EFFECTS OF PLANT DENSITY AND WEED CONTROL ON SWEET SORGHUM SUGAR, FORAGE YIELD AND ASSOCIATED WEEDS.

M.A. Bekheet,* S. Sh. Abdullah** and A.E. Ismail***

* Sugar Crops Res. Inst., Agric. Res. Center, Giza, Egypt

** Agron. Dept., Fac. Agric. (Sohag), South Valley Univ., Egypt

*** Weed Central Lab, Agric. Res. Center, Giza, Egypt

Abstract: Sweet sorghum or sorgho [*Sorghum bicolor var Saccharatum*, Moench (L.)] is grown in Egypt on a small scale as a summer forage crop and has a potential future for sugar production. Available information, however, is few on its cultural practices as a dual-purpose crop for sugar and forage. This study was conducted to determine the effects of plant density (70000, 93333 and 140000 plants/fed.) and some weed control treatments (hand hoeing once at 15 or 28, or twice at 15 and 28 days from sowing; using Gesaprim 80% or 90%, Herbazen 90%; and un-wedded) on growth, yields of sweet sorghum and associated weeds on newly reclaimed soils in Sohag Governorate, Egypt. Two field trials were carried out in summer of 2003 and 2004 seasons at the Experimental Farm of the Faculty of Agriculture, Sohag.

planting 140000 plants of sweet sorghum/fed. resulted in a significant redaction in dry weight of narrow and broadleaf weeds as well as total dry weight of weeds compared with planting 70000 plants/fed. The application of Herbazen 90%, Gesaprim 80% or Gesaprim 90% reduced significantly the dry weight of narrowleaf weeds, while practicing hand hoeing twice at 15 and 28 days after sowing was the best in reducing dry weight of broadleaf weeds. Applying Gesaprim 90%, Gesaprim 80% or Herbazen 90% reduced the dry weight of total weeds. The interaction between plant density and weeding control methods was almost significant on the studied weed traits. Increasing planting population from 70000 to 140000 plants/fed. resulted in a significant increase in stalk height, yield of stripped stalks. The stripped stalks yield in the higher density plots was 5.44 t/fed. higher than the lower density of 70000 plants/fed. However the mid plant density (93333 plants/fed.) seams to produced the highest forage yield/fed. Insignificant differences were detected in the percentages of total soluble solids (TSS%), sucrose, purity and reducing sugars percentage as affected by planting densities. Practicing hand hoeing twice at 15 and 28 days after planting had the highest values in stalk length, stalk diameter, stripped stalk yield, forage yield, TSS %, sucrose % and purity % and reducing sugars percentage of sweet sorghum. Under such conditions of this study, planting 140000 plants of sweet sorghum/fed. and practicing hand hoeing twice could be recommended for sweet sorghum production.

Key words: plant density, weed control, sweet sorghum sugar, forage yield, weeds.

Introduction

Sweet sorghum name is used to identify varieties of sorghum that have sweet juicy stems which may be used for forage and silage or to produce syrup. In china, sugar is produced from sweet sorghum which may become an important crop for energy (fuel alcohol) production and paper pulp in future Leto and Carrubba (1989). Sweet sorghum has been grown in Egypt for long time as a forage crop. Because of the increased-demand for sugar in Egypt, sweet sorghum might contribute besides sugarcane and sugar beet towards minimizing the gab between sugar-consumption and production. Cultural practices of sweet sorghum production for sugar and forage differ from those for forage only. Bitzer (1997) reported that plant density and weed management are among the main factors affecting growth, sugar and forage yields of sweet sorghum. Nichols, *et al*. (1981) reported that plant population of 124000 plants/ha in 90 cm between rows attained the highest yield of stripped stalks. Abbas and Al-Younis (1988) reported that increasing plant density from 67 000 to 200 000 plants/ha increased plant height, yield of stripped stems and sugar yields from 0.85 to 1.58 t/ha. Plant density of 133000 plants/ha gave the highest purity and extraction percentage and syrup yield. Fuller and Reagan (1989) found that increased plant density of sweet sorghum from 3.6 to 14.3 plants/m row decreased stalk barrel size and increased fiber content. El-Maghraby, *et al*. (1994) planted sweet sorghum on rows of 30 and 60-cm apart. They obtained the highest plant height, plant weight, and yields of forage, stalk, juice and syrup/fed. by planting on rows 30-cm apart, whereas the highest values of stalk diameter, Brix and sucrose content resulted from plants grown on rows of 60-cm apart. Thorat *et al*. (1995) indicted that planting sweet sorghum at 184000 plants/ha gave maximum grain (1.7 t/ha) and fodder (20 t/ha) yields. Increasing plant density decreased juice quality but pH, specific gravity (Mallikarjum *et al.*, 1997) and juice Brix (Galani *et al.*, 1991) were unaffected. Saheb *et al*. (1997) found that plant density of 120000 plants/ha produced the highest dry matter yield (12.82 t/ha), fresh stalk yield (31.87 t/ha), juice yield (10.64 t/ha.). Abo El-Wafa and Abo El-Hamd (2001) reported that increasing plant population from one to three plants/hill reduced remarkably diameter and weight of the stalk and whole plant weight but had no effect on plant height and all chemical characters of all varieties under study. Allam, *et al.* (2002) found that increasing plant density from 46000 to 140000 plants/fed. increased plant height, number of leaves/plant and grain yield/fed.

Weeds are considered the major constraints affecting growth and crop yields. Some researches indicated that crop density is one of the most easily

manipulated factors affecting weed abundance. Increasing the density of a crop is considered a useful way for suppressing weeds. Pinto, *et al.* (1982) revealed that good selective control of a mixed weed flora was obtained with 7 l Boxer (atrazine + alachlor), 5 l Triamex (simazine + atrazine), 5 l Simazinax 50 FW (simazine), 5 l Atrazinax 50 FW (atrazine) and 2.5 kg Karmex 80 PM (diuron)/ha. Pinto *et al* (1984) found that application of 5.0 l/ha Triamex 50 FW gave a fresh yield of 40.5 t/ha compared with 30.5 and 9.2 t/ha following hoeing and no control, respectively, and also gave 100% control of *Digitaria spp., Setaria geniculata, Amaranthus viridis, Echinochloa crus-galli*, other grass spp. and broadleaved weeds. Wellington *et al* (1984) showed that application of 1.2 kg atrazine + 1.3 kg alachlor/ha gave best weed control reducing av. number of weeds from 182.6 plants/0.5 m2 in untreated stands to 17.9 plants 30 days after emergence and also caused little damage to crop plants of sweet sorghum. Harika, *et al.* (1986) indicated that using Atrazine at 0.25 and 0.5 kg/ha pre-emergence and 10 days post-emergence had effective weed control and resulted in fresh and dry fodder yields of sorghum similar to weed-free conditions. Pre-emergence application of 1.0 kg/ha Atrazine was phytotoxic to sorghum and reduced fresh and dry fodder yields compared with 0.5 kg Atrazine/ha. Gill, *et al.* (1987) found that all weed control treatments (Simazine, Atrazine, Pendimethalin, Terbutryn, Piperophos and hand weeding) increased fodder yields of sorghum over the control. Sandhu, *et al.* (1987) studied the efficacy of Atrazine, Simazine, Linuron, Terbutryn and Cyanazine, each at 0.25 and 0.50 kg/ha; Pendimethalin at 0.5 and 0.75 kg/ha and Dinitramine at 0.5 and 0.75 kg/ha for weed control in sorghum. They found that all the herbicides gave effective control of weeds in sorghum but had little influence on green fodder yields. Kravtsov and Kotova (2004) found that all herbicide treatments increased green fodder yield by 6.4-19.6 tons/ha and reduced the number of weeds by 9.8-69.5%, compared to the untreated control.

Therefore, this work was conducted to study the effects of planting density and some weed control treatments on growth characters, yields of sugar and forage of sweet sorghum under new land condition of Sohag Governorate.

Materials ad Methods

A 2-year field experiment was carried out in summer of 2003 and 2004 seasons at the Agricultural Research and Services Center, Sohag Faculty of Agriculture, South Valley University, Egypt. The objective of this study was to investigate the effects of planting density and some weed control treatments on sugar and forage yields of sweet sorghum and accompanied weeds. The experiment soil was sandy-loam with sand-clay

loam transported top soil. Mechanical and chemical properties of the 30 cm top soil in 2003 and 2004 are shown as follows:

Soil property	2003	2004
Sand (%)	50.27	52.25
Silt (%)	19.37	21.35
Clay (%)	30.36	26.40
Soil texture	Sandy clay loam	Sandy clay loam
Organic mater(%)	2.10	1.89
Total N (%)	0.131	0.126
Soluble ions (meq/100 g soil)		
Ca^{++}	6.00	5.00
Mg^{++}	3.00	3.50
Na^{++}	0.55	0.61
K^{+}	1.00	0.50
$H CO_3^{-}$	3.00	3.50
Cl^{-}	3.50	3.50
$CaCO_3$ %	11.45	12.00
EC (dS/m) (1:5)	0.58	0.77
PH	7.09	7.74

After soil preparing, the experiment area was divided into 10.5 m^2 sub plots which consisted of five ridges of 3.5 m long and 0.6 m apart.

A split plot design with three replications was used in both seasons, Planting densities (i.e. 70000, 93333 and 140000 plants/fed.) that obtained from planting hills at 20, 15 and 10 cm spacing within row) were allocated in the main plots. While sub plots were assigned to weed control treatments which were:

1. Hand hoeing once at 15 days after sowing. 2. Hand hoeing once at 28 days after sowing. 3. Hand hoeing twice at 15 and 28 days after sowing.

4. Applying Gesaprim 90 % W.P. (Atrazine) herbicide at a rate of 600 g/fed. as pre-emergence after seeding and just before planting irrigation.

5. Applying Gesaprim 80 % W.P (Atrazine) herbicide at a rate of 750 g/fed. as pre-emergence after seeding and just before planting irrigation.

6. Applying Herbazen 80% W.P (Atrazine) herbicide at a rate of 750 g/fed. as pre-emergence after seeding and just before planting irrigation.

7. Unweeded (control).

Seeds of cv. Honey sweet sorghum were sown on third and seventh of June and harvested after four months in 2003 and 2004 seasons, respectively. Seedlings of 18 days-age were thinned after the first hoeing to leave two plants /hill. The other cultural practices were done as recommended.

Recorded data:

I. Weed measurements:

Weeds from one m^2 in each sub plot were pulled out after 60 days from sowing, separated to broad and narrow leaved weeds and air dried for seven days then oven dried at 70 C° until a constant weight to record the following items:

(1). Dry weight of narrowleaf weeds (g/m^2). (2). Dry weight of broadleaf weeds (g/m^2). (3). Dry weight of total narrow-and broadleaf weeds (g/m^2).

The dominant weed species counted in the experimental plots in both seasons were shown in (Table (1).

Table(1): Family, scientific name and common name of accompanied weeds of sweet sorghum during 2003 and 2004 season.

No	Family	Scientific name	Common name
1	Portulaceae	*Portulaca oleracea,* L.	Purslane
2	Tilaceae	*Corchorus olitorius,* L.	Malta jute
3	Amaranthaceae	*Amaranthus hybridus,* L.	pigweed
4	Poaceae	*Echinochloa colonum,* L.	Jungle-rice
5	Poaceae	*Digitaria sanguinalis,* L	Hairy finger grass

II. Sweet sorghum characters:

At harvest, the following characters were determined in a sample of 20 random plants from each sub plot:

1. Plant height (cm) was measured from soil surface to the base of panicle.

2. Plant diameter (cm) was measured on the fifth basal internode on the stalks.

3. Total soluble solids percentage (TSS %) in the juice was determined using "Hand refractometer". 4. Sucrose percentage in 100 cm^3 of juice was determined using "Saccharemeter" according to A.O.A.C. (1995). 5. Juice purity percentage was estimated as follows: Juice purity percentage = sucrose % / TSS % x 100.

6. Reducing sugar percentage was determined according the method described by the Chemical Control Lab. of the Sugar and Integrated Industries Company (Anonymous, 1981).

Yields of clean stalks and forage leaves (t/fed.) were estimated from the plants on the three middle ridges in each sub plot.

The collected data were statistically analyzed according to the method of Snedecor and Cochran (1981). Least significant differences (LSD) test at 5% probability level was used for treatments mean separation.

Results and Discussion

Survey of weeds at 60 days after sowing:

1.Dry weight of narrowleaf weeds:

Results in Table (2) revealed that increasing plant density from 70000 to 93333 to 140000 plants of sweet sorghum/fed resulted in a significant reduction in dry weight of narrowleaf weeds in 2003. Similar result was recorded in 2004 with no significant

difference between the effects of low and mid densities. This result might be due to the strong competition of dense planting on growth factors as water, light and nutrients, and hence, decreased weeds dry weight. The used weeding control treatments has a significant reduction in dry weight of narrowleaf weeds compared to unweeded (control) plots in both seasons of study. The application of Herbazen, Gesaprim 80 % and Gesaprim 90% were the most effective treatments, without significant differences among their effects. These results were coincided with that obtained by Pinto, *et al* (1984).

Dry weight of narrowleaf weeds was significantly influenced by the interaction between planting density and weed control treatments in both seasons. Almost, the used herbicides with the low density and hoeing with the high density of sweet sorghum were the best in suppressing growth of narrowleaf weeds.

Table(2): Dry weight of narrowleaf weeds (g/m^2) at 60 days after sowing of sweet sorghum as affected by plant density and weed control in 2003 and 2004 seasons.

Weed control treatments	2003 season				2004 season			
	Plants/fed			Mean	Plants/fed			Mean
	70000	93333	140000		70000	93333	140000	
Hand hoeing, 15 DAS*	206.60	167.40	121.87	165.29	158.67	163.33	136.67	152.89
Hand hoeing, 28 DAS*	133.33	85.07	67.53	95.31	108.67	95.00	72.00	91.89
Hand hoeing, 15&28 DAS*	45.23	37.87	33.47	38.86	6.67	8.87	1.47	5.67
Gesaprim 90%	0.00	17.37	10.33	9.23	0.00	0.00	1.53	0.51
Gesaprim 80%	12.90	5.87	0.00	6.26	0.00	0.80	0.00	0.27
Herbazen 80%	0.00	0.00	5.83	1.94	0.00	2.73	4.00	2.24
Un-weeded (Control)	835.67	615.60	573.60	674.96	632.67	592.00	472.67	565.78
Mean	176.25	132.74	116.09		129.52	125.25	98.33	
L.S.D at 0.05 level								
Planting density (A)		12.28				22.97		
Weeding treatment (B)		16.27				22.31		
(A) x (B)		28.18				38.65		

* DAS: Days after sowing.

2. Dry weight of broadleaf weeds:

Data presented in Table (3) showed that dry weight of broadleaf weeds decreased gradually as planting population of sweet sorghum increased from 70 to 93.3 to 140 thousand plants/fed in both seasons. However, this effect reached the level of significance in the first season only. This result might be due to the increased population of sweet sorghum decreased the opportunity of broadleaf weeds to get enough amounts of water, nutrients and solar radiation as well, which negatively reflected on weed growth, and in turn lowered their dry weight.

Table(3): Dry weight of broadleaf weeds (g/m^2) at 60 days after sowing of sweet sorghum as affected by plant density and weed control in 2003 and 2004 seasons.

Weed control treatments	2003 season				2004 season			
	Plants/fed			Mean	Plants/fed			Mean
	70000	93333	140000		70000	93333	140000	
Hand hoeing, 15 DAS	82.43	54.00	39.67	58.70	91.33	89.33	48.00	76.22
Hand hoeing, 28 DAS	53.13	47.93	37.67	46.25	43.33	36.67	36.00	38.67
Hand hoeing, 15 & 28 DAS	5.67	4.67	3.93	4.72	36.33	20.80	14.67	23.93
Gesaprim 90%	13.20	11.20	10.60	11.67	22.07	37.33	26.47	26.62
Gesaprim 80%	22.27	26.73	21.53	23.51	39.13	40.67	43.33	41.04
Herbazen 80%	43.47	18.00	7.13	22.87	48.00	38.67	24.67	37.11
Un-weeded (Control)	224.03	160.87	133.20	172.70	182.67	139.33	128.67	150.22
Mean	63.46	46.19	36.25		66.12	57.54	45.97	

L.S.D at $_{0.05}$

Planting density (A)	10.68	N.S
Weeding treatment (B)	10.70	17.62
(A) x (B)	18.54	N.S

The results showed that the used weed control treatments had a significant effect on the dry weight of broadleaf weeds. It was found that practicing hand hoeing twice at 15 and 28 days after sowing gave the best results in minimizing dry weight of broadleaf weeds, without significant difference with applying Gesaprem 90%. The heaviest dry weight of broadleaf weeds was obtained from the unweeded plots. Theses results were true in both seasons. These results are in agreement with those of Pinto, *et al.* (1984).

The interaction between planting density of sweet sorghum and weed control treatments had a significant effect on dry weight of narrowleaf weeds in the first season. Hand hoeing twice and Gesaprim 90% under the three planting densities attained the highest reduction in the dry weight of broadleaf weeds.

3. Total dry weight of weeds:

Data in Table (4) showed that total dry weight of weeds was significantly affected by the three planting densities of sweet sorghum. Increasing plant population from 70000 to 93333 to 140000 plants/fed. was accompanied with a gradual reduction in total dry weight of weeds in both seasons.

Table(4): Total dry weight of weeds (g/m^2) at 60 days after sowing of sweet sorghum as affected by plant density and weed control in 2003 and 2004 seasons.

Weed control treatments	2003 season				2004 season			
	Plants/fed			Mean	Plants/fed			Mean
	70000	93333	140000		70000	93333	140000	
Hand hoeing, 15 DAS	289.03	221.40	161.53	223.99	250.00	252.67	184.67	229.11
Hand hoeing, 28 DAS	186.47	133.00	105.20	141.56	152.00	131.67	108.00	130.56
Hand hoeing, 15 & 28 DAS	50.90	42.43	37.40	43.58	43.00	29.67	16.13	29.60
Gesaprim 90%	13.20	28.57	20.93	20.90	22.07	37.33	28.00	29.13
Gesaprim 80%	35.17	32.60	21.53	29.77	39.13	41.47	43.33	41.31
Herbazen 80%	43.47	18.00	12.97	24.81	48.00	41.40	28.67	39.36
Un-weeded (Control)	1059.7	776.47	706.80	847.66	815.33	731.33	601.33	716.00
Mean	239.71	178.92	152.34		195.65	180.79	144.31	

L.S.D at $_{0.05}$

Planting density (A)	14.05	21.08
Weeding treatment (B)	17.44	29.26
(A) x (B)	30.21	50.68

Weed control treatments had a significant effect on the total dry weight of weeds compared with the control (unweeded) in both seasons. In the first season, applying the herbicides of Gesaprim 90%, Gesaprim 80% or Herbazen gave the best results in respect to the reduction of total dry weight of all weeds, without significant differences among the effects of the three herbicides yet, the second season results, however, showed no significant differences among the effects of and hoeing twice and the three herbicides. These results are in consistence with those obtained by Pinto, *et al.* (1982); Sandhu, *et al.* (1987); and Wellington, *et al.* (1984).

The interaction between planting density and weed control treatments had a significant influence on the total dry weight of weeds in both seasons. The least value of dry weight of total weeds was recorded for herbazen 80% with low density in 2003 and for hand hoeing twice with the same density in 2004 season. However, the differences among the effects of hand hoeing twice and the used herbicides under any of used plant densities were almost not significant in both seasons.

4. Stalk height:

Data in Table (5) clarified that stalk height of sweet sorghum was significantly affected by planting density in both seasons. Increasing plant population density resulted in increasing plant height. The tallest sweet sorghum stalks (240.08 and 263.8 cm) were found in the highest-density plots in 2003 and 2004 seasons, respectively. This result could be due to the great competition among plants for solar radiation under the higher density which led to increasing plant height. This result is in accordance with that reported by Allam *et al.* (2002).

The results showed that practicing hand hoeing twice at 15 and 28 days after planting resulted in a significant increase in stalk length of sweet sorghum (265.40 and 286.62 cm) compared with unweeded treatment (212.89 and 227.54 cm) in the first and second season, respectively. This result could be attributed to that hoeing ensured conditions free of weeds and decreased their competition with sweet sorghum plants for water, light and nutrients, which ultimately enhanced plant growth.

Stalk height was insignificantly influenced by the interaction between planting densities and weed control treatments in both seasons.

Table(5): Stalk height (cm) of sweet sorghum as affected by planting density and weed control treatments in 2003 and 2004 seasons.

Weed control treatments	2003 season				2004 season			
	Plants/fed			Mean	Plants/fed			Mean
	70000	93333	140000		70000	93333	140000	
Hand hoeing, 15 DAS	239.67	246.33	257.23	247.74	250.00	266.90	279.23	265.38
Hand hoeing, 28 DAS	233.97	237.67	247.43	239.69	246.77	256.57	274.23	259.19
Hand hoeing, 15 & 28 DAS	246.63	271.23	278.33	265.40	267.77	298.90	293.20	286.62
Gesaprim 90%	230.77	237.50	236.17	234.81	246.20	242.03	258.80	249.01
Gesaprim 80%	213.53	235.80	219.23	222.86	232.77	258.23	238.67	243.22
Herbazen 80%	217.00	217.77	228.77	221.18	230.80	223.23	263.33	239.12
Un-weeded (Control)	211.30	214.00	213.37	212.89	223.33	220.20	239.10	227.54
Mean	227.55	237.19	240.08		242.52	252.30	263.80	

L.S.D at $_{0.05}$		
Planting density (A)	4.19	8.51
Weeding treatment (B)	16.14	16.79
(A) x (B)	NS	NS

5. Stalk diameter:

Data in Table (6) showed that stalk diameter of sweet sorghum was significantly affected by planting density in both seasons. Stalk diameter was gradually decreased as planting population was increased from 70000 to 93333 to 140000 plants/fed. due to the competition among plants for growth factors. This result is in line with those obtained by Abo El-Wafa and Abo El-Hamd (2001).

The results obtained that practicing hand hoeing twice at 15 and 28 days after planting led to a significant increase in stalk diameter of sweet sorghum (2.42 and 2.58 cm) compared to the control (2.04 and 2.01 cm) in both seasons, respectively. This result could be attributed to better growth

conditions free of weeds which enhanced plant growth.

Stalk diameter was significantly affected by the interaction between studied factors in the second season only. The thickest stalk diameter (2.87 cm) was recorded for plants sown at 70000 plants/fed and treated with hand hoeing at 15 day after sowing.

Table(6): Stalk diameter (cm) of sweet sorghum as affected by planting density and weed control treatments in 2003 and 2004 seasons.

Weed control treatments	2003 season				2004 season			
	Plants/fed			Mean	Plants/fed			Mean
	70000	93333	140000		70000	93333	140000	
Hand hoeing, 15 DAS	2.50	2.28	2.23	2.34	2.87	2.48	2.14	2.50
Hand hoeing, 28 DAS	2.40	2.10	2.11	2.20	2.68	2.33	2.03	2.35
Hand hoeing, 15 & 28 DAS	2.60	2.38	2.29	2.42	2.73	2.63	2.36	2.58
Gesaprim 90%	2.39	2.16	2.17	2.24	2.53	2.34	1.94	2.27
Gesaprim 80%	2.36	2.12	1.98	2.15	2.23	2.12	1.91	2.09
Herbazen 80%	2.22	2.10	2.06	2.13	2.33	2.22	1.89	2.15
Un-weeded (Control)	2.14	2.07	1.91	2.04	2.16	2.02	1.86	2.01
Mean	2.37	2.17	2.11		2.50	2.31	2.02	
L.S.D at $_{0.05}$								
Planting density (A)		0.14				0.13		
Weeding treatment (B)		0.08				0.08		
(A) x (B)		NS				0.13		

6. Net stripped-stalk yield:

Results in Table (7) indicated that increasing planting density from 70000 to 140000 plants/fed resulted in a significant increase in yield of stripped stalks amounted to 5.44 t/fed. in the first season and 2.80 t/fed in the second one, respectively. This result is agreed with those obtained by El-Maghraby *et al*. (1994).

Weeding treatments had a significant effect on net stripped stalk yield/fed in both seasons. Practicing hand hoeing twice at 15 and 28 days after planting led to obtain the highest stripped stalk yields (20.51 and 21.20 t/fed.), while the lowest yields (14.10 and 12.24 t/fed.) were recorded for the unweeded plots. in the first and second season, respectively.

Stripped stalk yield was significantly influenced by the interaction between planting densities and weed control treatments in both seasons. The greatest stalk yield **(**24.66 and 22.72 t/fed.**)** was recorded from plots sown with 140000 plants/fed. and hand-hoed twice at 15 and 28 days after sowing in the first and second seasons, respectively.

Table(7): Net stripped-stalk yield (t/fed) of sweet sorghum as affected by planting density and weed control treatments in 2003 and 2004 seasons.

Weed control treatments	2003 season				2004 season			
	Plants/fed			Mean	Plants/fed			Mean
	70000	93333	140000		70000	93333	140000	
Hand hoeing, 15 DAS	15.89	18.65	22.77	19.10	18.93	18.36	22.39	19.89
Hand hoeing, 28 DAS	16.04	17.24	19.38	17.55	17.46	17.78	19.54	18.26
Hand hoeing, 15 & 28 DAS	18.27	18.84	24.66	20.59	20.06	20.81	22.72	21.20
Gesaprim 90%	13.81	16.81	20.31	16.98	17.48	16.55	19.07	17.70
Gesaprim 80%	13.20	14.84	16.71	14.91	12.56	12.83	17.16	14.18
Herbazen 80%	12.52	14.40	19.75	15.56	14.22	14.55	18.76	15.85
Un-weeded (Control)	11.92	14.28	16.12	14.10	11.91	12.22	12.58	12.24
Mean	14.52	16.44	19.96		16.09	16.16	18.89	
L.S.D at $_{0.05}$								
Planting density (A)		0.63				0.50		
Weeding treatment (B)		0.65				0.86		
(A) x (B)		1.13				1.49		

7. Forage yield:

Data in Table (8) indicated that forage yield of sweet sorghum was significantly affected by planting density in both seasons. Planting 93333 plants/fed. produced the highest forage yield/fed in the first season. However, in the second one, planting 140000 plants/fed. gave the highest forage yield/fed., compared with the other two planting densities. This result is in accordance with that reported by El-Maghraby, *et al*. (1994).

Application of hand hoeing twice at 15 and 28 days after sowing led to a significant increase in forage yield/fed. of sweet sorghum (6.09 and 6.63 t/fed.) compared to the unweeded plots (2.94 and 3.99 t/fed.) in the first and second seasons, respectively. This result could be attributed to that the frequent hoeings ensured better habitat free of weeds emerged and compete with sweet sorghum plants for space, light and nutrients, and hence enhanced plant growth.

Table(8): Forage yield (t/fed) of sweet sorghum as affected by planting density and weed control treatments in 2003 and 2004 seasons**.**

Weed control treatments	2003 season				2004 season			
	Plants/fed			Mean	Plants/fed			Mean
	70000	93333	140000		70000	93333	140000	
Hand hoeing, 15 DAS	5.24	5.01	4.69	4.98	5.69	6.53	6.51	6.24
Hand hoeing, 28 DAS	5.58	5.75	5.44	5.59	5.10	5.12	6.14	5.45
Hand hoeing, 15 & 28 DAS	5.91	6.81	5.54	6.09	5.99	6.64	7.26	6.63
Gesaprim 90%	4.97	4.44	3.61	4.34	4.44	4.82	4.55	4.60
Gesaprim 80%	3.71	4.04	3.68	3.81	4.50	5.30	4.75	4.85
Herbazen 80%	4.33	5.12	3.54	4.33	4.81	4.85	5.74	5.13
Un-weeded (Control)	3.21	2.61	2.99	2.94	3.72	4.35	3.89	3.99
Mean	4.71	4.83	4.21		4.89	5.38	5.55	
L.S.D at $_{0.05}$								
Planting density (A)		0.10				0.20		
Weeding treatment (B)		0.38				0.45		
(A) x (B)		0.65				0.78		

Forage yield/fed. was significantly affected by the interaction between planting densities and weed control treatments in both seasons. The highest forage yield/fed. was recorded by the eradication of weeds repeatedly by hoeing at 15 and 28 days after sowing under planting 93333 in the first season and 140000 plants/fed. in the second season, respectively.

8. Total soluble solids percentage:

The results showed that the planting population of sweet sorghum had no significant effect on the total soluble solids percentage (TSS %) in both seasons (Table 9). Practicing hand hoeing twice at 15 and 28 days after sowing resulted in a significant increase in TSS% (15.03 and 15.49 %) compared with the unweeded treatment (12.65 and 12.99 %) in the first and second season, respectively. Total soluble solids percentage was significantly influenced by the interaction between planting densities and weed control treatments in both seasons. The highest TSS% was recorded as a result of eliminating weeds by hand hoeing twice at 15 and 28 days in plots sown at a mid population of 93333 plants/fed in the first season. In the second season, practice of hand hoeing once after 28 days in plots sown with 70000 plants/fed gave the highest value of TSS%.

Table(9): Total soluble solids percentage of sweet sorghum as affected by planting density and weed control treatments in 2003 and 2004 seasons.

Weed control treatments	2003 season				2004 season			
	Plants/fed			Mean	Plants/fed			Mean
	70000	93333	140000		70000	93333	140000	
Hand hoeing, 15 DAS	13.43	13.32	13.72	13.49	13.53	13.43	14.36	13.77
Hand hoeing, 28 DAS	14.62	14.92	14.38	14.64	15.89	13.99	14.42	15.10
Hand hoeing, 15 & 28 DAS	15.02	15.12	14.95	15.03	15.42	15.64	15.41	15.49
Gesaprim 90%	13.48	13.89	14.13	13.83	13.55	14.00	14.20	13.92
Gesaprim 80%	13.29	13.49	13.03	13.27	13.40	14.27	14.45	14.04
Herbazen 80%	13.03	13.46	13.57	13.35	13.17	13.57	13.75	13.50
Un-weeded (Control)	12.81	12.92	12.23	12.65	12.85	13.60	12.52	12.99
Mean	13.67	13.87	13.72		13.97	14.21	14.16	
L.S.D at $_{0.05}$								
Planting density (A)		N.S				N.S		
Weeding treatment (B)		0.22				0.48		
(A) x (B)		0.39				083		

9. Sucrose percentage:

Data in Table (10) showed no significant differences among planting population densities of sweet sorghum in their effects on sucrose percentage in both seasons. This result is in agreement with that obtained by Galani *et al.* (1991).

The results cleared that weeding treatments had a marked influence on this trait. Get ridding of weeds by hand hoeing twice at 15 and 28 days after planting resulted in the highest sucrose percentage (9.46 and 9.94 %) in the first and second seasons, respectively.

Sucrose percentage was not significantly affected by the interaction between planting densities and weed control treatments in both seasons. In spite of the interaction between plant density and weed control was not significant on this trait, plants sown at the mid density and hand-hoed twice gave the highest value in both seasons.

Table(10): Sucrose percentage of sweet sorghum as affected by planting density and weed control treatments in 2003 and 2004 seasons.

Weed control treatments	2003 season				2004 season			
	Plants/fed			Mean	Plants/fed			Mean
	70000	93333	140000		70000	93333	140000	
Hand hoeing, 15 DAS	8.55	8.09	8.21	8.28	8.54	8.42	8.99	8.65
Hand hoeing, 28 DAS	9.28	9.45	8.86	9.19	9.60	9.56	9.00	9.39
Hand hoeing, 15 & 28 DAS	9.35	9.68	9.33	9.46	9.93	9.94	9.94	9.94
Gesaprim 90%	8.20	8.37	8.54	8.37	8.58	8.61	8.71	8.63
Gesaprim 80%	8.03	8.19	7.65	7.96	8.43	8.88	8.90	8.74
Herbazen 80%	8.07	8.05	8.01	8.04	8.20	8.38	8.36	8.31
Un-weeded (Control)	7.65	7.59	7.56	7.60	7.74	8.06	7.69	7.83
Mean	8.45	8.49	8.31		8.72	8.84	8.84	
L.S.D at $_{0.05}$								
Planting density (A)		N.S				N.S		
Weeding treatment (B)		0.26				0.37		
(A) x (B)		N.S				N.S		

10. Purity percentage:

No significant effect on purity percentage was detected due to the three population densities of sweet sorghum in both seasons (Table 11). Practicing hand hoeing twice at 15 and 28 days after sowing gave a significant increase in purity percentage (62.89 and 64.16%) of sweet sorghum compared to unweeded plots (60.10 and 60.32%) in the first and second season, respectively.

Purity percentage was markedly affected by the interaction between planting densities and weed control treatments in both seasons. Hand hoeing twice at 15 and 28 days after sowing resulted in the highest value of this trait under the higher planting densities in both seasons.

Table(11): Purity percentage of sweet sorghum as affected by planting density and weed control treatments in 2003 and 2004 seasons.

Weed control treatments	2003 season				2004 season			
	Plants/fed			Mean	Plants/fed			Mean
	70000	93333	140000		70000	93333	140000	
Hand hoeing, 15 DAS	63.63	60.70	59.84	61.39	63.10	62.72	62.61	62.81
Hand hoeing, 28 DAS	63.46	63.31	61.60	62.79	60.45	63.80	62.41	62.22
Hand hoeing, 15 & 28 DAS	62.19	64.06	62.41	62.89	64.41	63.59	64.49	64.16
Gesaprim 90%	60.82	60.26	60.49	60.52	63.34	61.46	61.29	62.03
Gesaprim 80%	60.23	60.66	58.71	59.93	62.91	62.24	61.50	62.21
Herbazen 80%	61.91	59.75	59.01	60.22	62.25	61.73	60.79	61.59
Un-weeded (Control)	59.73	58.79	61.79	60.10	60.21	59.28	61.46	60.32
Mean	61.74	61.07	60.55		62.38	62.12	62.08	
L.S.D at $_{0.05}$								
Planting density (A)		N.S				N.S		
Weeding treatment (B)		1.36				1.17		
(A) x (B)		2.35				2.03		

11. Reducing sugars percentage:

Data in Table (12) revealed that the planting population density of sweet sorghum had no significant effect on reducing sugars percentage (RS%) in both seasons.

Eliminating weeds by two hand hoeings at 15 and 28 days after sowing gave a significant increase in RS% (4.46 and 4.83%) compared with unweeded treatment (2.60 and 2.83%) in the first and second season, respectively.

Reducing sugars percentage was insignificantly affected by the interaction between the studied factors in both season.

Table(12): Reducing Sugars percentage of sweet sorghum as affected by planting density and weed control treatments in 2003 and 2004 seasons.

Weed control treatments	2003 season				2004 season			
	Plants/fed			Mean	Plants/fed			Mean
	70000	93333	140000		70000	93333	140000	
Hand hoeing, 15 DAS	3.55	3.09	3.21	3.28	3.54	3.42	3.99	3.65
Hand hoeing, 28 DAS	4.28	4.45	3.86	4.19	4.27	4.56	4.00	4.28
Hand hoeing, 15 & 28 DAS	4.35	4.68	4.33	4.46	4.59	4.94	4.94	4.83
Gesaprim 90%	3.20	3.37	3.54	3.37	3.58	3.61	3.71	3.63
Gesaprim 80%	3.03	3.19	2.65	2.96	3.43	3.88	3.90	3.74
Herbazen 80%	3.07	3.05	3.01	3.04	3.20	3.38	3.36	3.31
Un-weeded (Control)	2.65	2.59	2.56	2.60	2.74	3.06	2.69	2.83
Mean	3.45	3.49	3.31		3.62	3.84	3.80	
L.S.D at $_{0.05}$								
Planting density (A)		N.S				N.S		
Weeding treatment (B)		0.26				0.35		
(A) x (B)		N.S				N.S		

References

Abbas, H.A. and A.H. Al-Younis (1988). Effect of nitrogen and plant populations on yield and quality of sweet sorghum. Field Crops Dep., College Agric., Univ. Baghdad, Iraq. 20 (2): 13-21.

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 Devlop., 21 (3): 475-492.

Allam, A.Y.; G.R. El-Nagar; M.M. Abd alla and N.Ibrahim (2002). Response of grain sorghum cultivars to planting density and nitrogen fertilization. Assuit. J. Agric. Sci., 33(2): 133-150.

Anonymous (1981). Chemical control in Egyptian sugar production factories. Jan., PP 232.

Association of Official Agricultural Chemist (A.O.A.C.). (1995). Official methods of analysis published by the A.O.A.C., Box 540, Washington, USA.

Bitzer, M.J. (1997). Production of sweet sorghum for syrup in Kentucky. Extension Bult., Colleg, Agric., Univ. Kentucky, USA.

El Maghraby, S.S.; L.M.A. Saif and M.H. El-Deeb (1994). Intercropping of sweet sorghum and sesame with different nitrogen level. I: The effect of intercropping on yield and its components of sweet sorghum and sesame plants. Annals. Agric. Sci. Moshtohor, 32:(3). 1279-1292.

Fuller, B.W. and T.E. Reagan (1989). The relationship of sweet sorghum plant fiber and survival of the sugar borer, *Diatraea saccharalis* (F.) (*Lepidoptera. Pyralidae*). J. Agric. Entomology. USA 6(2): 113-118.

Galani, N.N.; M.H. Lomte and S.D. Choudhari (1991). Juice yield and Brix as affected by genotype, plant density and N levels in high energy sorghum. Bharatiya. Sugar. India. 16 (4): 23-24.

Gill, H.S.; U.S. Walia and I.S. Thind. (1987). Chemical weed control in sorghum and ('Jowar') fodder. J. Res., Punjab Agric. Univ. 24: 1, 151.

Harika, A.S.; P.S. Tomer and T.K. Ganguly. (1986). Effect of dose and time of atrazine application on weed infestation and yield of fodder sorghum . J, Agric. Sci. UK. 107(2): 449-451.

Kravtsov, V.A and N. M Kotova. (2004). Sorghum-a promising crop for fodder production. Kukurza, I. Sorgo. (6): 21-22.

Leto, C. and A. Carrubba. (1989). Sweet sorghum, a possible energy source. In formatore Agrario, Italy. 45(44): 55-5-.

Mallikarjum, H.; M.D. Kachapur; S.A. Gaddanakeri and P.M. Sobarad (1997). Performance of sweet sorghum genotypes under

different levels of plant population. Cooperative. Sugar. India. 28 (11): 834-836.

Nichols, R.L.; W.L. Bryan; T.P. Gaines; G.L. Gascho and G.E. Monrae (1981). Effect of weed control, plant population and row spacing on sweet sorghum. Coastal Plain Exp. St. Tifton, GA 31793, U.S.A.

Pinto, J.J.O.; F.E. Xavier.; G.L. Brauner and A. M. Costa. (1982). Preliminary study of herbicides in sweet sorghum [*Sorghum bicolor* (L.) Moench.]. Abstracts of the XIV Brazilian Congress on Herbicides and Herbaceous Weeds (SBHED) and the VI Congress of the Latin American Weed Association (ALAM), Campinas, Undated, 147-148 .

Pinto, K.J.O.; F.E. Xavier.; V.L.P. Cunha and D.J.M.Cunha. (1984). Performance of herbicides in crops of sweet sorghum (Sorghum bicolor (L.) Moench . Anais,-XII-reuniao-tecnica-anual-do-sorgo. 222-224.

Saheb, S.D.; H.K. Singh and C.B. Singh (1997). Effect of planting density and nitrogen on biomass and juice yield of sweet sorghum [*sorghum bicolor*(L.) Moench]. Indian. J. Agronomy. 42(4): 634-636.

Sandhu, K.S.; Tarlok-Singh.; H.S. Gill and I.S. Thind. (1987). Bioefficacy of some herbicides for weed control in sorghum grown for fodder and grain. J. Res, Punjab-Agric. Univ, India. 24(3): 376-381.

Snedecor, G.W. and W.G. Cochran (1981). Statistical Methods. Seventh Ed. Iowa State Univ. Press, Ames, Iowa, USA.

Thorat, B.P.; M.S. Shinde; B.R. Patil and S.D. Ugale (1995). Response of sweet sorghum [*sorghum bicolor* (L.) Moench]. to plant population, nitrogen and phosphorus. Indian. J. Agron. 40(4): 601-603.

Wellington, J.M.; E. Marchezan.; M.I. Silva.; I.A.B. Pignataro.; G.J. Reck.; P.W. Sander and J. Parise. (1984). Performance of pre-emergence herbicides in sweet sorghum crops .Anais,-XII-reuniao -tecnica-anual-do-sorgo. 226-230 .

تأثير الكثافة النباتية وبعض طرق مقاومة الحشائش على محصول الذرة السكرية والحشائش المصاحبة

محمد ابوبكر بخيت* وصفوت شلبى عبدالله** وعبده عبيد احمد***

* معهد بحوث المحاصيل السكرية- مركز البحوث الزراعية- الجيزة- مصر

** قسم المحاصيل بكلية الزراعة بسوهاج ـ جامعة جنوب الوادى

*** المعمل المركزى لبحوث الحشائش ـ مركز البحوث الزراعية- الجيزة- مصر.

أجريت تجربتان حقليتان فى صيف موسمى 2003 و2004 فى المزرعة البحثية بكلية الزراعة بسوهاج (حى الكوثر). بهدف دراسة تأثير الكثافة النباتية (70000 ، 93333 ، 140000 نبات/ فدان) وبعض معاملات مقاومة الحشائش (العزيق مرة عند 15 يوم من الزراعة ، العزيق مرة عند 28 يوم من الزراعة ، العزيق مرتين عند 15،28 يوم من الزراعة ، استخدام مبيد جيسابريم 80% ، استخدام مبيد جيسابريم 90% ، استخدام مبيد الهربازين 80%، وبدون مقاومة- كنترول) على محصول وجودة الذرة السكرية والحشائش المصاحبة فى الأراضي حديثة الاستصلاح بسوهاج وأظهرت النتائج مايلى:-

زراعة 140000ألف نبات من الذرة السكرية/ للفدان أعطت انخفاض معنوى فى الوزن الجاف للحشائش ذات الأوراق العريضة والضيقة وكذلك الوزن الجاف للحشائش الكلية مقارنة بزراعة 70000 نبات للفدان.

إضافة مبيد الهربازين 90% أوالجيسابريم 80% أوالجيسابريم 90% أدى إلى نقص معنوياً الوزن الجاف للحشائش ضيقة الأوراق . بينما إستخدام العزيق مرتين بعد 15 و28 يوم من الزراعة قلل معنويا الوزن الجاف للحشائش عريضة الأوراق. كان تأثير التفاعل بين الكثافة النباتية ومعاملات مقاومة الحشائش غالبا معنويا فى خفض الوزن الجاف للحشائش.

زيادة الكثافة النباتية من 70000 إلى 140000 نبات للفدان أدت إلى زيادة معنوية بالنسبة لصفة ارتفاع الساق ، ومحصول السيقان. بينما أدت الكثافة المتوسطة (93333 نبات للفدان) الى زيادة معنوية فى محصول العلف مقارنة بالكثافتين الأخريين.

لم يلاحظ إى تأثر معنوى فى نسبة المواد الصلبة الذائبة للعصير والنسبة المئوية للسكروز% السكريات المختزلة باستخدام الكثافات موضع الدراسة .

استخدام عزقتين بعد 15 و28 يوم من الزراعة حققت زيادة معنوية فى ارتفاع الساق وقطر الساق ومحصول السيقان ومحصول العلف الأخضر والمواد الصلبة الذائبة والسكروز% والنقاوة % والسكريات المختزلة للذرة السكرية مقارنة بمعاملة الكنترول.

توصى هذه الدراسة بزراعة الذرة السكرية بكثافة نباتية 140000 نبات للفدان واستخدام العزيق مرتين بعد 15و 28 يوم من الزراعة لزراعتها فى ظروف متشابهة كمحصول ثنائى الغرض لإنتاج السكر والعلف الأخضر.