Assiut J. of Agri. Sci., 38 (1) (31-52)

EVALUATION OF SOME SPRING PLANTED SUGARCANE GENOTYPES UNDER DIFFERENT GROWING SEASONS: 3- TOLERANCE TO STRESS UNFAVORABLE GROWING SEASONS

B.D. Mohamed and A.B.A. El-Taib

Sugar Crops Res., Inst., ARC, Giza, Egypt.

Abstract: The present study was carried out at Kom-Ombo Agricultural Research Station farm during 2004/2005 and 2005/2006 seasons to evaluate the tolerance of 14-gentoypes to the stress found at unfavorable growing seasons length. The used genotypes were: GT54-9, Ph8013, G99-80, G99-103, G99-122, G99-160, G99-165, G99-208, G99-217, G2000-4, G2000-8, G2000-157, G2000-171 and G2000-176.

The growing seasons used were the combination of two planting dates and three harvesting dates resulting in vary six growing seasons (GS1 to GS6). The planting dates were 26 March (recommended date) and 26 April (late date) and the harvesting dates were 26 Feb., 26 March and 26 April. GS2 was the optimum growing season and the others were considered unfavorable growing seasons. The experimental design was randomized complete blocks with three replications arranged in split plots system.

At GS3; GT54-9, G99-103, G99-122, G2000-8 and G2000-157 genotypes was highly stress tolerant in (S) value based on cane or sugar yield while G99-80 and G2000-4 genotypes were highly stress tolerant based on sugar yield.

At GS4; G99-165 genotype was highly stress tolerant either (S) value based on cane yield or sugar yield while G99-80 genotype was highly stress tolerant when (S) value based on cane yield.

At GS5; G99-80, G99-122 and G99-165 genotypes were highly stress tolerant either (S) values based on cane or sugar yield.

At GS6; G99-122 and 2000-171 genotypes were highly stress tolerant either (S) value based on cane or sugar yield while Ph8013 and G2000-157 genotypes were highly stress tolerant when (S) values based on cane yield.

These results could be used as a foundation information system for chosing varieties for planting under Upper Egypt conditions to obtain high sugar yield throughout the length of the growing season.

Key words: sugarcane, genotypes, unfavorable seasons.

Introduction

The productivity of sugarcane is greatly affected by any stress found throughout the growing season which is determined by planting and harvesting dates. The free stress

growing season is obtained by optimal planting and harvesting dates. Late planting date, early harvesting date, late harvesting date and the combination between late planting date and early or late harvesting date resulted in unoptimal duration of the growing season and unoptimal condition prevailing during the growing season lead to the stress. To avoid the negative effect of this stress in cane and sugar yield, developing and planting tolerant genotype could be the main approach when the stress growing season is unavoidable and should received agreat emphasis in sugarcane breeding programs. Fischer and Maurer, 1978, reported that the tolerance of genotype stress is controlled by many physiological and morphological characters for which effective selection have not yet been developed and productivity potential is related to genetic make-up of a genotype. Hoey and Hossain, 1981 studied the stress at unfavorable growing seasons induced by unsuitable planting and harvesting dates and reported that harvesting date was more important than planting date in determining the stress effect on cane and sugar yield as well as their attributes. It has been observed that the early planted crop in spring season is better in yield and quality and delaying spring planting to April or May decreases sucrose content in sub-tropical climate (Solomon and Verma, 2005). Late mature sugarcane cultivars produce high yield of cane and sugar when they were planted and harvested at the optimal dates while agreat reduction in yield of cane and sugar was reported when their planting date was delayed and/or harvesting date was advanced in comparison to cultivars that are considered mid or early mature cultivars (Miller and James, 1978; Legender, 1985; Patel *et al.*, 1993; Imman-Bamber, 1994; Hapes *et al.*, 1995; Calderon *et al.*, 1996; Gawander *et al.*, 1996; Ramesh and Mahadevaswamy, 1996; Rao *et al.*, 1997 and Singh and Singh, 1998).

Sugarcane genotypes differ in their sucrose accumulation capacity. Early maturing genotypes accumulate more sucrose in short period whereas the accumulation of sucrose is less in case of late maturing ones. In addition, suboptimal conditions prevailing during ripening and maturity phase affect adversely the synthesis, accumulation and recovery of sucrose. However, the sucrose accumulated during the process of ripening tends to deplete at a faster rate when cane is left standing in the field after attainment of maturity (stand-over). Thus, seasonal and varietal planting and harvesting program with suitable varietal mix; early, mid and late maturing varieties has adominating influence in augmenting sucrose productivity per unit area during early milling and maintaining it high during late

season. With the advent of early maturing higher sugar varieties, sugar cane varietal planting has assumed a great significance (Solomon *et al.*, 2000). Egyptian cane sugar industry depends on GT54-9 cultivar as the main commercial cultivar which is mid-seasons maturity. Therefore, great reduction in sugar yield per unit area have been found at early and late months of the milling season. To overcome this problem, the present study was conducted and its objective was to search and identify genotypes. That are highly tolerant to the stress during growing season which is a result from late planting, early harvesting, late harvesting and the combination between late planting and early or late harvesting dates among 14-sugarcane genotypes at final stage of selection in the Egyptian sugarcane breeding program.

Materials and Methods

The present study was carried out at Kom-Ombo Agricultural Research Station farm during two successive plant cane seasons (2004/2005 and 2005-2006) to study the tolerance of 14-sugarcane genotypes grown under unfavorable growing seasons combinations. The used growing seasons were five unfavorable in addition to the favorable growing season. Representing the combinations of two planting dates i.e. recommended date (26 March) and late date (26 April) with three harvesting dates, i.e. 26 Feb., 26 March and 26 April. The combinations of the six growing season were;

GS1 (unfavorable): planting 26 March & harvesting 26 Feb. (11-month).

GS2 (favorable): planting 26 March & harvesting 26 March (12-month); recommended growing season).

GS3 (unfavorable): planting at 26 March & harvesting 26 April (13-months).

GS4 (unfavorable): planting at 26 April & harvesting 26 Feb. (10-months).

GS5 (unfavorable): planting at 26 April & harvesting 26 March (11-month).

GS6 (unfavorable): planting at 26 April & harvesting 26 April (12-month).

The average of minimum and maximum monthly temperature of the growing seasons were shown in table (1).

The genotypes used in this study were GT54-9, the commercial cultivar, while the second genotype Ph8013 which was introduced from Philippines. The other genotypes is promising genotypes in Egyptian sugarcane breeding programe, i.e. G99-80, G99-103, G99-122, G99-160, G99-165, G99-208, G99-217, G2000-4, G2000-8, G2000-157, G2000-171 and G2000-176.

Table(1): The minimum & maximum monthly temperature at the experimental region (seasons 2004 – 2005 and 2005 – 2006).

Month	Minimum		Maximum	
	Season 2004 – 2005	Season 2005 – 2006	Season 2004 – 2005	Season 2005 – 2006
April	16.0	16.2	35.8	35.9
May	20.6	17.7	41.7	38.2
June	20.8	21.0	41.3	40.8
July	21.7	20.3	43	42.0
August	20.9	22.0	41.1	42.5
September	19.3	18.4	39.8	40.6
October	19.0	17.1	37.1	35.7
November	12.9	10.1	29.9	29.0
December	6.6	9.3	24.9	27.6
January	5.9	7.4	23.1	25.1
February	9.5	8.7	26.9	28.1
March	11.0	11.2	31.1	31.6
April	--	14.4	--	34.8

The trail design was randomized complete blocks with three replications arranged in split-plot system. The growing seasons were allocated in the main plots and the genotypes were arranged in sub-plots. The sub-plot was 5 rows, 7 meter long and one meter apart. The recommended cultural practices of sugarcane production were adopted throughout the growing seasons.

At the harvest of each growing seasons the following data was recorded including;

Quality traits (Brix %, Sucrose %, Pol % and sugar recovery %) as well as cane yield components (number of millable stalks/feddan and stalk weight (kg)), cane yield (ton/fed.) and sugar yield (ton/fed.). The method of measuring and estimating these traits was described previously in part 1 and 2 of this study.

To assess the evaluated genotypes tolerance to unfavorable growing seasons, the GS2 (planting at 26 March & harvesting after 12-month at next 26 March) was chosen as a free stress environment, since it the recommended growing season under upper Egypt condition. The stress at GS1 was advancing the harvesting date one month. The stress at GS3 was delaying the harvesting date one month. The stress at GS4 was delaying planting one month and advancing the harvesting date one month. The stress at GS5 was delaying planting date one month. The stress at GS6 was delaying the planting date one month and delaying the harvesting date one month either. Thus, unfavorable growing seasons stress susceptibility index (S) was estimated as relative reduction in value of studied trait for each genotype from GS2 to each of the unfavorable growing season (GS1, GS3, GS4, GS5 and GS6) by using formula developed by Fischer and Maurer, 1978. The scale of "S" rating was suggested and applied by Kahanna-Chopra and Viswanathan, 1999.

$D = 1-(Y/Yp)/D$ Where:

Y = mean of any trait of a genotype at each harvesting date in a stress environment.

Yp = mean of any trait of a genotype at each harvesting date in a stress free environment.

D = Stress intensity = 1-(X/Xp)

X = mean Y of all genotypes.

Xp = mean Yp of all genotypes.

The "S" was used to characterize the relative unfavorable growing season stress tolerance of the various genotypes at favorable growing season (GS2), where $S \leq 0.5$= highly stress tolerance (H); $S > 0.5 \leq 1.00$ = moderately stress tolerant (M) and $S > 1.00$= susceptible.

Results and Discussion

1 - Tolerance based on Brix %:

Susceptibility index (S) presented in table (2) indicated that G99-103, G99-160, G99-165 and G2000-8 genotypes were highly stress tolerant ($S<0.5$) while G99-217 and G2000-157 were moderately stress tolerant ($S>0.5<1.0$). However, the other genotypes were susceptible ($S>1.00$) and the mean of susceptibility index (S) of growing seasons over genotypes indicated that sugarcane plants were susceptible to the growing seasons stress based in Brix %. Eggleston and Legendre, 2003, reported that sugarcane genotypes differed in their tolerance to the stress of growing seasons.

Furthermore, at GS1; G99-103 and G99-165 proved to be highly stress tolerant ($S<0.5$) while G2000-4, G2000-8 and G2000-171 genotypes were moderately stress tolerant. However, the other genotypes were susceptible.

At GS3; G99-103, G99-165, G99-217, G2000-8 and G2000-157

Table(2): Susceptibility index (S)of 14 – sugarcane genotypes at varying stress growing seasons based on Brix %.

Genotypes	GS2	GS1	S	GS2	GS3	S	GS2	GS4	S	GS2	GS5	S	GS2	GS6	S	S. mean
GT 54-9	22.29	20.48	1.21	22.29	21.49	2.76	22.29	19.80	1.03	22.29	21.92	0.92	22.29	20.44	2.37	1.66
PH 8013	22.77	21.14	1.07	22.77	22.49	0.95	22.77	19.46	1.34	22.77	22.64	0.32	22.77	21.68	1.37	1.01
G. 99-80	22.74	20.30	1.61	22.74	21.87	2.94	22.74	19.65	1.26	22.74	21.73	2.48	22.74	20.49	2.83	2.22
G. 99-103	21.28	21.70	-0.29	21.28	21.97	-2.49	21.28	18.67	1.14	21.28	21.50	-0.57	21.28	21.22	0.08	-0.43
G. 99-122	21.81	19.92	1.30	21.81	21.42	1.37	21.81	19.47	0.99	21.81	21.32	1.25	21.81	20.37	1.89	1.36
G. 99-160	22.11	20.60	1.02	22.11	21.73	1.32	22.11	21.09	0.43	22.11	22.57	-1.16	22.11	22.41	-0.39	0.24
G. 99-165	20.78	20.39	0.28	20.78	20.87	-0.33	20.78	19.44	0.60	20.78	21.19	-1.10	20.78	20.53	0.34	-0.04
G. 99-208	23.33	21.39	1.24	23.33	23.00	1.09	23.33	20.54	1.11	23.33	22.58	1.79	23.33	23.45	-0.15	1.02
G. 99-217	23.42	21.68	1.11	23.42	23.49	-0.23	23.42	19.83	1.42	23.42	22.73	1.64	23.42	23.27	0.18	0.82
G. 2000-4	22.34	21.26	0.72	22.34	21.37	3.34	22.34	20.95	0.58	22.34	21.87	1.17	22.34	21.49	1.09	1.38
G. 2000-8	21.93	20.96	0.66	21.93	21.98	-0.18	21.93	19.92	0.85	21.93	22.11	-0.46	21.93	21.92	0.01	0.18
G. 2000-157	21.29	19.05	1.57	21.29	22.74	-5.23	21.29	17.70	1.56	21.29	19.62	4.37	21.29	19.61	2.26	0.90
G. 2000 -171	22.97	21.69	0.83	22.97	21.55	4.75	22.97	21.55	0.57	22.97	22.13	2.04	22.97	22.44	0.66	1.77
G. 2000-176	23.04	20.61	1.58	23.04	22.09	3.17	23.04	20.26	1.12	23.04	22.55	1.19	23.04	21.82	1.51	1.71
Mean	22.29	20.80	1.00	22.29	22.00	0.84	22.29	19.88	1.00	22.29	21.89	0.99	22.29	21.51	.00	

genotypes were highly stress tolerant (S<0.5) while Ph8013 genotype was moderately stress tolerant (S>0.5<1.0). However, the other genotypes were susceptible.

At GS4; G99-160 genotype was the only genotype among used genotypes which was highly stress tolerant indicating that this genotype had ability to tolerate in term of Brix % the late planting date and early harvesting date which they found at this growing season and G99-122, G99-165, G2000-4, G2000-8 and G2000-171 genotypes were moderately stress tolerant while the other genotypes were susceptible.

At GS5; Ph8013, G99-103, G99-160, G99-165 and G2000-8 genotypes were highly stress tolerant while GT54-9 genotype was moderately stress tolerant and the other genotypes were susceptible.

At GS6; G99-103, G99-160, G99-165, G99-208, G99-217 and G2000-8 genotypes were highly stress tolerant while G2000-171 was moderately stress tolerant and the other genotypes were susceptible. These results indicated that Brix % is essentially a relative character whose expression is controlled by strong and very evident genotype by environmental interaction. Solomon and Verma, 2005, reported that all abiotic stress such as unfavorable growing season affect the normal ripening, increased reducing sugar and polysaccharides such as dextrans. Accordingly, the Brix % increased.

2 - Tolerance based on sucrose %:

Susceptibility index (S) shown in table (3) indicated that G99-103, G99-160 and G99-165 genotypes were highly stress tolerant while over genotypes, the main 'S' for stress of growing seasons indicating moderately stress tolerant (S>0.5≤1.0). Differences among sugarcane genotypes in sucrose % and their tolerance at growing seasons were reported by Solomon and Verma, 2005.

At GS1; G99-103 and G99-165 were highly stress tolerance (S<0.5) while G99-160, G2000-4, G2000-8 and G2000-171 genotypes were moderately stress tolerant (S>0.5≤1.0) while the other genotypes were susceptible (S>1.0).

At GS3; G99-103, G99-165, G99-217 and G2000-157 genotypes were highly stress tolerant (S<0.5) while G99-122, G99-160 and G99-208 genotypes were moderately stress tolerant (S>0.5≤1.0) and the other genotypes were susceptible.

At GS4; non of used genotypes recorded highly tolerant to the stress at GS4 which was late planting by one month and early harvesting by one month resulting in 10-months duration of this growing season while GT54-9, G99-122, G99-160, G99-165, G2000-4, G2000-8 and G2000-171 genotypes were moderately stress tolerant (S>0.5≤1) and the other genotypes were susceptible (S<1.0).

Table(3): Susceptibility index (S) of 14 – sugarcane genotypes at varying stress growing seasons based on sucrose %.

Genotypes	GS2	GS1	S	GS2	GS3	S	GS2	GS4	S	GS2	GS5	S	GS2	GS6	S	S. mean
GT 54-9	19.53	17.88	1.12	19.53	18.39	2.24	19.53	16.91	1.00	19.53	18.76	1.16	19.53	17.19	1.87	1.48
PH 8013	19.68	18.01	1.13	19.68	18.96	1.40	19.68	16.49	1.20	19.68	20.03	-0.52	19.68	18.25	1.13	0.87
G. 99-80	19.64	17.30	1.58	19.64	18.48	2.26	19.64	16.43	1.21	19.64	18.07	2.36	19.64	16.91	2.16	1.92
G. 99-103	17.55	18.00	-0.34	17.55	18.09	-1.18	17.55	14.98	1.09	17.55	17.77	-0.37	17.55	17.41	0.12	-0.14
G. 99-122	18.94	17.15	1.26	18.94	18.56	0.77	18.94	16.56	0.93	18.94	17.98	1.49	18.94	17.10	1.51	1.19
G. 99-160	19.47	18.01	1.00	19.47	19.05	0.83	19.47	17.97	0.57	19.47	19.67	-0.30	19.47	19.31	0.13	0.45
G. 99-165	16.38	16.59	-0.17	16.38	16.89	-1.19	16.38	14.94	0.65	16.38	16.56	-0.32	16.38	15.74	0.61	-0.09
G. 99-208	20.08	18.00	1.38	20.08	19.58	0.95	20.08	16.84	1.20	20.08	19.20	1.29	20.08	19.73	0.27	1.02
G. 99-217	20.19	18.57	1.07	20.19	20.33	-0.27	20.19	16.16	1.48	20.19	19.18	1.47	20.19	19.63	0.43	0.84
G. 2000-4	19.15	17.98	0.81	19.15	17.84	2.62	19.15	17.70	0.56	19.15	18.61	0.83	19.15	17.62	1.24	1.21
G. 2000-8	18.86	17.93	0.66	18.86	18.30	1.14	18.86	17.26	0.63	18.86	18.92	-0.09	18.86	18.48	0.31	0.53
G. 2000-157	18.48	16.21	1.63	18.48	19.32	-1.74	18.48	14.36	1.65	18.48	16.38	3.35	18.48	16.03	2.06	1.39
G. 2000 -171	20.10	18.67	0.95	20.10	18.50	3.05	20.10	18.27	0.68	20.10	18.68	2.08	20.10	18.84	0.98	1.55
G. 2000-176	20.05	17.62	1.61	20.05	18.77	2.45	20.05	17.11	1.09	20.05	19.13	1.35	20.05	18.61	1.12	1.52
Mean	19.15	17.71	0.98	19.15	18.65	0.95	19.15	16.57	1.00	19.15	18.50	0.98	19.15	17.92	1.00	

At GS5; Ph8013, G99-103, G99-160, G99-165 and G2000-8 genotypes were highly stress tolerant while G2000-4 was moderately stress tolerant and the other genotypes were susceptible.

At GS6; G99-103, G99-160, G99-208, G99-217 and G2000-8 genotypes were highly stress tolerant (S<0.5) while G99-165 and G2000-171 were moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible. Solomon and Verma, 2005, sugarcane genotypes different in their sucrose accumulation capacity and early maturing genotypes accumulate more sucrose in a lesser period and they could tolerate the stress of late planting or early harvest. However, late maturing genotypes accumulate less sucrose in longer period and they are susceptible to late planting and/or early harvesting dates.

3 – Tolerance based on pol %:

Susceptibility index (S) presented in table (4) indicated that G99-103, G99-160, G99-165 and G2000-8 genotypes were highly stress tolerance (S>0.5) while the susceptibility index (S) means over genotypes indicated that sugarcane plants were moderately tolerant to the stress at growing seasons used (S>0.5≤1.0).

Furthermore, at GS1, G99-103, G99-165 and G2000-8 proved to be highly stress tolerant while G99-160 and G2000-4 genotypes were moderately stress tolerant and the other genotypes were susceptible.

At GS3, G99-103, G99-160, G99-165, G99-217 and G2000-157 genotypes were highly stress-tolerant (S<0.5) while G99-122 and G2000-8 genotypes were moderately stress tolerant (S>0.5>1.0) and the other genotypes were susceptible (S>1.0).

At GS4, non of the genotypes were highly stress tolerant while GT54-9, G99-122, G99-160, G99-165, G2000-4, G2000-8, G2000-171, and 2000-176 genotypes were moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible.

At GS5, G99-103, G99-160, G99-165, G2000-8 and G2000-176 proved to be highly stress-tolerant (S<0.5) while Ph8013 and G99-122 genotypes were moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible (S>1.0).

At GS6, G99-103, G99-160 and G2000-8 genotypes proved to be highly stress tolerant (S<0.5) while G99-165, G99-208, G99-217 and G2000-176 genotypes were moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible (S>1.0). Singh and Solomon, 2005, reported that tolerance of sugarcane genotypes to stress based on pol % dependent on severity and duration of stress. Also, differences among sugarcane genotypes in stress tolerant was found.

Table(4): Susceptibility index (S)of 14 – sugarcane genotypes at varying stress growing seasons based on pol %.

Genotypes	GS2	GS1	S	GS2	GS3	S	GS2	GS4	S	GS2	GS5	S	GS2	GS6	S	S. mean
GT 54-9	16.14	14.83	1.13	16.14	15.33	1.85	16.14	14.08	0.95	16.14	15.31	1.10	16.14	14.31	1.50	1.31
PH 8013	16.14	14.77	1.18	16.14	15.63	1.16	16.14	13.49	1.22	16.14	15.68	0.61	16.14	14.73	1.15	1.07
G. 99-80	16.26	14.07	1.87	16.26	15.14	2.54	16.26	13.33	1.34	16.26	14.73	2.02	16.26	13.69	2.09	1.97
G. 99-103	14.47	15.16	-0.66	14.47	14.89	-1.07	14.47	12.49	1.02	14.47	14.58	-0.16	14.47	14.17	0.27	- 0.12
G. 99-122	15.49	13.99	1.35	15.49	15.15	0.81	15.49	13.43	0.99	15.49	14.78	0.98	15.49	13.93	1.33	1.09
G. 99-160	16.16	15.10	0.91	16.16	15.99	0.39	16.16	14.98	0.54	16.16	16.13	0.04	16.16	15.77	0.32	0.44
G. 99-165	13.94	13.64	0.30	13.94	13.92	0.05	13.94	12.41	0.82	13.94	13.62	0.49	13.94	13.23	0.67	0.47
G. 99-208	16.82	15.30	1.26	16.82	15.97	1.86	16.82	14.24	1.14	16.82	15.65	1.49	16.82	16.11	0.56	1.26
G. 99-217	16.97	15.60	1.12	16.97	16.96	0.02	16.97	13.39	1.57	16.97	15.56	1.78	16.97	16.06	0.71	1.04
G. 2000-4	16.24	15.35	0.76	16.24	15.08	2.63	16.24	14.93	0.60	16.24	15.03	1.60	16.24	14.66	1.29	1.38
G. 2000-8	15.34	14.92	0.38	15.34	14.94	0.96	15.34	14.19	0.56	15.34	15.54	-0.28	15.34	14.80	0.46	0.42
G. 2000-157	15.33	13.42	1.73	15.33	16.18	-2.04	15.33	12.17	1.53	15.33	13.59	2.43	15.33	13.52	1.56	1.04
G. 2000 -171	16.56	15.34	1.02	16.56	15.49	2.38	16.56	14.88	0.75	16.56	15.54	1.32	16.56	15.15	1.12	1.32
G. 2000-176	16.09	14.46	1.41	16.09	15.29	1.83	16.09	14.08	0.93	16.09	15.82	0.36	16.09	14.97	0.92	1.09
Mean	15.85	14.71	0.98	15.85	15.42	0.96	15.85	13.72	1.00	15.85	15.11	0.98	15.85	14.65	1.00	

4 – Tolerance based on sugar recovery %:

Susceptibility index (S) shown in table (5) indicated that G99-103, G99-160 and G99-165 genotypes were highly stress tolerant (S>0.5) while Ph8013, G99-217 and G2000-8 genotypes were moderately stress tolerant (S>0.5>1.0) and the other genotypes were susceptible. The susceptibility index (S) means over genotypes indicated that sugarcane plant showed moderately tolerant to the stress at the growing seasons (S>0.5<1.0).

At GS1; G99-103 and G99-165 genotypes were highly stress tolerant (S<0.5) while G99-160, G2000-4, G2000-8, G200-171 genotypes were moderately stress tolerant (S>0.5<1.0) while the other genotypes were susceptible (S>1.0).

At GS3; G99-103, G99-165, G99-217 and G2000-157 genotypes were highly stress tolerant (S<0.5) while G99-122, G99-160, and G99-208 genotypes were moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible (S>1.0).

At GS4; none of genotypes were highly stress tolerant while GT54-9, G99-122, G99-160, G99-165, G2000-4, G2000-8 and G2000-171 genotypes were moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible (S>1.0).

At GS5; Ph8013, G99-103, G99-160, G99-165 and G2000-8 were highly stress tolerant (S<0.5) while G2000-4 was moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible.

At GS6; G99-103, G99-160, G99-208 and G2000-8 proved to be highly stress tolerant (S<0.5) while Ph8013, G99-165, G99-217 and G2000-171 genotypes were moderately stress tolerant (S>0.5≤1.0) and the other genotypes were susceptible (S>1.0). Solomon and Verma, 2005, reported that the sucrose accumulated during the process of ripening tends to deplete at faster rate when case is left standing in the field after attainment of maturity and resulted in reduction of sugar recovery %. Thus, the harvesting at optimum time is essential and the sugarcane genotypes differ in their optimum harvesting date.

5- Tolerance based on number of millable stalks (fed.):

Data shown in table (6) indicated that G99-80, G99-122 and G2000-171 genotypes was highly tolerance to unfavorable growing seasons according to their "S" values which were 0.15, 0.03 and 0.17, respectively, while G99-165, G99-208, G99-217, G2000-8 and G2000-157 genotypes were moderately stress tolerance which their "S" value were 0.73, 0.67, 0.96, 0.94 and 0.53, respectively. However, the other genotypes were susceptible. Du *et al.*, 1999, reported that tolerance of sugarcane to unfavorable growing seasons varies among genotypes. The mean of "S" values over all

Table(5): Susceptibility index (S)of 14 – sugarcane genotypes at varying stress growing seasons based on sugar recovery%.

Genotypes	GS2	GS1	S	GS2	GS3	S	GS2	GS4	S	GS2	GS5	S	GS2	GS6	S	S. mean
GT 54-9	13.45	12.29	**1.08**	13.45	12.52	**2.10**	13.45	11.50	**0.98**	13.45	12.78	**1.28**	13.45	11.96	**1.51**	**1.39**
PH 8013	13.46	12.23	**1.15**	13.46	12.81	**1.47**	13.46	11.17	**1.15**	13.46	13.86	**-0.76**	13.46	12.47	**1.00**	**0.80**
G. 99-80	13.43	11.76	**1.56**	13.43	12.50	**2.10**	13.43	11.06	**1.19**	13.43	12.12	**2.50**	13.43	11.30	**2.16**	**1.90**
G. 99-103	11.72	12.06	**-0.36**	11.72	12.08	**-0.93**	11.72	9.84	**1.08**	11.72	12.22	**-1.09**	11.72	11.60	**0.14**	**- 0.23**
G. 99-122	12.99	11.71	**1.24**	12.99	12.71	**0.63**	12.99	11.24	**0.91**	12.99	12.15	**1.66**	12.99	11.52	**1.54**	**1.19**
G. 99-160	13.44	12.39	**0.98**	13.44	13.12	**0.72**	13.44	12.21	**0.62**	13.44	13.52	**-0.15**	13.44	13.19	**0.25**	**0.48**
G. 99-165	10.67	11.01	**-0.40**	10.67	11.16	**-1.39**	10.67	9.59	**0.68**	10.67	10.74	**-0.17**	10.67	10.09	**0.74**	**- 0.11**
G. 99-208	13.71	12.15	**1.43**	13.71	13.29	**0.93**	13.71	11.21	**1.23**	13.71	13.02	**1.29**	13.71	13.32	**0.39**	**1.05**
G. 99-217	13.79	12.65	**1.04**	13.79	13.92	**-0.29**	13.79	10.66	**1.53**	13.79	12.96	**1.54**	13.79	13.26	**0.52**	**0.87**
G. 2000-4	13.04	12.16	**0.85**	13.04	11.99	**2.45**	13.04	11.96	**0.56**	13.04	12.64	**0.79**	13.04	11.73	**1.37**	**1.20**
G. 2000-8	12.87	12.21	**0.64**	12.87	12.28	**1.39**	12.87	11.82	**0.55**	12.87	12.89	**-0.04**	12.87	12.63	**0.25**	**0.56**
G. 2000-157	12.67	11.00	**1.66**	12.67	13.11	**-1.05**	12.67	9.51	**1.68**	12.67	11.19	**2.99**	12.67	10.66	**2.16**	**1.49**
G. 2000 -171	13.83	12.75	**0.98**	13.83	12.61	**2.68**	13.83	12.38	**0.71**	13.83	12.63	**2.22**	13.83	13.08	**0.74**	**1.47**
G. 2000-176	13.76	11.99	**1.62**	13.76	12.74	**2.25**	13.76	11.56	**1.08**	13.76	12.96	**1.49**	13.76	12.64	**1.11**	**1.51**
Mean	**13.06**	**12.02**	**0.96**	**13.06**	**12.63**	**0.93**	**13.06**	**11.12**	**0.99**	**13.06**	**12.55**	**0.97**	**13.06**	**12.10**	**0.99**	

Table(6): Susceptibility index (S)of 14 – sugarcane genotypes at varying stress growing seasons based on number of millable stalks/fed.

Genotypes	GS2	GS1	S	GS2	GS3	S	GS2	GS4	S	GS2	GS5	S	GS2	GS6	S	S. mea
GT 54-9	41500	33700	2.21	41500	42000	0.40	41500	39600	0.54	41500	38600	1.07	41500	37600	1.42	1.13
PH 8013	39400	33100	1.88	39400	43300	3.30	39400	35200	1.25	39400	34000	2.11	39400	32900	2.50	2.21
G. 99-80	37000	34300	0.86	37000	38200	1.08	37000	40400	-1.08	37000	37400	-0.17	37000	36900	0.04	0.15
G. 99-103	38700	36900	0.55	38700	40200	1.29	38700	31800	2.10	38700	34700	1.59	38700	37100	0.62	1.23
G. 99-122	37700	37900	- 0.06	37700	38500	0.71	37700	35500	0.68	37700	38600	-0.37	37700	39700	-0.80	0.03
G. 99-160	39600	38500	0.32	39600	41900	1.94	39600	35300	1.28	39600	29900	3.77	39600	29100	4.02	2.27
G. 99-165	38800	34200	1.39	38800	40000	1.03	38800	41000	- 0.67	38800	38400	0.16	38800	34300	1.76	0.73
G. 99-208	38400	38600	- 0.06	38400	40300	1.65	38400	30700	2.36	38400	38300	0.04	38400	40000	-0.63	0.67
G. 99-217	41300	41400	- 0.03	41300	39300	-1.61	41300	32700	2.45	41300	34600	2.50	41300	37200	1.50	0.96
G. 2000-4	39200	34300	1.46	39200	40100	0.77	39200	43100	-1.17	39200	36200	1.18	39200	29200	3.86	1.22
G. 2000-8	38100	35800	0.71	38100	40900	2.45	38100	31900	1.91	38100	37900	0.08	38100	39200	-0.44	0.94
G. 2000-157	42300	35000	2.03	42300	40600	-1.34	42300	35800	1.81	42300	40700	0.58	42300	43500	-0.43	0.53
G. 2000 -171	34800	30900	1.32	34800	36100	1.25	34800	30300	1.52	34800	36400	- 0.71	34800	40600	-2.52	0.17
G. 2000-176	38900	34500	1.33	38900	40600	1.46	38900	35800	0.94	38900	34600	1.70	38900	32400	2.53	1.59
Mean	38978	35650	0.98	38978	40142	1.03	38978	35650	0.99	38978	36450	0.97	38978	36407	0.96	

genotypes showed that cane plants had moderately stress tolerance ($S \geq 0.5 \leq 1.0$) under unfavorable growing seasons used except at GS3 they were susceptible.

Furthermore, the data in table (6) indicated that at GS1; G99-122, G99-160, G99-208 and G99-117 genotypes were highly stress tolerance ($S<0.5$) indicating that these genotypes had the potential in producing millable stalk tolerate the harvesting at 11-months age which one months earlier than that of the optimum growing seasons (GS2). G99-80, G99-103 and G2000-8 genotypes were moderately stress tolerant ($S>0.5 \leq 1.0$) while the other genotypes were susceptible. At GS3; GT54-9, G99-217 and G2000-157 genotypes were highly stress tolerant ($S<0.5$) indicating that there genotypes had the potential in producing millable stalks to tolerant the harvesting at the 13-month (one month later of the optimum growing season).

At GS4; G99-80, G99-165 and G2000-4 genotypes were highly stress tolerant ($S<0.5$) indicating that these genotypes had the potential in producing millable stalks in stress resulting fro planting one month later and harvesting one month earlier. GT54-9, G99-122 and G2000-176 genotypes were moderately stress tolerant ($S>0.5<1.0$), while the other genotypes were susceptible ($S>0.1$). At GS5; G99-80, G99-122, G99-165, G99-208, G2000-8 and G2000-171 genotypes were highly stress tolerant indicating that these genotypes had potential in producing millable stalks in stress resulting from dealing planting one month, while G2000-157 was moderately stress tolerant ($S>0.5<1.0$) and the other genotypes were susceptible ($S>1.0$).

At GS6; G99-80, G99-122, G99-208, G2000-8, G2000-157 and G2000-171 genotypes were highly stress tolerant ($S<0.5$). G99-103 genotype was moderately stress tolerant ($S>0.5<1.0$), while the other genotypes were susceptible ($S>0.1$).

6 – Tolerance based on stalk weight (kg):

Susceptibility index (S) shown in table (7) indicated hat GT54-9, Ph8013, G99-122, G99-165 and G2000-176 genotypes were highly stress tolerant ($S<0.5$). Over genotypes, moderately stress tolerant was obtained by cane plants grown at GS1, GS4, GS5 and GS6 ($S>0.5<1.0$), while cane plants grown at GS3 were susceptible.

Furthermore, at GS1; GT54-9, Ph8013, G99-122, G99-165, G2000-171 and G2000-176 genotypes were highly stress tolerant ($S<0.5$).

At GS3; GT54-9, G99-103, G99-122 and G2000-8 genotypes were highly stress tolerant ($S<0.5$).

At GS4; G99-165 and G2000-176 genotypes were highly stress tolerant ($S<0.5$) while the other genotypes were susceptible indicating that a

Table(7): Susceptibility index (S)of 14 – sugarcane genotypes at varying stress growing seasons based on stalk weight (kg) .

Genotypes	GS2	GS1	S	GS2	GS3	S	GS2	GS4	S	GS2	GS5	S	GS2	GS6	S	S. mean
GT 54-9	1.207	1.405	-7.13	1.207	1.174	-0.94	1.207	1.044	0.73	1.207	1.131	0.46	1.207	1.220	-0.15	-1.41
PH 8013	1.330	1.447	-3.82	1.330	1.447	3.03	1.330	0.981	1.43	1.330	1.124	1.13	1.330	1.474	-1.55	0.04
G. 99-80	1.077	1.036	1.66	1.077	1.122	1.44	1.077	0.930	0.74	1.077	1.053	0.16	1.077	0.975	1.35	1.07
G. 99-103	1.707	1.674	0.84	1.707	1.565	-2.87	1.707	1.435	0.86	1.707	1.379	1.40	1.707	1.401	2.56	0.56
G. 99-122	1.181	1.219	-1.40	1.181	1.103	-2.28	1.181	1.072	0.50	1.181	1.116	0.40	1.181	1.153	0.34	-0.49
G. 99-160	1.175	1.051	4.59	1.175	1.206	0.91	1.175	0.765	1.90	1.175	0.872	1.88	1.175	0.841	4.06	2.67
G. 99-165	1.178	1.262	-3.10	1.178	1.258	2.34	1.178	1.139	0.18	1.178	1.159	0.12	1.178	1.212	-0.41	-0.17
G. 99-208	1.257	1.070	6.47	1.257	1.306	1.34	1.257	0.904	1.53	1.257	0.894	2.11	1.257	1.026	2.62	2.81
G. 99-217	1.283	1.059	7.59	1.283	1.462	4.81	1.283	0.967	1.34	1.283	1.037	1.40	1.283	0.989	3.27	3.68
G. 2000-4	1.383	1.137	7.73	1.383	1.419	0.90	1.383	0.855	2.07	1.383	1.272	0.58	1.383	1.568	-1.91	1.87
G. 2000-8	1.271	1.179	3.15	1.271	1.190	-2.20	1.271	1.104	0.71	1.271	1.038	1.34	1.271	1.071	2.25	1.09
G. 2000-157	1.362	1.346	0.51	1.362	1.385	0.58	1.362	1.248	0.45	1.362	1.280	0.44	1.362	1.242	1.26	0.65
G. 2000 -171	1.299	1.352	-1.77	1.299	1.487	4.99	1.299	1.081	0.91	1.299	1.084	1.21	1.299	1.226	0.80	1.23
G. 2000-176	1.169	1.239	-2.60	1.169	1.266	2.86	1.169	1.061	0.50	1.169	0.993	1.10	1.169	1.228	-0.72	0.23
Mean	1.277	1.248	0.91	1.277	1.314	1.06	1.277	1.042	0.99	1.277	1.102	0.98	1.277	1.187	0.96	

great reduction in stalk weight of these genotype sand this reduction due to the short duration of GS4 (10-months).

At GS5; GT54-9, G99-80, G99-122, G99-165 and G2000-157 were highly stress tolerant indicating that these genotypes had potential ability to achieve almost the same stalk weight at GS5 and GS2 (recommended growing season) in spite of planting them one month later at GS5.

At GS6; GT54-9, Ph8013, G99-122, G99-165, G2000-4 and G2000-176 genotypes were highly stress tolerant with exception of highly stress tolerant genotypes at each growing season, the behaviour of the other genotypes ranged between moderately to susceptible to the stress at varing growing seasons used.

7- Tolerance based on cane yield (ton/fed.):

Susceptibility index (S) presented in table (8) indicated that, over growing seasons, GT54-9 and G99-122 genotypes were highly stress tolerant (S<0.5). The highly stress tolerant of GT54-9 genotype based on cane yield was attributed to its highly stress tolerant based on stalk weight (S= -1.41), Table (7) while the highly stress tolerant of G99-122 genotype based on cane yield due to its highly stress tolerant based on stalk weight (S= -0.49), table (7) and number of millable stalks (S= 0.03) table (6). These results pointed out that emphasizes should be directed toward improving mainly stalk weight and secondary sta" mb since the results proved that stalk weight proved to more effective in cane yield than that of number of millable stalks. For instance, GT54-9 genotypes was highly stress tolerant based on cane yield in spite of it was susceptible to stress based on stalk number (S= 1.13) table (6).

G99-80, G99-103, G99-165, G2000-8 and G2000-157 genotypes were moderately stress tolerant (S>0.5<1.0). However, the other genotypes were susceptible (S>1.0). Over genotypes, sugarcane plants grown at GS1, GS4, GS5 and GS6 were moderately stress tolerant (S>0.5<1.0) and they susceptible at GS3 (S>1.0).

At GS1; GT54-9, G99-122, G99-165 and G2000-176 genotypes were highly stress tolerant (S<0.5) indicating that these genotypes should be recommended when the planting date is the recommended date and the harvesting date is at age of 11-months.

At GS3; GT54-9, G99-103, G99-122, G2000-8 and G2000-157 were highly stress tolerant while G2000-4 was moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible (S>1.0).

At GS4; G99-80 and G99-165 were highly stress tolerant (S<0.5) while GT54-9, G99-122, G2000-8,

Table(8): Susceptibility index (S)of 14 – sugarcane genotypes at varying stress growing seasons based on cane yield (ton /fed.).

Genotypes	GS2	GS1	S	GS2	GS3	S	GS2	GS4	S	GS2	GS5	S	GS2	GS6	S	S. mean
GT 54-9	49.92	47.52	0.45	49.92	48.97	-0.34	49.92	40.97	0.70	49.92	43.44	0.68	49.92	45.89	0.60	0.42
PH 8013	51.58	47.98	0.65	51.58	61.88	3.57	51.58	33.03	1.40	51.58	37.78	1.40	51.58	48.34	0.47	1.50
G. 99-80	39.57	35.52	0.96	39.57	42.81	1.46	39.57	38.68	0.09	39.57	39.31	0.03	39.57	35.96	0.68	0.64
G. 99-103	66.32	61.66	0.66	66.32	61.83	-1.21	66.32	45.39	1.23	66.32	47.69	1.47	66.32	57.42	1.56	0.74
G. 99-122	44. 30	45.69	-0.29	44. 30	42.45	-0.74	44. 30	38.09	0.54	44. 30	42.97	0.16	44. 30	45.49	-0.20	-0.11
G. 99-160	46.84	41.38	1.09	46.84	50.85	1.53	46.84	26.92	1.65	46.84	26.12	2.32	46.84	24.94	3.49	2.02
G. 99-165	45.12	43.10	0.42	45.12	49.91	1.90	45.12	46.19	-0.09	45.12	44.48	0.07	45.12	41.38	0.62	0.58
G. 99-208	48.15	40.74	1.44	48.15	52.61	1.66	48.15	27.73	1.65	48.15	34.05	1.53	48.15	40.87	1.13	1.48
G. 99-217	52.74	43.90	1.57	52.74	56.37	1.23	52.74	31.46	1.57	52.74	35.77	1.68	52.74	36.61	2.28	1.67
G. 2000-4	54.17	39.00	2.62	54.17	56.74	0.85	54.17	36.49	1.27	54.17	46.17	0.77	54.17	45.20	1.24	1.35
G. 2000-8	47.87	42.18	1.11	47.87	48.18	0.12	47.87	35.68	0.99	47.87	39.26	0.94	47.87	41.46	1.00	0.33
G. 2000-157	57.48	47.17	1.68	57.41	56.05	-0.42	57.41	44.63	0.87	57.41	51.10	0.58	57.41	53.62	0.49	0.64
G. 2000 -171	44.87	41.09	0.79	44.87	53.71	3.52	44.87	32.61	1.06	44.87	39.43	0.63	44.87	49.05	-0.70	1.06
G. 2000-176	45.44	43.04	0.49	45.44	50.80	2.11	45.44	37.84	0.65	45.44	34.24	1.29	45.44	40.10	0.88	1.08
Mean	49.60	44.28	0.97	49.60	52.37	1.08	49.60	36.84	0.97	49.60	40.13	0.97	49.60	42.95	0.97	

G2000-157 and G2000-176 genotypes were moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible (S>1.0).

At GS5; G99-80, G99-122 and G99-165 genotypes were highly stress tolerant (S<0.5) while GT54-9, G2000-4, G2000-8, G2000-157 and G2000-171 genotypes were moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible.

At GS6, Ph8013, G99-122, G2000-157 and G2000-171 genotypes were highly stress tolerant (S<0.5) while GT54-9, G99-80, G99-165, G2000-8 and G2000-176 genotypes were moderately stress tolerant (S>0.5≤1.0) and the other genotypes were susceptible (S>1.0).

8 - Tolerance based on sugar yield (ton/fed.):

Susceptibility index (S) presented in table (9) indicated that over growing seasons, GT54-9, G99-103, G99-122 and G2000-8 genotypes were highly stress tolerance were highly stress tolerance (S<0.5) while G99-80 and G2000-4 were moderately stress tolerance (S>0.5<1.0) and the other genotypes were susceptible (S>1.0).

Over genotypes, sugarcane plants moderately stress tolerance to the stress at GS1, GS4, GS5 and GS6 while they were susceptible to the stress at GS3.

At GS1; G99-103 and G99-122 and G99-165 were highly stress tolerant (S<0.5) while GT54-9, Ph8013, G2000-8 and G2000-171 genotypes were moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible (S>1.0).

At GS3; GT54-9, G99-80, G99-103, G99-122. G2000-4, G2000-8 and G2000-157 genotypes were highly stress tolerant (S<0.5) while the other genotypes were susceptible (S>1.0).

At GS4; G99-165 genotype was highly stress tolerant (S<0.5) while GT54-9, G99-80, G99-122, G2000-8, G2000-171 and G2000-176 genotypes were moderately stress tolerant (S>0.5<1.0) while the other genotypes were susceptible (S>1.0).

At GS5; G99-80, G99-122 and G99-165 were highly stress tolerant (S<0.5) while GT54-9, G2000-4, G2000-8, G2000-157 and G2000-171 genotypes were moderately stress tolerant (S>0.5<1.0) and the other genotypes were susceptible (S>1.0).

At GS6; G99-122 and G2000-171 genotypes were highly stress tolerant (S>0.5) while GT54-9, Ph8013, G99-165, G99-208 and G2000-8 genotypes were moderately stress tolerant (S>0.5<1.0) while the other genotypes were susceptible (S>1.0).

The results indicated that, over growing seasons, GT54-9 and G99-122 genotypes were highly stress tolerant either in susceptibility

Table(9): Susceptibility index (S)of 14 – sugarcane genotypes at varying stress growing seasons based on sugar yield (ton /fed.).

Genotypes	GS2	GS1	S	GS2	GS3	S	GS2	GS4	S	GS2	GS5	S	GS2	GS6	S	S. mean
GT 54-9	6.706	5.892	0.70	6.706	6.128	-3.45	6.706	4.709	0.80	6.706	5.544	0.77	6.706	5.488	0.91	-0.05
PH 8013	6.988	5.910	0.90	6.988	7.925	5.36	6.988	3.695	1.27	6.988	5.225	1.12	6.988	6.045	0.67	1.86
G. 99-80	5.333	4.225	1.21	5.333	5.369	0.27	5.333	4.187	0.58	5.333	4.753	0.48	5.333	4.067	1.19	0.75
G. 99-103	7.797	7.508	0.22	7.797	7.464	-1.71	7.797	4.461	1.15	7.797	5.831	1.12	7.797	6.065	1.11	0.38
G. 99-122	5.768	5.375	0.40	5.768	5.418	-2.43	5.768	4.296	0.69	5.768	5.220	0.42	5.768	5.251	0.45	- 0.09
G. 99-160	6.194	4.939	1.18	6.194	6.615	2.72	6.194	3.296	1.26	6.194	3.517	1.91	6.194	3.281	2.35	1.88
G. 99-165	4.786	4.774	0.01	4.786	5.576	6.60	4.786	4.439	0.20	4.786	4.742	0.04	4.786	4.102	0.71	1.51
G. 99-208	6.600	4.966	1.44	6.600	7.001	2.43	6.600	3.134	1.42	6.600	4.436	1.45	6.600	5.428	0.89	1.53
G. 99-217	7.278	5.559	1.37	7.278	7.860	3.20	7.278	3.362	1.45	7.278	4.645	1.60	7.278	4.884	1.64	1.85
G. 2000-4	6.969	4.761	1.84	6.969	6.675	-1.68	6.969	4.340	1.02	6.969	5.800	0.74	6.969	5.294	1.20	0.62
G. 2000-8	6.158	5.162	0.94	6.158	5.920	-1.54	6.158	4.259	0.83	6.158	5.061	0.79	6.158	5.231	0.75	0.35
G. 2000-157	7.275	5.219	1.64	7.275	7.345	0.38	7.275	4.232	1.13	7.275	5.708	0.95	7.275	5.693	1.09	1.04
G. 2000 -171	6.202	5.271	0.87	6.202	6.821	3.99	6.202	4.028	0.94	6.202	4.997	0.86	6.202	6.444	-0.20	1.29
G. 2000-176	6.284	5.194	1.01	6.284	6.513	1.46	6.284	4.368	0.82	6.284	4.437	1.30	6.284	5.017	1.01	1.12
Mean	6.453	5.340	0.98	6.453	6.616	1.11	6.453	4.058	0.97	6.453	4.994	0.97	6.453	5.164	0.98	

index (S) values based on cane yield or sugar yield. In addition, G2000-8 genotype was highly stress tolerant when (S) values based on sugar yield. At GS1; G99-122 and G99-165 genotypes were highly stress tolerant either (S) values based on cane yield or sugar yield while GT54-9 genotype was highly stress tolerant when (S) value based on cane yield and it was moderately stress tolerant when (S) values based on sugar yield. However, G99-103 genotype was highly stress tolerant when (S) value based on sugar yield and it was moderately stress tolerant when (S) values based on cane yield.

References

Calderon, H., R. Besosa; A. Amaya; C.A. Luna Moreno and C. Cassalett. 1996. Evaluation of sugarcane varieties for early harvesting, under tropical conditions. Proc. ISSCT. 22:293-297

Du, Y.C., A. Nose and K. Wasona. 1999. Thermal characteristics of C4 photosynthetic enzymes from leaves of three sugarcane species differing in cold sensitivity. Plant Cell Physiol., 40: 298-304.

Eggleston, G. and B. Legendre. 2003. Mannitol and oligosaccharides as new criteria for determining cold tolerance in sugarcane varieties. Food Chem., 80: 451-461.

Fischer, R.A. and R. Maurer, 1978. Drought resistance in spring wheat cultivars. 1- Grain yield response. J. Agric. Res. 29: 897-907.

Gawander, J.S., R.A. Wood and D. Morton. 1996. Prod[illegible] sugarcane in Fji as affected by planting dates, age at harvest and season. Proc. ISSCT. 22: 33-38.

Hapes, R.S., R.B. Doule and J M Rapale. 1995. A study of evaluation of sa[illegible] early and mid-late maturing sugarcane varieties in pre-season planting. Cooperative sugar, 26 (10): 771-775. (C.f. Field Crop Abst., 48: 2090, 1996)

Hoey, P.M. and A.H.M.D. Hossain. 1981. The effect of time of planting and harvesting on yield parameers of sugar cane at SRI. Bangladesh J. Sugar Cane, 3: 37-43.

Inman-Bamber, N.G. 1994. Effect of age and season on components of yield of sugarcane in South Africa. Proc. Of the Annual cong., South Africa. Sugar. Technologists, Association 1994. No 68: 23-27 (C.f. Field Crop Abst., 49: 1273, 1996).

Khanna-Chopra, R. and C. Viswanathan. 1999. Evaluation of heat stress tolerance in irrigated environment of *T [illegible]estivum* and related species. 1- Stability in yield and [illegible]ield components. Euphytica, 106: 169-180.

Legendre, B.L. 1985. Changes in juice quality of nine commercial

sugarcane verities grown in Louiziana. ASSCT. 4, April : 54-57.

Miller, J.D. and N.J. James. 1978. Maturity of six sugarcane varieties in Florida. ASSCT 7 (New Series) June: 107-111.

Patel, H.S., N.J. Mehta, M.P. Patel, R.T. Khatri and P.L. Naik. 1993. Evaluation of early cane cultivars under varying harvesting dates. Indian Sugar, 43: 641-644.

Ramesh, P. and M. Mahadevaswamy. 1996. Effect of planting season and harvesting age of plant and ratoon crops on yield an quality of sugarcane (*Saccharum officinarum*) varieties. Indian J. of Agric., Sci. 66: 641-644.

Rao, K.L , T.C., Devi and D.V.N. Raju. 1997. Effect of time of planting and age at harvest on yield and quality of early maturing sugarcane verities. Cooperative sugar, 29: 175 -178 (C.f. Field Crop Abst., 51: 3685, 1998).

Singh, Ishwar and S. Solomon. 2005. Sugarcane: Production Management and Agro-Industrial Imperatives. International Book Distributing Co., India (Publishing Division): 307-319.

Singh, R.K. and G.P. Singh. 1998. Effect of sampling time on efficacy of selection for quality traits in sugarcane. Sugarcane, No. 3: 13-17.

Solomon, S. and Verma Manjusha. 2005. Sugar cane: Production Management and Agro-Industrial Imperatives. International Book Distributing Co., India (Publishing Division): 585-619.

Solomon, S., H.N. Shahi, B.L. Srivastava and G.P. Rao. 2000. Cane sugar: Production Management, International Book Distribution company, Lucknow (India).

تقييم بعض التراكيب الوراثية لقصب السكر المزروعة فى الربيع تحت مواسم زراعية مختلفة ٣ – تحمل الإجهاد فى مواسم النمو الغير مناسبة

بازيد دردير محمد ، أشرف بكرى أحمد الطيب

معهد بحوث المحاصيل السكرية – مركز البحوث الزراعية – الجيزه – مصر

تـم إجراء هذه الدراسة فى مزرعة محطة بحوث كوم أمبو الزراعية خلال موسمى ٢٠٠٤/ ٢٠٠٥ ، ٢٠٠٥/٢٠٠٦ لتقدير تحمل أربعة عشر تركيباً وراثياً للإجهاد الموجود فى مواسم النمو الغـير مناسبة والتراكيب الوراثية المستخدمة هى : جيزه ٩/٥٤ والفلبينى ٨٠١٣ وجيزه ٩٩-٨٠ وجيزه ٩٩-١٠٣ وجيزه ٩٩-١٢٢ وجيزه ٩٩-١٦٠ وجيزه ٩٩-١٦٥ وجيزه ٩٩-٢٠٨ وجيزه ٩٩-٢١٧ وجـيزه ٢٠٠٠-٤ وجـيزه ٢٠٠٠-٨ وجـيزه ٢٠٠٠-١٥٧ وجـيزه ٢٠٠٠-١٧١ وجيـزه ٢٠٠٠-١٧٦.

وكانـــت مواسم النمو المستخدمة عبارة عن توافيق لميعادين زراعة وثلاث مواعيد حصاد نتج عـــنها ســـتة مواســـم نمـــو مختلفة (GS1-GS6) . وكانت مواعيد الزراعة ٢٦ مارس (الميعاد الموصـــى به) و ٢٦ أبريل (الميعاد المتأخر) وكانت مواعيد الحصاد ٢٦ فبراير و ٢٦ مارس و ٢٦ أبـــريل . وكـــان موسم النمو الثانى هو الموسم الأمثل وبقية المواسم كانت غير مناسبة . وكان تصميم التجربة قطاعات كاملة العشوائية محتوية على ثلاث مكررات وتم ترتيبها فى نظام القطع المنشقة مرة واحدة .

وقد أوضحت النتائج :

١- كان التركيبين الوراثيين جيزه ٥٤-٩ وجيزه ٩٩-١٢٢ عالية التحمل للإجهاد سواء تم حساب معـــامل الحساســـية علـــى أساس محصول القصب أو محصول السكر بالإضافة إلى أن التركيب الوراثـــى جـــيزه ٢٠٠٠-٨ كـــان عالى التحمل للإجهاد عند حساب معامل الحساسية على أساس محصول السكر .

٢- فـــى موســـم النمو الأول (GS1) كان التركيبين الوراثيين جيزه ٩٩-١٢٢ وجيزه ٩٩-١٦٥ عالية التحمل للإجهاد سواء تم حساب معامل الحساسية على أساس محصول القصب أو محصول الســـكر بينما كان التركيب الوراثى جيزه-تايوان ٥٤-٩ عالى التحمل للإجهاد عند حساب معامل الحساسية على أساس محصول القصب وكان متوسط التحمل للإجهاد عند حساب معامل الحساسية على أساس محصول السكر . وكان التركيب الوراثى جيزه ٩٩-١٠٣ عالى التحمل للإجهاد عندما تـــم حساب معامل الحساسية على أساس محصول السكر وكان متوسط الحساسية عند حساب على أساس محصول القصب .

٣- فى موسم النمو الثالث (GS3) كانت التراكيب الوراثية جيزه تايون ٥٤-٩ وجيزه ٩٩-١٠٣ وجـــيزه ٩٩-١٢٢ وجيزه ٢٠٠٠-٨ وجيزه ٢٠٠٠-١٥٧ عالية التحمل للإجهاد سواء تم حساب معـــامل الحساسية على أساس محصول القصب أو محصول السكر بينما كان التركيبين الوراثيين جـــيزه ٩٩-٨٠ وجيزه ٢٠٠٠-٤ عالية التحمل للإجهاد عند حساب معامل الحساسية على أساس محصول السكر .

٤- فـــى موسم النمو الرابع (GS4) كان التركيب الوراثى جيزه ٩٩-١٦٥ عالى التحمل للإجهاد ســـواء تـــم حســـاب معامل الحساسية على أساس محصول القصب أو محصول السكر بينما كان التركيـــب الوراثى جيزه ٩٩-٨٠ عالى التحمل للإجهاد عند حساب معامل الحساسية على أساس محصول القصب .

٥- فـــى موسم النمو الخامس (GS5) كانت التراكيب الوراثية جيزه ٩٩-٨٠ وجيزه ٩٩-١٢٢ وجـــيزه ٩٩-١٦٥ عالية التحمل للإجهاد سواء تم حساب معامل الحساسية على أساس محصول القصب أو محصول السكر .

٦- فـــى موســـم النمو السادس (GS6) كان التركيبين الوراثيين جيزه ٩٩-١٢٢ وجيزه ٢٠٠٠-١٧١ عالـــية الـــتحمل للإجهاد سواء تم حساب معامل الحساسية على أساس محصول القصب أو محصـــول السكر بينما كان التركيبين الوراثيين الفلبينى ٨٠١٣ وجيزه ٢٠٠٠-١٥٧ عالية التحمل للإجهاد عند حساب معامل الحساسية على أساس محصول القصب .

وهـــذه النتائج يمكن استخدامها كمعلومات أساسية لعمل خريطة صنفية تحت ظروف مصر العليا للحصول على أعلى محصول سكر خلال موسم العصير .