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EVALUATION OF SOME SWEET SORGHUM VARIETIES (*Sorghum bicolor* L. *Moench*) UNDER TWO SOWING DATES

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ABSTRACT: Two field trials were carried out at Giza Experimental Station, Agricultural Research Center during the summer seasons of 2005 and 2006.

Fourteen sweet sorghum varieties were evaluated for their yielding ability, juice quality and processing parameters under two sowing dates i.e. May 5th and 25th Analysis of variance showed:

Most yielding traits, juice quality and processing parameters acted better in the early planting date (May 5) than in the late one (May 25).

Great variation in most studied traits have been detected among the fourteen sweet sorghum varieties under investigation.

Not all sweet sorghum varieties perform good for stalk, syrup and alcohol production, quality and processing parameters in the first planting date, but some of them were suitable for the second planting date.

Results also cleared that Mn3306, Planter, Rex, Rio, SS405 and Tracy varieties which distinguished with high potential ability on producing syrup and ethanol are recommended for both syrup and/ or ethanol production.

Key words: Sweet sorghum, varieties, planting date, evaluated, juice quality and processing parameters.

INTRODUCTION

Cane syrup is a very popular product in Egypt; its manufacture consumes about 5% of the total cane area (Annual report 2005, by Sugar Crops Council). The continuous increase demand necessaries more attention

forwards sweet sorghum as an ancillary source of syrup which distinguish with abundant sweet juice and acceptable syrup quality. In addition. Sorgo could be used as bio-energy resource. Moreover, sweet sorghum is better than sugarcane and corn in terms of food calories production per unit area. Nevertheless, not all sweet sorghum cultivars are equally good for syrup and alcohol production, but there is a good deal of variation from one to anther in their potential yield, quality traits and processing characteristics (Bapat, *et al* 1987; AbdEl-Karim *et al* 1999; Allam *et al* 2001 and Saleh, 2004).

Nowadays, the demand for ethanol as free octane fuel increased steadily, therefore, sorghum juice performance always with high percentage of simple sugars and can be directly acted upon by yeast to produce alcohol. In this connection, Kresovich and Henderlong (1984) reported on the feasibility of sorghum for ethanol production, moreover, Smith *et al* (1987), Somani *et al* (1992) and Smith and Buxton (1993) stated that sweet sorghum juice was a good substrate for production of alcohol by yeasts.

Under subtropics and temperate environments, suitable sowing date received great attention (Almodares *et al* 1994; Besheit *et al* 1996 and Taha Nour and El-Koliey (1999).

Therefore, selecting the suitable sowing date, the proper varieties which perform high yielding ability, juice quality and processing parameters under agroclimatic conditions of El-Giza governorate were the aim of the present study.

MATERIALS AND METHODS

The present investigation was carried out at Giza Agricultural Research Station, Agricultural Research center (ARC) to evaluate fourteen sweet sorghum cultivars namely, Brandes, Dale, Honey, Leoti, Mn 3306, Mn 3556, Planter, Rex, Rio, Smith, SS405, Tracy, Umberalla and Williams under two sowing dates in the summer of 2005 and 2006 seasons. Randomized Complete Block Design with three replications was carried out. Each plot consisted of 5 rows, 7m long and 60cm apart ($21m^2$). Spacing among hills were 25cm. Planting date was May 5 and 25 in both seasons, respectively.

Other cultural practices such as hoeing, thinning, fertilization, irrigation...etc were maintained aimed at levels to assure optimum production. Harvest time was carried out for each cultivar at hard dough stage. The three middle guarded rows were used to determine yield of the millable stalks and stalk components (stalk length, diameter and weight).

Twenty five stripped stalks were taken randomly from each plot and were immediately crushed through 3 roller lab. mill, the raw juice was filtered and weighed. Juice extraction percentage (JEP) was calculated according to the equation:

JEP = (Juice weight X 100) / stripped stalks weight

and juice yield (ton/fed) was calculated according to the equation:

Juice yield = (Stripped yield X juice extr. %) / 100

Apparent brix, sucrose, reducing sugars, purity, fermentable sugar percentages (FSP) were determined from the equations:

Purity = (Sucrose % X 100) / Brix

FSP = Sucrose % + Reducing sugars %

according to methods of Meade and Chen (1977). Theoretical ethanol yield (ETOH) was calculated according to Smith and Buxton (1993).

Three kg juice for each sample were used for syrup manufacture. Syrup extraction percentage (SEP) and Syrup yield (SY) ton/fed were also calculated from the equations:

SEP = (syrup weight X 100) / juice weight

Sy = SEP X juice weight

Percentage data were transformed to arcin before statistical analysis. Analysis of variance was computed for each trait in each season according to Steel and Torre (1980). Treatment means were compared using L.S.D. at 5% level of probability.

RESULTS AND DISCUSSION

Effects on Stalk Component and Stalk Yield (ton/fed)

Average stalk component (stalk length, diameter and weight) and stalk yield (ton/fed) insignificantly affected by sowing dates in both seasons Tables 1 and 2. Nevertheless, sowing on May 5, slightly improved stalk yield by 0.5 and 1.2 ton/fed in both seasons as sowing was carried out for about three weeks later. These results are mainly conformable with taller, thicker and heavier

stalk recorded in the early sowing Tables 1 and 2. Such effect may be due to that sorghums are tropic and subtropics plants where high temperature, great light intensity and long photoperiod obviously enhanced growth and yield. Similar findings are reviewed by Almodares *et al* (1994), Becheit *et al* (1996) and Taha, Nour and EI-Koliey (1999).

Average stalk yield (ton/fed) and stalk components (stalk length and weight) were significantly differed among the used fourteen sweet sorgo varieties in 2005 and 2006 seasons. However, the differed in stalk diameter among sorgo varieties in both seasons were too small to reach the level of significance (Table 1 and 2).

The highest stalk yield in both seasons was of Planter variety (29.0 and 30.0) followed by Mn3306 (29.0ton/fed) and SS405 (28.8ton/fed) in the first season and by SS405 (29.1ton/fed) and Rex (28.3ton/fed) varieties in the second season. Dale variety gave the lowest stalk yield (14.2 and 14.0 ton/fed) in both seasons, respectively. Table 1 and 2. Meantime, the highest stalk yield varieties are distinguished with the highest stalk performance in terms of stalk height, diameter and weight. In this connection, numerous reports showed that individual stalk performance and stalk yield differed greatly among sweet sorghum varieties and most variations are genetically. (Bapat *et al* 1987; Abd El-Karim *et al* 1999 and Saleh 2004).

Dealing with the behavior of the used varieties within sowing date, data in Tables 1 and 2 indicated that sweet sorghum varieties had different and substantial respond within sowing date in both seasons. Early sowing (May 5) was more suitable for Brands, Mn3306, Planter, Rex, Rio, Smith, SS405, Umbrella and Williams which verified better stalk yield (ton/fed) in both seasons than late sowing (May 25). On the other hand sowing about 3 weeks later (May 25) yielded better stalk yield for Dale, Haney, Leoti, Mn3306 and Tracy. Similar results were reviewed by Almodares *et al* (1994) who stated that the interaction between cultivars and date of planting were significant for stripped stalk yield.

Juice Quality Parameters

Brix (Total Soluble Solids), Sucrose (Pol) and reducing sugar

Table 1.Effect of sowing date on stalk length and diameter (cm) of some sweet sorghum varieties in 2005 and 2006 seasons

Sowing dates / Varieties	Stalk length (cm)						Stalk diameter (cm)					
	2005 season			2006 season			2005 season			2006 season		
	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean
Brandes	294	256	**275**	273	250	**262**	1.9	2.1	**2.0**	1.9	2.0	**2.0**
Dale	275	241	**258**	272	237	**255**	1.9	2.0	**2.0**	1.9	2.0	**2.0**
Honey	247	314	**281**	233	310	**272**	1.9	2.0	**2.0**	1.9	2.0	**2.0**
Leoti	232	285	**259**	227	280	**254**	1.7	2.0	**1.9**	1.8	1.8	**1.8**
Mn3306	369	357	**363**	387	350	**369**	2.1	2.1	**2.1**	2.2	2.0	**2.1**
Mn3556	328	342	**335**	342	339	**341**	2.1	1.9	**2.0**	2.2	2.0	**2.1**
Planter	353	322	**338**	395	335	**365**	2.0	2.2	**2.2**	2.1	2.2	**2.2**
Rex	347	284	**316**	349	298	**324**	2.0	2.0	**2.0**	2.0	2.1	**2.1**
Rio	362	304	**333**	371	298	**335**	2.2	2.1	**2.2**	2.2	2.2	**2.2**
Smith	317	279	**298**	323	295	**309**	2.2	2.0	**2.1**	2.2	2.1	**2.2**
SS405	325	350	**338**	343	363	**353**	2.0	1.9	**2.0**	1.9	2.0	**2.0**
Tracy	285	309	**297**	290	320	**305**	2.0	1.9	**2.0**	1.9	1.9	**1.9**
Umbrela	330	270	**300**	346	275	**311**	2.2	2.0	**2.1**	2.3	2.0	**2.2**
Williams	287	257	**272**	300	262	**281**	2.0	1.9	**2.0**	2.2	1.9	**2.1**
Mean	**311**	**298**	**304**	**318**	**301**	**309**	**2.0**	**2.0**	**2.0**	**2.1**	**2.0**	**2.0**
L.S.D at 0.05												
Sowing date (A)			Ns			Ns			Ns			Ns
Varieties (B)			28			17			Ns			Ns
AxB			40			24			Ns			Ns

Table 2. Effect of sowing date on average stalk weight (g) and stalk yield (ton/fed) of some sweet sorghum varieties in 2005 and 2006 seasons

Sowing dates / Varieties	Stalk weight (g)						Stalks yield (ton/fed)					
	2005 season			2006 season			2005 season			2006 season		
	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean
Brandes	540	503	**522**	560	547	**553**	16.2	15.1	**15.7**	16.8	16.4	**16.6**
Dale	450	497	**473**	463	470	**467**	13.5	14.9	**14.2**	13.9	14.1	**14.0**
Honey	690	710	**700**	847	877	**862**	20.7	21.3	**21.0**	25.4	26.3	**25.9**
Leoti	703	773	**738**	753	793	**773**	21.1	23.2	**22.2**	22.6	23.8	**23.2**
Mn3306	950	980	**965**	980	687	**833**	28.5	29.4	**29.0**	29.4	25.6	**27.5**
Mn3556	853	823	**838**	860	783	**822**	25.6	24.7	**25.2**	25.8	23.5	**24.7**
Planter	993	937	**965**	1013	987	**1000**	29.8	28.1	**29.0**	30.4	29.6	**30.0**
Rex	910	877	**893**	960	923	**942**	27.3	26.3	**26.8**	28.8	27.7	**28.3**
Rio	750	577	**663**	710	617	**663**	22.5	17.3	**19.9**	21.3	18.5	**19.9**
Smith	697	607	**652**	653	607	**630**	20.9	18.2	**19.6**	19.6	18.2	**18.9**
SS405	637	950	**793**	947	990	**968**	29.1	28.5	**28.8**	29.7	28.4	**29.1**
Tracy	563	860	**712**	920	880	**900**	16.9	25.8	**21.4**	27.6	26.4	**27.0**
Umbrela	730	607	**668**	763	680	**722**	21.9	18.2	**20.1**	22.9	20.4	**21.7**
Williams	760	630	**695**	693	640	**667**	22.8	18.9	**20.9**	20.8	19.2	**20.0**
Mean	731	738	**734**	795	749	**772**	22.6	22.1	**22.4**	23.9	22.7	**23.3**
L.S.D at 0.05												
Sowing date (A)			Ns			Ns			Ns			Ns
Varieties (B)			80			120			1.7			1.5
AxB			113			169			1.5			2.1

in $100cm^3$ juice are the most important feature of juice quality in sugar crops including sweet sorghum.

Data in Table 3 indicate that brix and sucrose values were significantly higher in the first planting date (May5) than those of May25. On the contrary, reducing

sugars of the second planting date (May25) was slightly higher than the first planting date. The superiority of quality traits in the early planting date may be due to that environment conditions were more suitable for sugar synthetic and accumulate than late planting. The obtained results are in harmony with those of Almodares *et al* (1994), Besheit *et al* (1996) and Taha, Nour and El-Koliey (1999).

Significant variation among the used sweet sorghum varieties in brix, sucrose and reducing sugar have been detected in both seasons Table 3.

Umbrella variety gave the highest brix value (14.6 and 16.3%) in 2005 and 2006 seasons. Meantime, Leote variety exhibited

the lowest brix value (11.8%) in the first season and Mn3556 (11.7%) in the second season. Moreover, seven varieties in both seasons were exceeded than the average over all varieties,

meantime, insignificantly differed with the highest brix value Parvatikar and Manjunath (1991) and Ma et al (1992) reported that significant linear correlation between the brix and total sugar content of the juice and the total sugar content could therefore be calculated from brix. In this connection under Egyptian condition AbdEl-Karim *et al* (1999) and Allam *et al* (2001) mentioned to marked variation in brix values among sorghum varieties.

Regarding sucrose% trait, data in Table 3 cleared that Mn3306 and Planter varieties exhibited the highest sucrose% (9.2 and 10.2%) in both seasons, respectively. While, Leoti variety recorded the lowest sucrose% (5.0 and 5.5%) in the two seasons.

Rio variety displayed the highest reducing sugar (6.3 and 6.5%) in 2005 and 2006 seasons. However, Honey variety recorded the lowest reducing sugar (2.2 and 2.3%) in both seasons. The variation in juice quality parameters may be extremely diverse genetically. In the same

Table 3. Effect of sowing date on brix, sucrose and reducing sugar percentages of some sweet sorghum varieties in 2005 and 2006 seasons

Varieties \ Sowing dates	Brix (%)						Sucrose (%)						Reducing sugars (%)					
	2005 season			2006 season			2005 season			2006 season			2005 season			2006 season		
	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean	5May	25May	
Brandes	13.8	13.9	13.9	14.6	16.4	15.5	6.4	5.7	6.1	7.1	6.5	6.8	5.4	4.4	4.9	5.1	5.8	5.5
Dale	11.8	13.2	12.5	13.6	14.3	14.0	5.2	5.1	5.2	5.9	5.4	5.7	4.4	3.8	4.1	6.2	7.3	6.8
Honey	12.6	12.7	12.6	14.3	13.2	13.7	6.2	5.4	5.8	6.9	5.9	6.4	2.2	2.3	2.2	2.2	2.3	2.3
Leoti	12.1	11.6	11.8	13.3	12.5	12.9	5.4	4.6	5.0	5.7	5.2	5.5	2.2	5.4	3.8	3.1	3.6	3.4
Mn3306	15.5	13.3	14.4	16.7	11.4	14.1	9.7	8.6	9.2	9.8	7.4	8.6	3.9	6.1	5.0	6.9	3.1	5.0
Mn3556	15.5	9.3	12.4	13.7	9.7	11.7	8.5	5.9	7.2	7.7	6.2	6.9	4.6	4.7	4.7	2.5	2.4	2.5
Planter	11.7	15.6	13.6	14.5	16.8	15.6	7.5	10.2	8.9	9.2	11.1	10.2	2.8	6.0	4.4	4.8	3.2	4.0
Rex	10.0	13.7	11.9	12.1	14.3	13.2	6.2	8.7	7.5	7.4	9.2	8.3	6.0	5.0	5.5	4.2	6.9	5.6
Rio	14.6	13.9	14.3	14.4	15.2	14.8	7.8	5.8	6.8	8.0	6.2	7.1	5.6	7.0	6.3	8.1	5.0	6.5
Smith	12.4	12.9	12.7	16.2	14.3	15.3	6.2	5.1	5.7	7.7	5.6	6.7	5.0	5.8	5.4	3.3	5.2	4.3
SS405	15.8	12.5	14.2	17.1	14.7	15.9	9.4	7.2	8.3	10.3	8.5	9.4	3.2	3.7	3.5	2.6	4.9	3.7
Tracy	14.8	11.0	12.9	15.7	12.7	14.2	8.6	6.1	7.4	9.17	6.9	8.0	6.3	5.8	6.1	5.0	6.4	5.7
Umbrela	17.3	11.9	14.6	19.2	13.3	16.3	10.6	6.8	8.7	11.3	7.6	9.5	3.2	4.4	3.8	1.4	3.5	2.5
Williams	17.4	11.5	14.4	19.2	12.5	15.9	9.2	5.7	7.5	9.8	6.4	8.1	7.1	6.2	6.7	5.9	7.2	6.5
Mean	14.0	12.6	13.3	15.3	13.7	14.5	7.6	6.5	7.1	8.3	7.0	7.7	4.4	5.0	4.7	4.4	4.8	4.6
L.S.D at 0.05																		
Sowing date (A)			Ns			0.66			0.37			0.34			Ns			Ns
Varieties (B)			11.4			2.20			0 99			1.05			1.2			1.4
AxB			17.0			3.10			1.4			1.49			1.8			2.1

time eight and seven varieties in the first and second seasons exceeded the average over all varieties and most of them did not differed significantly with the highest sucrose and reducing sucrose, respectively.

Worth to mention that sweet sorghum with low sucrose and high reducing sugars content are more suitable for syrup production and low fermentable industries due to non or less sucrose crystallization takes place through processing.

Juice quality parameters significantly affected by the interaction between planting dates and varieties Table 3. In general in early planting most varieties distinguished with high quality traits in both seasons, give evident that those varieties were early mature ones. Planter and Rex varieties in spite of their higher stalk yield in the first planting date, their quality traits were better in the second planting date given or indication that both varieties were late mature ones. These results are in line with those of Almodares et al (1994) who reported that interaction between cultivars and date of planting were significant for Brix value and Pol%.

Juice Processing Parameter

Purity and Total fermentable sugars are the most aspects judging sweet sorghum suitability for syrup and ethanol alcohol production.

The first planting date (May5) significantly increased purity trait by 3.1% (from 51.4 to 54.5%) and 2.3% (from 51.7to 54.0%) and total fermentable sugars by 5.22 % (from 11.5 to 12.1%) and 7.63% (from 11.8 to 12.7) in the first and second seasons, respectively Table 4. Such increase may be due to the observed increase in brix and sucrose percoatuses discussed before. Similar results were reviewed by Almodares *et al* (1994) and Besheit *et al* (1996).

The results in Table 4 indicate significant variation in purity and total fermentable sugar among varieties in both seasons. The highest purity was Planter variety (65.0%) in both seasons followed by Mn 3306 (63.8 and 62.1 %) and Rex (62.6 and 63.0 %). The varieties next in order and ranked the fourth, fifth, sixth and seventh were Mn 3556 SS405, Trecy and umbrella, respectively in both seasons. On the other hand, Dale variety gave the lowest purity (41.5 and 40.6 %) in 2005 and 2006 seasons followed by Leoti and Brandes, respectively. These

Table 4. Effect of sowing date on purity and total fermentable sugars percentage of some sweet sorghum varieties in 2005 and 2006 seasons

Sowing dates / Varieties	Purity%						Total fermentable sugars percentage					
	2005 season			2006 season			2005 season			2006 season		
	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean
Brandes	46.4	40.8	43.6	48.7	39.7	44.2	11.8	10.1	11.0	12.2	12.3	12.3
Dale	44.2	38.7	41.5	43.6	37.6	40.6	9.6	8.9	9.3	12.1	12.7	12.4
Honey	49.2	42.6	45.9	48.4	44.7	46.6	8.4	7.7	8.1	9.1	8.2	8.7
Leoti	44.7	39.8	42.3	42.7	41.7	42.2	7.6	10	8.8	8.8	8.8	8.8
Mn3306	62.7	64.8	63.8	58.9	65.2	62.1	13.6	14.7	14.2	16.7	10.5	13.6
Mn3556	54.8	63.6	59.2	55.7	63.8	59.8	13.1	10.6	11.9	10.2	8.6	9.4
Planter	64.2	65.7	65.0	63.7	66.3	65.0	10.3	16.2	13.3	14	14.3	14.2
Rex	61.7	63.4	62.6	61.4	64.5	63.0	12.2	13.7	13.0	11.6	16.1	13.9
Rio	53.4	41.7	47.6	55.6	40.6	48.1	13.4	12.8	13.1	16.1	11.2	13.7
Smith	49.8	39.6	44.7	48.1	39.4	43.7	11.2	10.9	11.1	11	10.8	10.9
SS405	59.7	57.6	58.7	60.4	57.8	59.1	12.6	10.9	11.8	12.9	13.4	13.2
Tracy	58.2	55.3	56.8	58.7	54.7	56.7	14.9	11.9	13.4	14.2	13.3	13.7
Umbrela	61.4	56.9	59.2	58.7	57.2	58.0	13.8	11.2	12.5	12.7	11.1	11.9
Williams	52.9	49.6	51.3	51.3	50.9	51.1	16.3	11.9	14.1	15.7	13.6	14.7
Mean	54.5	51.4	53.0	54.0	51.7	52.9	12.1	11.5	11.8	12.7	11.8	12.2
L.S.D at 0.05												
Sowing date (A)			0.85			2.10			0.4			0.5
Varieties (B)			1.1			2.40			1.4			1.8
AxB			1.5			3.40			1.9			3.2

findings are in harmony with those of Abd El-Karim (1999) and Allam, *et al.* (2001).who reported that juice purity differ greatly among sorghum cultivars and ranged between 37.6 to 85.0%.

Dealing with total fermentable sugars, data in 2005 season indicated that total fermentable sugars of the tested fourteen sorghum varieties averaged 11.8 % with a range of 8.1% for Honey variety to 14.2% for Mn 3306 variety Table 4, while, in 2006 season, average value was 12.3% with a range of 8.7%for Honey variety to 12.7% for Williams variety. Further more, nine varieties in 2005 and 2006, respectively accumulated fermentable sugars greater than or equal their averages Table 4. Total fermentable sugars (sum product of juice contents of sucrose and reducing sugars) refers to the simple sugars or easy fermentable sugars which directly acted upon by yeast to produce alcohol (Smith and Buxton, 1993; Abd El-Karim *et al* 1999 and Allam *et al* 2001).

The interaction between planting dates and varieties significantly affected purity and total fermentable sugars Table 4. In both seasons and in the second planting date Planter variety exhibited the highest purity percentage, while Dale gave the lowest purity Table 4. Meantime in the first season the highest total fermentable sugars was achieved in the first plant date by Williams variety and Mn 3306 variety in the second season, while, Honey variety gave the lowest fermentable sugars in both seasons in the second planting dates.

Juice Extraction Percentage (JEP) and Juice Yield (ton/fed)

Planting date did not significantly affect JEP and juice yield (ton/fed) in both seasons, except JEP in 2005 season Table 5. Similar findings were reported by Besheit *et al* (1996).

Varieties significantly affected JEP and juice yield in both seasons Table3. In first season, the highest JEP was of Smith variety (51.1%) followed by Mn 3306 (50.4%) and Tracy (50.0%). However, in the second season Tracy variety ranked the first (48.0%) followed by Rex (45.0%), Rio (44.7%) and Brades (44.3%), respectively Table 3. Honey variety exhibited the lowest JEP (37.7 and 30.5%) in both seasons. Moreover, JEP of seven and eight varieties exceeded

Table 5. Effect of sowing date on juice extraction percentage and juice yield (ton/fed) of some sweet sorghum varieties in 2005 and 2006 seasons

Sowing dates / Varieties	Juice extraction percentage						Juice yield (ton/fed)					
	2005 season			2005 season			2005 season			2005 season		
	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean
Brandes	49.6	45.7	47.8	45.3	43.2	44.4	8.0	6.9	7.5	7.6	7.1	7.3
Dale	45.1	42.0	43.7	42.6	40.5	41.7	6.1	6.3	6.2	5.9	5.7	5.8
Honey	35.7	39.7	37.7	26.7	34.3	30.5	7.4	8.5	7.9	6.8	9.0	7.9
Leoti	46.4	43.3	45.0	29.9	32.9	31.4	9.8	10.0	9.9	6.8	7.8	7.3
Mn3306	54.0	46.8	50.4	33.1	44.2	38.8	15.4	13.8	14.6	9.7	11.3	10.5
Mn3556	46.1	50.7	48.4	29.7	41.7	35.7	11.8	12.5	12.2	7.7	9.8	8.7
Planter	44.6	37.5	40.9	32.4	39.6	36.0	13.1	10.5	11.8	9.8	11.7	10.8
Rex	46.5	44.5	45.5	47.2	42.7	45.0	12.7	11.7	12.2	13.6	11.8	12.7
Rio	44.3	43.6	44.0	44.1	45.2	44.8	10.0	7.5	8.8	9.4	8.4	8.9
Smith	42.5	59.6	51.2	35.3	46.9	41.1	8.9	10.8	9.9	6.9	8.5	7.7
SS405	38.9	46.3	42.6	36.4	45.2	40.8	11.3	13.2	12.3	10.8	12.8	11.8
Tracy	53.1	46.8	50.0	50.8	45.1	48.0	9.0	12.1	10.5	14.0	11.9	13.0
Umbrela	42.4	48.3	45.5	35.9	40.6	38.4	9.3	8.8	9.0	8.2	8.3	8.3
Williams	46.2	42.5	44.5	44.5	41.6	43.2	10.5	8.0	9.3	9.3	8.0	8.6
Mean	45.3	45.5	45.4	38.1	41.7	39.9	10.3	10.1	10.2	9.1	9.5	9.3
L.S.D at 0.05												
Sowing date (A)			Ns			2.6			Ns			Ns
Varieties (B)			5.9			7.4			1.6			1.6
AxB			0.9			1.4			2.2			2.3

than all varieties average in the first and second seasons, respectively, indicating that these varieties were more succulent than the others.

Dealing with juice yield (ton/fed). Mn3306 variety gained the highest juice yield 14.6ton/fed followed by SS405 variety 12.3 ton/fed in the first season, while in the second season Tracy 13.0ton/fed) and Rex (10.7 (ton/fed) ranked the first and the second varieties among the other varieties Table 3. Otherwise, Dale variety recorded the lowest juice yield 6.2 and 5.8 ton/fed in both seasons. Such effect may be due to that the used varieties markedly differed in both JEP and stalk yield as mentioned before and used in juice yield calculation. Those results are supported by those of Bapat *et al* (1987), AbdEl-Karim (1999) and Allam *et al* (2001). The interaction between planting dates and varieties significantly affected JEP and juice yield in both seasons Table 5. In the first planting date Brands, Rex and Williams gave higher JEP and juice yield in both seasons than their values in the second season. However, Honey, Mn3306, Smith and SS405 had a vice versa trend concerning to the second planting date. These results give evident that those varieties were more stable than the other varieties across years. The data also in Table 5 indicated that the other varieties behaved inconsistently between seasons with respect to planting dates.

Syrup Extraction Percentage (SEP) and Syrup Yield (Kg/fed)

Planting date slightly affected SEP in both seasons Table 6 while, sowing on May 5 increased syrup yield in both seasons as compared with planting date as May 25. Similar results were reported by Besheit *et al* (1996) who showed that sowing date insignificantly affected syrup extraction.

Syrup extraction percentage and syrup yield differed significantly among varieties in both seasons Table 6. Planter and Mn3306 exhibited the highest SEP (9.6% and 9.4%) in the first and second seasons, respectively. Meanwhile, the highest syrup yield in first season was of Mn 3306 (1311.7Kg/fed) followed by Mn 3556 (1137.2 Kg/fed) and Planter (1135.2 Kg/fed), the variety next in order was SS405 (1072.5 Kg/fed). In the second season. Tracy exhibited the highest syrup yield (114.9 Kg/fed) followed by Rex (1074.1 Kg/fed) and SS405

(1022.8 Kg/fed). On the other hand, Dale variety gave the lowest SEP and syrup yield in both seasons Table 6.

The variation among varieties potential of syrup production was greatly associated with the higher total fermentable sugars, sucrose and reducing sugars values as mentioned before. The obtained results are in accordance with those of AbdEl-Karim *et al* (1999) and Allam *et al* (2001).

The interaction between Sowing dates X varieties significantly affected SEP and syrup yield in both seasons Table 6. Brands, Dale, Rio, Umberlla and Williams varieties were suitable for early sowing, where, their syrup yield was apparently higher in both seasons than the other varieties. On the contrary, Honey, Leoti, Mn 3306, Smith and SS 405 were suitable for late sowing date where their syrup potential productivity were higher in both seasons as compared with other varieties.

Ethanol Alcohol (ETOH) Yield (L/fed)

Data in Table 6 indicate that early sowing increased significantly ETOH production in both seasons. The percent of increase in ETOH amounted 6.02 L/fed (from 628.7 to 666.6 L/fed) in the first season and 3.059 (from 601.0 to 622.6 L/fed) in the second season. Such effect may be due to the superiority of early sowing date on sucrose %, reducing sugars and total fermentable sugars as mentioned before.

Ethanol yield exhibited significant differences among sorghum varieties in both seasons Table 6. In the first season, ethanol yield ranged between 303.9 L/fed for Dale variety and1095.6 L/fed for Mn 3306 variety with average value of 641.6 L/fed. However, in the second season ethanol yield ranged between 383.9 for Dale variety to 950.4 L/fed for Tracy variety with average value of 611.8 L/fed. Meantime ethanol yield of seven varieties in the two seasons were over their averages. In this connection, Kresovich and Henderlong (1984) reported on the feasibility of sorghum for ethanol production. Moreover Smith *et al* (1987), Somoni *et al* (1992) and Smith and Buxton (1993) stated that sweet sorghum juice was a good substrate for production of alcohol by yeasts. Furthermore the variation among sweet sorghum ability in ethanol production

Table 6. Effect of sowing date on syrup extraction percentage, syrup yield (ton/fed) and ethanol yield (L/fed) of some sweet sorghum varieties in 2005 and 2006 seasons

Sowing dates / Varieties	Syrup extraction percentage						Syrup yield (ton/fed)						Ethanol yield (L/fed)					
	2005 season			2006 season			2005 season			2006 season			2005 season			2006 season		
	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean	5May	25May	Mean
Brandes	8.2	6.5	7.4	7.6	6.4	7.0	659	449	549	578	453	514	505	371	438	494	464	479
Dale	6.4	5.3	5.9	7.5	5.5	6.5	390	332	361	444	314	378	311	297	304	382	386	384
Honey	9.7	9.4	9.6	9.7	8.6	9.2	717	795	757	658	776	723	331	347	339	329	394	361
Leoti	8	8	8.0	8.7	9	8.9	783	804	793	588	705	646	396	535	466	317	367	342
Mn3306	8.5	9.5	9.0	9.5	9.3	9.4	1308	1307	1312	925	1052	989	1114	1077	1096	865	633	749
Mn3556	9.8	8.9	9.4	7.7	9.3	8.5	1157	1115	1137	590	911	742	823	707	765	416	449	432
Planter	9.6	9.6	9.6	9.6	8.2	8.9	1259	1012	1135	946	961	960	719	909	814	734	892	813
Rex	8.3	7.4	7.9	9.5	7.4	8.5	1054	866	958	1291	875	1074	825	854	839	840	1014	927
Rio	8.3	9.9	9.1	9.1	7.6	8.4	827	747	787	855	636	741	711	514	613	805	499	652
Smith	8.5	9.6	9.1	7.9	9.8	8.9	755	1041	893	547	837	684	530	630	580	405	491	448
SS405	8.8	8.7	8.8	8.1	9.2	8.7	996	1148	1073	876	1181	1023	759	766	763	743	916	829
Tracy	9.3	8.7	9.0	9.3	7.9	8.6	835	1051	947	1304	941	1115	712	765	738	1058	843	950
Umbrela	8.7	7.6	8.2	8.8	8	8.4	808	668	737	724	663	693	682	524	603	556	490	523
Williams	8.9	8.3	8.6	7.1	5.8	6.5	938	667	798	657	463	556	914	509	712	774	578	676
Mean	**8.6**	**8.4**	**8.5**	**8.6**	**8.0**	**8.3**	**887**	**845**	**866**	**783**	**758**	**771**	**667**	**629**	**648**	**623**	**601**	**612**
L.S.D at 0.05																		
Sowing date (A)			Ns			Ns			23			Ns			6.9			8.7
Varieties (B)			0.9			0.9			158			205			93			99
AxB			1.3			1.3			223			291			Ns			Ns

observed in this work were affirmed previously by Abd El-Karim *et al* (1999) and Allam *et al* (2001).

The interaction between the two variables significantly affected ethanol yield in the two seasons Table 6. Meantime according to the varieties stability in ethanol production in both seasons, Brands, Mn 3306, Rio, Tracy, Umbrella and Williams were suitable for early sowing, whereas, Honey, Planter, Rex, Smith and SS405 for late sowing. Perusal of the obtained data under the conditions of this work, it is clear that the following varieties Mn 3306, Planter, Rex, Rio, SS 405 and Tracy which distinguished with high potential ability on producing syrup and ethanol were recommended for dual purpose (I.e. syrup and ethanol production).

REFERENCES

Abd El-Karim, H.A., T.S. El-Ammari, and Maria G. Beshay. 1999. Evaluation of some sweet sorghum cultivars for syrup, and biomass production. J. Agric. Sci. Mansoura, 24 (10): 5285-5595.

Allam, S.M., A.M. Nassar, A.M. Abo El-Wafa, and M.K. Ali. 2001. Quality, and processing evaluation of some sweet sorghum varieties, and their potentialities for Syrup and ethanol production. J.Agric. Sci. Mansoura Univ., 26 (1): 1-12.

Almodares, A., A. Sepahi, and A.D. Karve. 1994. Effect of planting date on yield and sugar production of sweet sorghum. Ann of Plant

Physiology 8 (1): 49-54.

Bapat, P.R., H.D. Jadhav, S.L. Gaur, C.B. Salunkhe, U.M. Ingle, D.N. Kulkarni, and S.S. Throat. 1987. Sweet sorghum cultivars for production of quality syrup, and jaggery in maharashtra. Technology, and applications for alternative uses of sorghum. Proc. of the National Seminar Parbhani Maharashtra India 2-3 Feb. 1987, 203-206.

Besheit, S.Y., M.K. Ali, Maria G. Beshay and A.M. Abou Dooh. 1996. Stalk, and technological characteristics of two sweet sorghum cultivars as influenced by sowing date. Adv. Agric. Res., 1 (1): 28-35.

Kresovich, S., and P.R. Henderlog. 1984. Agronomic potential of sorgum as raw material for

ethanol production in central Ohio. Energy Agric. , 145-153.

Ma, Z.H., D.Li, and X. B. Nimg. 1992. Study on brix degree, total sugar content, and their relationship in juice of sweet sorghum stem.J. of Shenyang Agric. Univ. China., 23 (3):

187-191.

Meade, G.P., and J.C.P. Chen. 1977. Cane sugar handbook (11th Ed.) Jhon Wiley, and Sons, Interscifnce, New York.

Parvatikar, S.R., and T. V. Manjunath. 1991. Alternate uses of sorghum sweet sorghums a new prospectus for juicy stalks, and grain yields. J. of Maharashtra Agric. Univ.. India. 6 (3): 352-354.

Saleh, G.G. 2004. Growth, and yield of biofertilized sweet sorghum under stress ecological conditions. Ph.D. Thesis, Enviro. Sci. Dept. Agric. Sci. (Agron.), Ain-Shams Univ., Egypt.

Somani, R.B., D.B. Bhasharkar, D.B. Patil, and R.B. Pandrangi. 1992. Evaluation, and utilization of sweet sorghum cultivars for alcohol production. Ann. of Plant Physiol. 6 (1): 60-67

Smith, G. A. , M. O. Bagby , R. T. Lewellan , D. L. Doncy, P. H. Moore, F. G. Hills , L. G. Campbell G. L. Hogaboam , G. E. Coe, and K. Freeman. 1987. Evaluation of sweet sorgum for fermentable sugar production. Crop Sci., 27, 788-793.

Smith, GA and D.R.Buxton. 1993. Temperate zone sweet sorghum ethanol production potential. Bioresource Technology 43 (1): 71-75.

Steel, R.C., and J.H. Torrie. 1980. Principles, and procedures of statistics. Mc Graw Hill Book Company Inc. New York.

Taha, Nour-El-Hoda, M.T., and M.M. El-Koliey. 1999. Response of sweet sorghum to irrigation intervals, and nitrogen fertilization. Assiut J. Agric. Sci. 30, 3: 65-80.

تقييم بعض أصناف الذرة السكرية تحت ميعادين للزراعة

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أقيمت تجربتان حقليتان فى محطة البحوث الزراعية بالجيزة. مركز البحوث الزراعية. خلال صيف موسمى ٢٠٠٥ و ٢٠٠٦ وذلك بهدف تقييم القدرة الإنتاجية – صفات جودة العصير والصفات التكنولوجية لأربعة عشر صنفا من الذرة السكرية تحت ميعادين للزراعة هى الخامس والخامس والعشرون من مايو. وقد أوضحت نتائج التحليل الأحصائى ما يلى:

أدت الزراعة المبكرة (٥مايو) للذرة السكرية تحت ظروف محافظة الجيزة الى تفوق معظم الصفات الأنتاجية وصفات الجودة والصفات التكنولوجية مقارنة بالتأخير فى الزراعة (٢٥مايو).

تباينت الأصناف الأربعة عشر المستخدمة تباينا واضحا فى جميع الصفات تحت الدراسة . أوضحت النتائج أنة ليس كل الأصناف أظهرت تفوقا فى الصفات الأنتاجية وصفات الجودة والصفات التكنولوجية فى ميعاد الزراعة الأول بل بعضها أظهر تفوقا فى ميعاد الزراعة الثانى .

توصى الدراسة بزراعة أصناف الذرة السكرية أم أن ٣٣٠٦. بلانتر. ريكس. ريو. شوجر. سورجو ٤٠٥ وتربس لأنتاج الشراب وكحول الإيثانول لتفوقهم فى معظم الصفات الأنتاجية والجودة مقارنة بالأصناف الأخرى.