydrate and chlorophyll content of forage sorghum (*Speedfeed hybrid*) International Journal of Biosciences. 6 (4):157-164.

Mohamed, H.F., (1997). Chemical and technological studies on the sugar Crops Syrup (Treacle). M.Sc. Thesis, Fac. of Agric. Minia Univ. Egypt.

Mohamed, K.E.S.; H. Ferweez and S.M. Allam (2006). Effect of K fertilization on yield and quality of sweet sorghum juice and syrup. Bull. Fac. Agric., Cairo Univ. 57: 401-416.

Montogomery, E.G., (1911). Correlation studies of Corn. Nebraska Agric. Exp. Sta. 24th Annals Report. (C.F. Agron. J. 53: 187-188).

Moran, R. and D. Porath, (1982). Chlorophyll determination in intact tissues using N,N-Dimethyl formamide. Plant Physiol., 69: 1370-1381.

Moustafa, Zeinab, R.; H.W.A. Wahba and H. A. Samia (2006). Effect of injected ammonia Gas and applied potassium rates with or without some microniutrients on sugar beet productivity. Annals agric. Sci., Moshtohor, 44 (4): 1447-1460.

Nadir, N.; M. Mel; M.I.A. Karim and R.M. Youns (2009). Comparison of sweet sorghum and cassava for ethanpl production by using Saccharomyces cerevisiae. J. Applied Sci., 9: 3068-3073.

Nemeat, A.E.A.E., (2001). Yield and quality of sugar beet as affected by sources levels and time application of nitrogen fertilizer. J. Agric. Res. Tanta Univ., 27: 450-462.

Nour El Hoda, M.; F.A. El-Latie; M.S. Mona, and Laila, M.S., (1994). Yield and quality of juice and syrup of sweet sorghum with relation to sowing dates and harvest stages. J. Agric. Sci. Mansoura Univ. 24 (6): 2701-2709.

Osman, M.S.H; H. Ferweez and A.M.H. Osman (2005). Productivity and technological qualities of juice and syrup of nine sweet sorghum (*Sorghum bicolor* L. *Moench*) varieties. Egyptian J. of Agric. Res. 83 (3): 1255-1267.

O'Mahony, M. (1986). Sensory Evaluation of Food: Statistical Methods and Procedures. CRC Press, pp. 487.

Patra, P.; B.K. Pati; G.K. Ghosh; S.S. Mura and A. Saha (2013). Effect of Biofertilizers and Sulphur on Growth, Yield, and Oil Content of Hybrid Sunflower (*Helianthus annuus*. L) In a Typical Lateritic Soil. 2: 603 doi:10.4172/scientificreports.603

Seied, N. E. S.; R. Yaegoob; B. P. Amin and B. Shokati (2013). Effect of chemical fertilizers and bio-fertilizers application on some morpho-physiological characteristics of forage sorghum, Int. J. of Agro. and Plant Prod., 4 (2): 223-231.

Sharief, A.E.; A.N. Attia; A.A. Salama and A.E. Mousa (2004). Effect of nitrogen fertilizer sources and time of splitting on root yield and quality of sugare beet in North Delta. 4^{th} Scient. Conf. Agric. Sci., Assiut, 2: 856-866.

Singh, M. M.; M. L. Mautya; S. P. Singh and C. H. Mishra (2005). Effects of nitrogen and biofertilizers inoculation on productivity of forage sorghum (*Sorghum bicolor* L.). Indian J. of Agric. Sci. 73: 167-168.

Van Oosterom, E. J.; A. K. Borrell; S. C. Chapman and G. L. Hammer (2010). Functional dynamics of the nitrogen balance of Sorghum: I.N demand of vegetative plant parts. Field Crop Res. 155:19-28.

Yadav, H. K.; T. Thomas and V. Khajuria (2010). Effect of different levels of sulphur and biofertilizer on the yield of Indian mustard (*Brassica juncea* L.) and soil properties, Journal of Agricultural Physics, 10: 61-65.

Yadav, P. C.; A. C. Sadhu and P.K. Swarnkar (2007). Yield and quality of multi-cut forage sorghum (*Sorghum sudanense* L.) as influenced by integrated nitrogen management. Ind. j. of Agron., 52: 330-334.

التأثير المتكامل للنيتروجين المعدنى والسماد الحيوى على ثلاثة أصناف من نبات الذرة الرفيعة السكرية.

خالد عبدالدايم عبدالعال[1], شيماء عبد العظيم بدوى[2] , رانيا محمد عبد العزيز[3] و شهرزاد محمد مرشدي نعينع[3]
[1]قسم النبات الزراعى – كلية الزراعة – جامعه كفر الشيخ- مصر.
[2]قسم المحاصيل – كلية الزراعة – جامعه كفر الشيخ- مصر.
[3]معهد بحوث المحاصيل السكرية مركز البحوث الزراعية مصر.

أجريت تجربتان حقليتان خلال موسمي ٢٠١٣ و٢٠١٤ في منطقة النوبارية بمحافظة الإسكندرية بتصميم القطع المنشقة مرة واحدة فى أربع مكررات وذلك لدراسة تأثير ثلاثة مستويات من التسميد النيتروجينى المعدنى والسماد الحيوى (٦٠٠ جم سيريالين) على صفات النمو وتركيز كلوروفيل ا ، ب ومحصول السيقان والعصير والعسل والجودة فى ثلاث أصناف من الذرة الرفيعة السكرية هى:- (Sorgo, Brandes and Planter) وكانت المعاملات كالآتى: ٤٥ كجم نيتروجين (نترات الأمونيوم ٣٣.٥% نيتروجين/فدان كسماد معدني مع إضافة ٦٠٠ جرام سيريالين (نيتروجين حيوى) و٦٥ كجم نيتروجين (نترات الأمونيوم ٣٣.٥% نيتروجين/فدان كسماد معدني مع إضافة ٦٠٠ جرام سيريالين (نيتروجين حيوى) و ٨٥ كجم ن/فدان (الموصى به) بدون إضافة السماد الحيوى وكانت أهم النتائج المتحصل عليها هى:

١. أظهرت النتائج أن هناك اختلافات معنوية في صفات طول وقطر الساق ومساحة الأوراق وتركيز كلوروفيل أ ، ب والمحصول الكلى والسيقان النظيفة والشراب (طن/فدان) والنسبة المئوية للسكروز والمواد الصلبة الذائبة الكلية للعصير ونسبة النقاوة واستخلاص العصير والنسبة المئوية للسكريات المختزلة، وقد تفوق الصنف بلانتر على كلا الصنفين براندز وسورجو في كلا الموسمين.
٢. أدى استخدام السماد النيتروجيني بمعدل ٦٥ كجم ن/فدان + 600 جم سيريالين إلى زيادة معنوية فى الصفات المذكورة سابقاً، حيث سجل هذا المعدل أعلى المتوسطات فى معظم الصفات فى كلا الموسمين ثم المعدل ٤٥ كجم ن/فدان + ٦٠٠ جم سيريالين مقارنةً بالمعدل الموصى به ٨٥ كجم ن/فدان في كلا الموسميين.

لذلك توصى هذه الدراسة للحصول على محصول عالي كماً ونوعاً بإضافة ٦٥ كجم ن/فدان + ٦٠٠ جم سيريالين مع الأصناف الآتية بلانتر وبراندز وسورجو على الترتيب.