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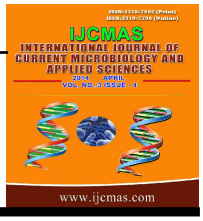

Original Research Article

Lighting spot around yield and technological characteristics of some sweet sorghum varieties

El-Geddawy, Dalia I.H[1], N.M.M.Awad[1] and Sahar and M.I. Moustafa[2]

Sugar Crops Res. Inst., Agric. Res. Centre,Giza, Egypt.
Agron[1]. Res. and Technology Res[2]. Divisions
Corresponding author

A B S T R A C T

Two field experiments were carried out in a sandy soil at El Qureen village Sharkia Governorate during 2012 and 2013 seasons to evaluate productivity and technological characteristics of juice and syrup of six sweet sorghum varieties (*Sorghum bicolor L. Moench*) namely Sorgo, Rex, Planter, Brandes, Honey and S.S.301. Randomized complete block design with four replications was used. The important results could be summarized as follows: There were significant differences between the examined sweet sorghum varieties in respect to stalk dimensions as well as number of internods / stalk. Sweet sorghum varieties viz Brands, Honey and S.S.301 over passed the other varieties with respect to yields of gross, stripped, juice and syrup. Results showed that sweet sorghum S.S. and Planter varieties as well as Brands variety surpassed significantly most of the studied varieties in respect to chemical properties of juice in terms of TSS % and purity %. Sweet sorghum variety S.S.301 recorded the highest significant values of total sugars % and sucrose % in the extracted juice over the tested varieties.

Keywords

Sorghum bicolor L. Moench; number of internods / stalk; total sugars % and sucrose %.

Introduction

Sweet sorghum (Sorghum bicolor L. Moench) is one of the most important multipurpose crop for production of golden syrup and treacle and alcohol from stalk juice. Its bagasse and green foliage could be used as an excellent fodder for animals, as organic fertilizer or for paper manufacturing. 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 hemicelluloses). So, it is one of the most important and useful crops in summer season. The great profitable of sweet

sorghum is attributed to lower cost of planting and all agricultural and agronomical practices, beside its short duration in the soil, i.e. about 120 days **(**Mokadem et al. 1999; Abo - El Wafa and Abo- El Hamd 2001 and Abbas 2002).

The findings of Miller and Creelman (1982) for Rio, Wary and Tracy varieties; Taha et al. (1994) for Sart and Honey varieties; Ferweez (1997) for Honey and Roma varieties; Mokadem et al. (1999) for Brandes, Dale, Sart, Tracy, Wiley, Williams, Honey, Sugar Drip, Brawley, Rio, Roma, Romada and Rex varieties and Abo-El Wafa and Abo-El Hamd (2001) for Umbrella, Smith, Leati, Williams, Tracy, Planter and S.S. 301 varieties supported a great differences between various sorghum varieties in stalk diameter, height of stalk, number of internodes, yield and its components, juice and syrup quality parameters.

Datta,et al (2012) showed that sweet sorghum juice of ICSV25274 variety contains 2.9 reducing sugars , 18.5 % total sugar and 1.12 % protein .Al-Labboudy et al (2008) found significant variation among the used sweet sorghum varieties in brix , sucrose , purity and reducing sugars %. El-Geddawy (2014) found that the highest amount of juice was obtained from honey with 60 kg.N/fed. followed by Brands with 80 kg.N/fed.for juice weight. While the highest amount of syrup was obtained from Brands with 80 kg.N/fed. followed by Honey with 80 kg.N/fed. She added that TSS % increased with increasing N- fertilizer in both varieties ,the highest sucrose percentage was produced in Honey variety ,also she found that Brands 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 objective of this work was to evaluate six sweet sorghum varieties in relation to yield and its components, physical properties and chemical composition of their juice and syrup

Materials and Methods

Two field experiments were carried out in a sandy soil at El Qureen village Sharkia Governorate during 2012 and 2013. Six varieties of sweet sorghum namely Sorgo, Rex, Planter, Brandes, Honey and S.S. 301 were sown in a randomize complete block design with four replications.

Physical and chemical properties of the experimental site were analyzed at Soil, Water and Environment Research Institute, Agricultural Research Center. according to Jakson (1967) are shown in Table 1.

Plot size was 21 m^2 consisted of the five rows, 6 meter long and 70 cm apart. Sowing was done Sowing date was at the 1^{st} week of June and harvest 120 days later in both seasons. Nitrogen fertilizer was in the form of ammonium nitrate (33.5% N) applied as recommended (80 kg. N/fed) in two equal doses (the first one after 30 days from sowing and the second one 15 days later), as well as phosphorus fertilizer was applied in the form of ordinary superphosphate (15.5% P_2O_5) as recommended (15 P_2O_5 kg/fed at seed bed

preparation) , whereas potassium fertilizer was added in the form of potassium sulfate (48 % K_2O/fed.) at the rate of 48 kg. K_2O/fed.

Data recorded:

At dough stage (content of seeds are firm and easily crushed between thumb and index fingers), plants were harvested. A sample of twenty stalks were taken at random to determine the following parameters:

Vegetative characters: stalk length, diameter and number of internodes were measured.

Yield and yield components: gross yield and stripped yield were determined by weighing the three guarded rows for each treatment, they were used to estimate the corresponding values/fed. While, juice and syrup yields were determined by weighing the juice extracted and syrup produced (A.O.A.C. 1995).

Physical properties of juice and syrup

*-Total soluble solids % (TSS%) or Brix % was determined by Brix hydrometer standardized at 20^{o}C
*-purity% was determined by the following equation:
Purity % = Sucrose% x 100/TSS%.
*-Juice and syrup extraction% = juice or syrup yield (ton/fed) x 100/stripped stalks (ton/fed.).
*- pH value was measured by a Beckman pH (Collins et al. 1977).

Chemical analysis of **sorghum juice and syrup**

Sucrose % , reducing sugars % and total sugars % were determined according to the methods described in A.O.A.C. (1995).

The stripped stalks of sweet sorghum were passed through a three roller mill to extract the juice. The raw juice was screened though layers of clean cheesecloth to remove the large pieces of suspended matters. Then, evaporated in open stainless steel pan (capacity 6 liters). The concentration process was carried out as rapidly as possible, first using direct flame to boiling point, then, indirect using a hot plate (to TSS % about 73% after cooling reached 75. 00 ± 0.50%). All data were subjected to the proper statistical analysis according to the procedures outlined by Gomez and Gomez (1984). Means of treatments were compared at the probabilities level of 5% using the Least Significant Difference (LSD). Combined analysis over the two seasons was carried out.

Results and Discussion

Vegetative characters

Data presented in Table(2) show the values of stalk dimensions and number of internodes of six sweet sorghum varieties . Results given appeared significant differences between the examined sweet sorghum varieties in respect to stalk dimensions as well as number of internods / stalk. This finding was fairly true in the two growing seasons however , this influence was insignificantly for the combined over the two seasons. This result is in line with that reported by Abo-El wafa and Abo-El Hamd(2001).

Sweet sorghum variety Brands recorded the highest values of the above mentioned studied characteristics followed by Honey variety then S.S.301 > Its well known that

the vegetative traits affected by the environmental conditions and gen extraction action, and because of the studied varieties grown in one location ,then it could be concluded that the differences between the studied varieties mainly due to gen make up effect.

Yield and its components:

Concerning varietal effect on gross and stripped stalk yield as well as juice and syrup yield, the results obtained in Table (3) cleared that the above mentioned three varieties is still over passed the other varieties with respect to gross yield ,stripped yield ,juice yield and syrup yield. This effect was significantly in the two growing seasons , meanwhile it did not reach to the level of significance for the combined over the two seasons. This finding is in agreement with that found by EL-Geddawy et al (2014) who stated that the two examined sweet sorghum varieties significantly differed in their stripped stalk ,juice and syrup yields Sweet sorghum variety Brandes attained the highest values in the studied traits in the two seasons as well as their interactions. In addition to gen make up influence it could be noticed that the recoded superiority in yields properties of the above mentioned varieties i.e. Brands , Honey and S.S.301 mainly due to the their superiority in vegetative characteristics i.e. stalk dimension and number of internodes which in turn reflected on the values of yield and its components (Table.3).

Chemical and physical juice properties:

Figures in Table.4 show the effect of six sweet sorghum varieties on sweet sorghum juice of some chemical and physical properties. Data collected pointed out that sweet sorghum S.S. and Planter varieties as well as Brands variety surpassed significantly most of the studied varieties in respect to chemical properties of juice in terms of TSS % and purity %. The differences between varieties with respect to their chemical composition had been reported by Al-Lboboudy et al (2008). Sweet sorghum variety S.S. 301 recorded the highest significant values of th TSS % And purity % over all the examined varieties. This distinct superiority of this variety may be due to gen expression effect.

Once more, physical properties of sweet sorghum juice of the studied varieties revealed significant differences between the tested varieties in the two seasons. Honey variety produced the highest juice extraction values with significant difference over Planter, Brands and S.S.301 varieties and with no significance difference with Sorgo and Rex varieties. The lowest juice extraction value was recorded with S.S.301 variety. More over pH values of sweet sorghum juice appeared insignificant effect by the tested varieties in the two seasons. The combined over the two season of the studied varieties showed insignificantly effect on the chemical and physical properties of sweet sorghum juice.

Chemical and physical syrup properties:

Results illustrated in Table (5) reveal varietal influence on chemical and physical properties of sweet sorghum syrup. The available data in Table (5) pointed out that sweet sorghum varieties viz; Planter , S.S.301 and Honey attained the highest values of syrup extraction % and purity % compared with the other varieties , however Planter , S.S.301 varieties recorded significant superiority

Table.1 Physical and chemical properties of the experimental site

Particle size			Soil textural	E.C. ds/m	Soil pH (1:2.5)	Organic matter %	CaCO3 %
Sand %	Silt %	Clay %	Sandy				
65.40	23.45	11.15		4.25	8.90	1.93	1.71

Soluble Cations (meq/L)				Soluble anions(meq/L)				available contents (ppm)		
Ca++	Mg++	Na+	K+	CO3--	HCO3-	Cl-	SO4--	N	P	K
6.10	3.18	14.40	0.26	1.04	1.90	8.50	15.10	26.2	4.85	278.10

Table.2 Vegetative characters as affected by six sweet sorghum varieties

Vegetative Characters	Stalk height (cm)			Stalk diameter (cm)			No. of internodes/stalk		
Varieties	2012	2013	Com.*	2012	2013	Com.*	2012	2013	Com.*
Sorgo	312.7	322.5	317.6	2.60	2.64	2.62	17. 95	17.98	17.97
Rex	223.4	235.7	229.6	2.04	2.04	2.04	17.34	17.49	17.37
Planter	305.7	307.6	306.6	2.14	2.19	2.17	17. 49	17.58	17.49
Brandes	385.4	411.3	398.5	3.01	2.90	2.96	20.78	20.82	20.80
Honey	361.3	364.2	362.7	2.81	2.78	2.80	19.72	19.85	19.74
S.S. 301	354.3	355.4	354.8	2.70	2.74	2.72	18.45	18.34	18.45
F value	* *	* *	- -	* *	* *	- -	* *	* *	- -
LSD 0.05	9.76	9.76	N.S	0.10	0.08	N.S	0.13	0.10	N.S

Table.3 Yield and its components as affected by six sweet sorghum varieties

Yield	Gross yield (ton/fed)			Stripped yield (ton/fed)			Juice yield (ton/fed)			Syrup yield (ton/fed)		
Variety	2012	2013	*Com.**	2012	2013	Com.*	2012	2013	Com*	2012	2013	Com.*
Sorgo	33.3	33.9	33.6	25.5	26.2	25.9	14.5	14.9	14.7	1.9	2.0	2.0
Rex	25.7	26.5	26.1	19.9	19.6	19.8	11.3	11.8	11.7	1.7	1.8	1.8
Planter	30.8	31.5	31.2	23.6	24.1	23.9	12.6	13.0	12.8	2.1	2.2	2.2
Brandes	44.0	44.6	44.3	33.7	34.2	33.9	18.1	18.7	18.3	2.9	2.9	2.9
Honey	39.7	40.5	40.1	30.8	31.5	31.2	18.7	18.2	18.5	2.9	2.9	2. 6
S.S. 301	35.1	35.2	35.21	26.5	26.8	26.7	13.9	14.2	14.0	2.9	2.9	2.6
F value	* *	* *	- -	* *	* *	- -	* *	* *	- -	* *	* *	- -
LSD 0.05	1.63	1.27	N.S	1.28	1.20	N.S	0.9	0.6	N.S	0.2	0.2	N.S

Table.4 Physical and chemical properties of the extracted juice of six sweet

Property	Total soluble solids (TSS%)			Purity % juice			Juice extraction %			pH value		
Varieties	2012	2013	Com *	2012	2013	Com *	2012	2013	Com *	2012	2013	Com*
Sorgo	17.5	17.7	17.6	56.9	57.0	57.0	53.2	53.7	53.4	5.7	5.7	5.7
Rex	19.2	19.3	19.2	54.5	53.2	53.8	53.5	54.7	54.1	5.7	5.7	5.7
Planter	19.7	19.2	19.5	62.5	63.4	63.0	49.0	49.8	49.4	5.8	5.8	5.8
Brandes	18.7	18.9	18.8	56.1	56.1	56.1	51.2	51.7	51.4	5.8	5.7	5.7
Honey	18.4	18.5	18.5	61.2	61.0	60.6	58.5	55.5	57.0	6.0	5.7	5.9
S.S. 301	21.8	21.0	21.4	63.2	66.1	64.6	48.5	49.4	49.0	6.0	5.8	5.9
F value	* *	* *	- -	* *	* *	- -	* *	* *	- -	- -	- -	- -
LSD 0.05	0.96	0.77	N.S	4.1	5.5	N.S	2.4	2.3	N.S	N.S	N.S	N.S

Table.5 Physical properties of the produced syrup of six sweet sorghum varieties

Property	Syrup extraction %			Purity %			pH value		
Varieties	2012	2001 3	Com. *	2012	2013	Com.*	2012	2013	Com.*
Sorgo	8.3	8.3	8.3	38.1	36.6	37.3	5.30	5.20	5.25
Rex	9.7	9.7	9.7	36.60	36.20	36.40	5.20	5.40	5.30
Planter	9.9	10.3	10.1	44.20	45.20	44.70	5.50	5.60	5. 55
Brandes	9.4	9.4	9.4	39.70	39.40	39.55	5.40	5. 40	5.40
Honey	9.3	9.4	9.3	41.50	42.00	41.75	5. 50	5. 40	5. 55
S.S. 301	10.7	10.8	10.75	44.30	44.70	44.50	5.60	5.50	5.55
F value	* *	* *	- -	* *	* *	- -	- -	- -	- -
LSD 0.05	0.51	0.43	N.S	1. 71	1.40	N.S	N.S	N.S	N.S

Table.6 Chemical composition of the extracted juice of six sweet sorghum varieties

Constitute	Total sugars %			Sucrose %			Reducing sugars %		
Varieties	2012	2013	Com.*	2012	2013	Com.*	2012	2013	Com.*
Sorgo	14.8	15.0	14.9	10.2	10.4	10.3	4.50	4.50	4. 50
Rex	16.6	16.6	16.60	10.7	10.6	10.65	5.80	5.90	5.85
Planter	18.0	17.70	17.80	12.5	12.7	12.6	5.00	5.50	5.25
Brandes	16.1	16.2	16.15	10.8	10.8	10.8	5.20	5.40	5.30
Honey	16.4	16.0	16.20	11.5	11.4	11.4	4.70	4.90	4.80
S.S. 301	19.3	19.4	19.3	13.9	14.0	13.95	5.00	5.50	5.25
F value	* *	* *	- -	* *	* *	- -	- -	- -	- -
LSD 0.05	1.11	1.56	N.S	0.91	0.91	N.S	0.61	0.41	N.S

Table.7 Chemical composition of the produced syrup of six sweet sorghum varieties

Constitute	Total sugars %			Sucrose %			Reducing sugars %		
Varieties	2012	2013	Com.*	2012	2013	Com.*	2012	2013	Com.*
Sorgo	62.2	61.8	62.0	28.8	27.7	28.25	33.1	33.8	33.45
Rex	61.7	62.0	61.85	27.8	27.5	27.65	33.7	33.4	33.55
Planter	63.3	63.7	63.55	33.8	34.2	34.0	28.9	29.0	28.95
Brandes	62.1	62.3	62.2	30.1	29.8	29.95	31.7	32.1	31.90
Honey	63.6	63.7	63.65	31.4	31.8	31.6	31.8	31.5	31.65
S.S. 301	62.4	62.1	62.25	33.6	33.8	33.75	28.3	27.7	28.00
F value	- -	* *	- -	* *	* *	- -	* *	* *	- -
LSD 0.05	N.S	1.31	N.S	1.12	1.09	N.S	1.19	1.36	N.S

over all the examined varieties in this respect. The obtained results was found by El-Geddawy (2014)

As for the influence of the tested varieties, results obtained revealed that the differences between the studied varieties did not reach the level of significant with respect to pH values of sweet sorghum syrup .Once more, the results obtained in Table(5) cleared that there were no significant influence on chemical and physical properties of sweet sorghum varieties in the combined of the two growing seasons.

Chemical composition of juice

Table (6) demonstrate the influence of six sweet sorghum varieties on chemical composition of juice.

Results given showed that sweet sorghum variety S.S.301 recorded the highest significant values of TSS % and sucrose % over the tested varieties followed by Sweet sorghum planter. This finding was completely true in the two growing seasons, however this effect was insignificantly in the combined over the two season. More over, it is clearly show that the values of reducing sugar of sweet sorghum juice insignificantly affected by the examined varieties. This result was fairly true in both season and their combined.

Chemical composition of syrup

Figures in Table (7) reveal the influence of sweet sorghum varieties on chemical composition of sweet sorghum syrup. The collected data demonstrated that total sugars % insignificantly affected by the tested varieties in the 1st season and the combined over the two seasons ,however, it was significantly in the 2nd season. Regardless the significance effect, it could be noted that Planter and Honey varieties recorded the highest values of total sugars %.

Once more, Planter and S.S.301 varieties produced the highest sucrose and reducing sugars percentages followed by Honey variety with significant difference with Planter and S.S.301 varieties. These results were true in both seasons and their combined. This results is in accordance with Abo-El Wafa and Abo-El Hamd (2001)

References

Abbas, H.M. 2002. Effect of period and regions of processing on quality Parameters of Egyptian treacle Black Honey. Minia J. Agric. Res. and Develop. 22 4: 337-354.

Abo-El Wafa, A.M. and A.S. Abo - El Hamd 2001. Evaluation of some sweet sorghum varieties under different plant populations in Upper Egypt. Minia J. Agric., Res. and Develop. 21 3: 475-492.

Al-Labobody,A.H.;A.M.Abd El-Razek and S.Y.Besheit 2008. Evaluation of some sweet sorghum varieties Sorghum bicolor,L,Moenchunder two sowing dates.Zagazig J.Agric.Res., 35 1: 1-18

A.O.A.C. 1995. Association of Official Analytical Chemists. Official methods of analysis, 16th Ed., AOAC International, Washington, D.C., USA.

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.

Collins, J.I. I.E. Mc Carty and J.D. Peavy 1977. Quality of sorghum syrup produced in Tennessee. Depart. of Food Techn. and Sci. Tennessee Farm and Home Sci., Report, USA, Act. – Dec., 104, pp. 12- 15.

Datta,S.A.Poshadri, P.S.Rao;C.H.R.Reddy and B.V.S. Reddy2012.

Innovative use of sweet sorghum juice in the beverage industry. International Food Research Journal.194:1361-1366

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.

Ferweez, H.F. 1997. Chemical and technological studies on the sugar crops syrup Treacle. M.Sc. Thesis, Fac. of Agric., Minia Univ. Egypt.

Jakson, M.L. 1967 : Soil chemical analysis. Prentice. Hall. Inc. Englewood Cliffs. NJ. USA.

Gomez, K.A. and A.A. Gomez 1984. Statistical Procedures for Agric. Res., 2nd Ed. John Willey and Sons, New York, pp.680.

Mokadem, S.A.; M.A. Salem and Taha, Nour El. Hoda, M. 1999. Evaluation of yield and its components as well as syrup reduction of some sweet sorghum varieties *Sorghum bicolor L. Moench* grown under middle Egypt environmental conditions. Minia J. Agric. Res. and Develop.19: 207-218.

Taha, Nour El-Hoda, M.; L.M. Saif; F.A. Abd El-Latif and M.K. Aly 1994. Effect of plant population and nitrogen fertilization in relation to yield and quality of sweet sorghum. Egypt. J. Appl. Sci. 9 7: 860-868.