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EVALUATION AND BORER SENSITIVITY OF SOME NEW EGYPTIAN PROMISING SUGAR CANE VARIETIES

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Abstract

Six new Egyptian sugar cane varieties and the main commercial one GT 54/9 were planted at El-Mattana Research Station Quena governorate during 1993, 94 and 95 as plant cane, first and second ratoon crops, respectively, to evaluate technological characters and susceptibility to borer infestation. Analysis of variance for each year and combine analysis over years revealed:

1- Wide variation in brix, sucrose % juice (Pol%), sugar% cane (Richese), sugar extraction% (Rendment), glucose ratio and purity were obsreved among varieties within and over seasons.

2- For most traits the promising varieties were better or at least equal to the commercial variety.

3- The new varieties were significantly higher in Kg sugar per ton cane (S/TC). Varieties could be arranged in descending order as follows: G 84/47, 84/68, 85/285, 85/166, 85/37 and GT 54/9.

4- Susceptibility to borer infestation (*Chilo agamemnon*) was less in plant cane than the 1st ratoon crop (mean bored joints 5.80% and 10.76% for plant cane and 1st ratoon, respectively).

5- All varieties including the commercial one suffered less than 10% bored joints in the plant cane and 1st ratoon except G 84/68, 85/231 and 85/258 in the 1st ratoon which recorded 10.68%, 15.38% and 17.22% bored joints, respectively.

INTRODUCTION

The Egyptian sugar cane breeding and selection program places considerable emphasis on producing varieties with high yielding potential high sugar content, resistance to disease and insect pests and ratoon longevity.

Brix, sucrose, purity percentages, glucose ratio, sugar% cane (Richese), sugar extraction % (Rendment) and sugar Kg/ton cane (S/TC) have received more attention in the last selection stage which known as the out field testing stage.

Varietal selection at precommerical stage is one of the major components in successful prodution of sugar cane. Although production of sugar per unit area is a very important characteristic, but it is not the only factor on which cane is evaluated the quality of cane is also important (Glaz *et al.* 1991).

Lionnet (1995) pointed out that cane quality has important effect on performance and on the quality of sugar produced, and added that to study long termternds and plan future strategies the attention being given to cane quality to wealth of information that has become available over the years.

Brix measures the total soluble solids in the juice and a high proportion of these solids consists of sucrose, the correlation is usually high enough to make brix a very useful corrolated characteristics for selection (Kang *et al.* 1983).

Hogarth (1977) reported that selection for sugar by measuring brix should be effective because brix has high degree of genetic determination and is not greatly affected by plant competition.

The sugar cane borer (*Chilo agamemnon, Blesz*) is the most destructive pest of sugar cane in Egypt (Abou Doh, 1988). This has led to increased testing in recent years to evaluate and identify superior commerial and unexplored gerplasm to breed improved borer resistant sugar can varieties.

The main objective of this study is to evaluate the technological characteristics of some new promising sugar cane varieties developed in Egypt and their resistance to the sugar cane borer under natural infestation conditions using the bored joints as the damage assesment criterion.

MATERIALS AND METHODS

The present work was carried out at El-Mattana Research Station (Quena governorate, Upper Egypt) during three successive seasons 1992/93, 1993/94 and 1994/95 as plant cane, first and second ratoon, respectively. Six promising cane varieties developed locally from Egyptian Fuzz named G 84/47, 84/68, 85/166, 85/231 and 85/258 and the standard variety GT 54/9 were used (G84/68, G85/258 and GT54/9 were biparental varieties and the others were open pollination).

Varieties were planted in a field trial in a randomized complete block design with four replications in March 20, 1992. Plot size was 42 m2 (6 ridges 7 m long and one meter apart). The package of recomended cultural practices for plant cane and ratoons were adopted uniformaly as and when needed. Harvesting was carried out on March 26, 1993, April, 3, 1994 and March, 25, 1995 for plant cane, first and second ratoon, respectively (The date of harvest considerd as the begining of the new crop of 1st and 2nd ratoon).

At harvest a sample of 25 stalks from each plot was taken randomly, stripped, cleaned, for estimating borer infestation, number of joints and tunnel joints were calculated and then the cane sample was crushed through 3 roller lab. mill and juice was analyzed according to Meade and Chen (1977) methods to calculate the following parameter:

Glucose ratio	= % reducing sugars x 100/%Sucrose in juice
Sugar % cane (Richese)	= Sucrose/100 gm juice x (100-(Fibere% cane x 1.3) + 2.5/100
Sugar extraction (Rendment)	= Sugar % cane x purity
Sugar ton cane (S/TC)kg	= Sugar extrafction % x 1000 kg cane
Bored %	= Tunneled Joints x 100/Total joints

All data were subjected to statistical analysis according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

Brix:

Significant differences were found among varieties for brix degrees. The highest brix degrees 23.27, 22.95, 22.18 and 22.80 were recorded for cane variety G 84/68 in plant cane, 1st, 2nd ratoon and pooled data over years, respectively (tables 1and 2 fig 1). Data over years Table 2 show that brix degrees of G 84/68 (22.80%) and G 84/47 (22.13%) were significantly higher than that of the commercial variety GT 54/9 (21.39). A Similar trend was also observed in plant cane, while in the 1^{st} and 2^{nd} ratoon all the new varieties had high brix values approximately equal to the commercial one except G 85/166 and G 85/231 in the 1st ratoon and G 85/166 in the 2^{nd} ratoon where brix values were significantly less. These results were supported with those of Hogarth (1977), Kang *et al.* (1983), More *et al.* (1994) and Patil *et al.* (1994) who stated that high proportion of brix consists of sucrose, the correlation is usually high enough to make brix a very use-

Table 1. Technological characteristics of some Egyptian promising sugar cane varieties.

Varieties	Birx	Apparent Sucrose in 100 cm3 juice	Apparent Purity %	Glucose ratio %	Sugar % cane	Sugar Extration %	Suger Ton cane (S/TC) kg
Plant cane 1992-93							
G 84/47	22.61 b	19.67 a	87.02 c	1.31 d	13.50 a	11.75 a	117.5 a
G 84/68	23.27 a	19.30 b	82.94 e	1.43 d	12.93 b	10.72 de	107.2 de
G 85/37	20.55 e	17.77 f	86.47 c	2.48 a	12.16 d	10.52 e	105.2 e
G 85/166	20.94 d	18.61 cd	88.86 a	2.37 ab	12.91 b	11.47 b	114.7 b
G 85/231	20.69 de	18.30 c	88.46 ab	2.13 c	12.66 c	11.18 c	111.8 c
G 85/258	20.88 d	18.37 de	87.97 b	2.57 a	12.68 c	11.15 c	111.5 c
GT 54/9	22.03 c	18.75 c	85.11 d	2.24 bc	12.73 bc	10.84 d	108.4 d
First ratoon 1993-94							
G 84/47	22.41 b	19.05 a	85.01 ab	3.78 b-d	12.93	10.99 a	109.9 a
G 84/68	22.95 a	19.30 a	84.78 bc	3.52 cd	13.02	11.04 a	110.4 a
G 85/37	21.42 c	18.03 b	84.17 c	3.79 b-d	12.17	10.25 cd	102.5 cd
G 85/166	20.44 d	17.50 c	85.64 a	4.29 a	11.92	10.21 cd	102.1 cd
G 85/231	20.61 d	17.51 c	84.96 a-c	4.03 ab	11.88	10.09 d	100.9 d
G 85/258	21.26 c	18.10 b	85.14 ab	3.48 d	12.29	10.46 b	104.6 b
GT 54/9	21.32 c	18.02 b	84.52 bc	3.84 bc	12.19	10.31 bc	103.1 bc
Second ratoon 1994-95							
G 84/47	21.39 b	17.97 b	84.02 c	2.19a	12.12 b	10.18 b	101.8 b
G 84/68	22.18 a	18.59 a	83.86 c	0.91 d	12.53 a	10.50 a	105.0 a
G 85/37	21.69 b	18.21 b	83.97 c	1.55 b	12.28 b	10.31 ab	103.1 ab
G 85/166	20.51 d	17.45 d	85.09 b	1.52 b	11.85 c	10.08 b	100.8 b
G 85/231	20.92 c	17.94 b	85.73 a	1.07 cd	12.23 b	10.48 a	104.8 a
G 85/258	20.97 c	17.81 c	84.93 b	1.34 bc	12.08 b	10.26 ab	102.6 ab
GT 54/9	20.83 c	17.39 d	83.49 c	1.43 b	11.69 c	9.76 c	97.6 c

ful correlated characteristics for selection, moreover, brix has high degree of genetic determination.

Table 2. Technological characteristics of some Egyptian promising sugar cane varieties. (combined over seasons)

Varieties	Birx	Apparent Sucrose	Apparent Purity %	Glucose ratio %	Sugar % cane	Sugar Extraction %	Sugar Ton cane (S/TC) Kg
Season (S)							
1992/93	21.57a	18.68a	86.69a	2.07b	12.80a	11.09a	110.9a
1993/94	21.49a	18.22b	84.89b	3.82a	12.34b	10.48b	104.8b
1994/95	21.21b	17.91c	84.44c	1.43c	12.11b	10.23c	102.3c
Significance	**	**	**	**	**	**	**
Varieties (V)							
G 84/47	22.13b	18.90a	85.35c	2.42c	12.85a	10.97a	109.7a
G 84/68	22.80a	19.06a	83.86f	1.95d	12.83a	10.76b	107.6b
G 85/37	21.22cd	18.00b	84.87d	2.61ab	12.20b	10.36d	103.6d
G 85/166	20.63e	17.85b	86.53a	2.73a	12.22b	10.59c	105.9c
G 85/231	20.74e	17.92b	86.38ab	2.41c	12.26b	10.58c	105.8c
G 85/258	21.04d	18.00b	86.01b	2.46bc	12.35ab	10.62c	106.2c
GT 54/9	21.39c	18.05b	84.37e	2.05bc	12.20b	10.30d	103.0d
Significance	**	**	**	**	*	**	**
Interaction							
S x V	**	**	**	**	N.S.	**	**
L.S.D.5 %	0.35	0.45	0.65	0.28	-	0.22	2.20
L.S.D. 1%	0.46	0.60	0.87	0.37	-	0.29	2.90

Sucrose % Juice, Sugar % Cane and Sugar Extraction %:

Data over three seasons (plant cane and two ratoons), Table 2, show that the G 84/47 and G 84/68 were significantly superior in sucrose % juice (Pol %), sugar % cane (Richese) and sugar extraction % (Rendment) than of G 85/37. G 85/166, G 85/231 and G 85/258 or GT 54/9 (the commercial variety). Meantime, all varieties had a higher sugar % cane and sugar extraction % than GT 54/9. A similar trend was observed in the separated years (Table 1 and Fig 1).

In general, both separate or pooled data apperantly showed the superiority of G 84/47 and G 84/68 in the three mentioned traits than the other varieties includ-

ing the commercial one. This superiority is strong evidence of the accurate selection program. These results are in harmony with those of Nayyar and Malik (1989), Rahman *et al* (1989), More *et al* (1994), Patil *et al.* (1994) who reported that differences were found in sucrose % Juice commercial cane sugar % (CCS) and sugar recovery %.

Data Tables 1 and 2 also, shows obviously that the cane varieties characterized with higher values of sucrose % juice, sugar% cane and sugar extraction % had in the same time higher brix values. These results confirm those reported by Hogarth (1977) and Kang *et al.* (1983).

Glucose ratio :

Glucose ratio is the ratio of reducing sugars % to sucrose % in juice. It is well known that there is inverse relations between the content of reducing sugars in juice and sugar extraction % during processing. Thus the loss of sucrose in molasses during processing increases significantly with the increase in reducing sugars. Therefore, in breeding and selection program varieties with minimal reducing sugars are prefered.

The differences in glucose ratio due to variety were significant in plant cane, 1st and 2nd ratoon as well as pooled data over the three years (tables 1 and 2). In this study data in Tables 1 and 2 and Fig 1 also show that the higer sugar % cane and sucrose % juice varieties the lower the glucose ratio, where cane varieties G 84/47 and G 84/68 in plant cane 1st and 2nd ratoon as well pooled data recorded the lesser values of glucose ratio as compared to other new varietie or the commercial one. These results may explain why these varieties were distinguished with higher sugar extraction %. Reducing sugars differ widely among varieties (Patil *et al.*, 1994).

Purity :

Purity is the relationship between sucrose and total soluble solids (Brix) in cane juice.

The differences in purity percentage of the different cane varieties in plant cane, 1st, 2nd ratoon and combined data over years were found significant (Tables 1 and 2). Meantime G 85/166 and G 85/231 exhibited the highest significant purity values compared with the other new varieties or the commercail one (GT 54/9).

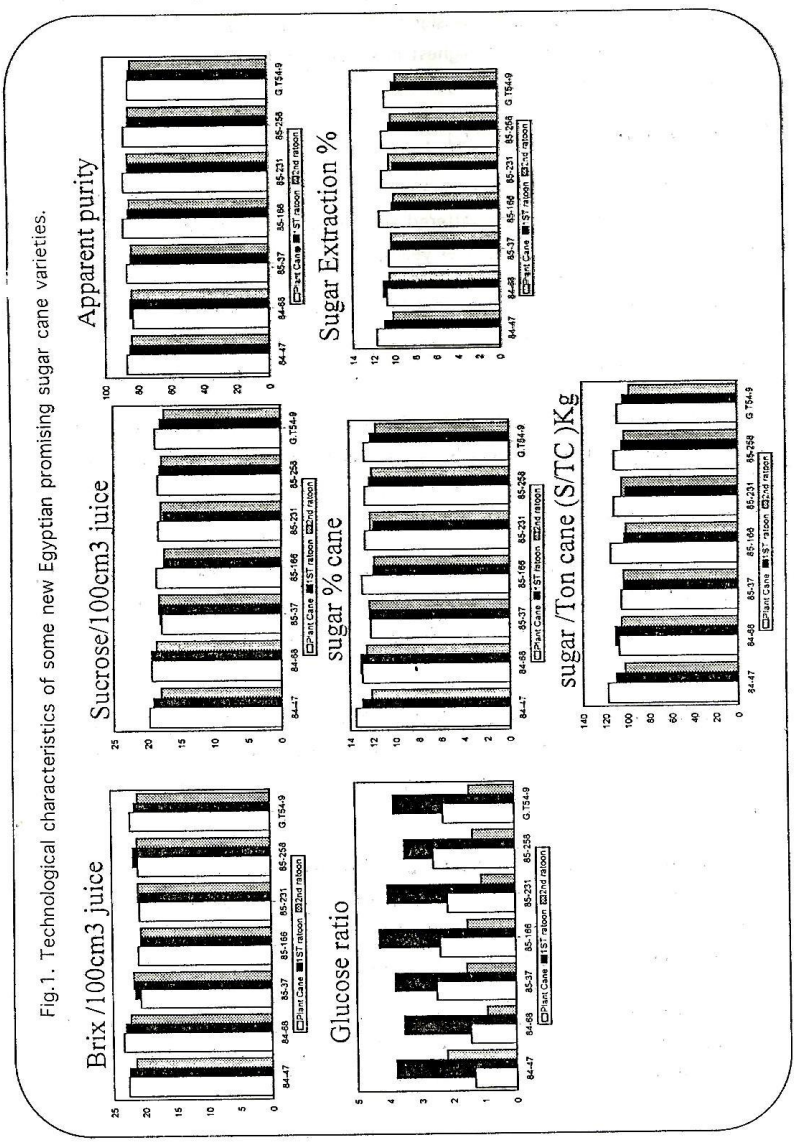

Fig.1. Technological characteristics of some new Egyptian promising sugar cane varieties.

(Tables 1 and 2 and Fig 1). It is also detected that purity of all varieties was higher than that of GT 54/9 the commercial check, except G 84/68 where its purity value in plant cane and pooled data was significantly less than GT 54/9 and this may be due to that this variety had the highest brix value. In this connection. Similar results were obtained by Patil *et al.* (1994).

Sugar yield/ton cane (S/TC) :

It is evident from the tables 1 and 2 that the mean values of sugar in kg per ton cane (S/Tc kg) significantly differed among varieties in plant cane, 1st and 2nd ratoon as well in combined data over years.

It is noted from pooled data that S/TC for the new varieties were significantly higher than that of the commercial one except G 85/37 where its S/TC was slightly higher (103.6 kg) (insignificant) than GT 54/9 the commrcial one (103 kg).

Data collected in separate years (Table 1 and Fig 1) indicate that the new varieties did not perform consistently across years. In plant cane G 85/166 (114.7 kg) and G 85/231 and G 85/258 which gave 111.8 kg and 111.5 kg, respectively, but the other varieties were less than GT 54/9.

The first ratoon G 84/68 gave the highest sugar/Ton cane of 110.4 kg followd by G 84/47 (109.9 kg) and G 85/258 (104.6 kg), while GT 54/9 (103.1 kg) was better than G 85/37, G 85/166 and G G 85/231 which recorded 102.5, 102.1 and 100.9 kg respectively.

Regarding the second ratoon, G 84/68, G 85/231, G 85/37 and G 85/258 gave the highest (insignificant difference) sugar/Ton cane which recorded 105.0, 104.8, 103.1 and 102.6 kg as compared to the commercial variety GT 54/9 (97.6 kg).

To sum up, maximization of sugar per cane weight unit and hence per unit area under a given environment will depend not only upon the genotype but upon many other conditions of higher productivity (Nayyar and Malik, 1989; Rahman *et al.*, 1990; More *et al.*, 1994 and Patil *et al.* 1994).

The superiority of some cane varieties in sugar /Ton cane might have resulted from better quality performance in terms of higher sugar% cane, sugar% juice and sugar extration% and lower glucose ratio as mentioned before.

With regards to the effect of years and years x varieties interaction on the technological characters (Table 2). Data from the combined variance analysis show that years and years x varieties interaction significantly affected all the measured traits indicating that the used cane varieties did not perform consistently across years. The high quailty traits were recorded in plant cane followed by the 1st and 2nd ratoon in descending order. Singh *et al.* (1983) reported highly significant differences between twelve varieties of sugar cane (*Saccharum* Spp.) planted over two years and three locations to measure the stability parameters of five qualitative chracters. Environmental as well as variety x environmental interaction played a significant role in determining these characters.

Borer infestation :

Resistance to the sugar cane borer was evaluated by comparing the, damage caused by borer expressed as the percentage of bored joints. Based on this criterion, differences in average percentage of bored joints among varieties were significant in both plant cane and 1st ratoon. Bored joints ranged from 4.15% to 8.13 and from 6.4% to 17.22% in plant cane and 1st ratoon, respectively (Table 3). Cane variety G 85/258 gave the highest bored joints% (rank 2) in both plant cane and 1st ratoon while, G 84/68 and G 85/166 (rank 7) gave the lowest bored joints in plant cane and 1st ratoon, respectively (Table 3).

Table 3. Mean percentage of *Chilo agamemnon* infestation (bored joints %).

Varieties	Plant cane (1992/93)	Rank	1st Ratoon (1993/94)	Rank
	Bored joints %		Bored joints %	
G 84/47	5.11c	5	8.46c	5
G 84/68	4.15 c	7	10.68 b	3
G 85/37	5.83 bc	3	9.37 bc	4
G 85/166	4.64 c	6	6.40 d	7
G 85/231	7.22 ab	2	15.38 a	2
G 85/258	8.13 a	1	17.22 a	1
GT 54/9	5.49 c	4	7.80 cd	6
Mean	5.80		10.76	

It is worth mentioning that, the susceptibility of the new varieties was less in plant cane than those of 1st ratoon where the average bored joints recorded 5.80% and 10.76% for plant cane and 1st ratoon, respectively (Table 3). Data also clearly showed that in plant cane varieties suffered less than 10% bored joints (minimum losses in sugar yield). In the 1st ratoon, this is true for G 84/47, G 85/37, G 85/166, as well as G T 54/9 the commercial variety. Gaber and Rashwan (1990) stated that the meterorological factors such as temperature and humidity were responsible for borer population density.

The obtained results are in line with those of Macede *et al* (1977), Mesbah *et al* (1987) and Gaber and Rashwan (1990) who found that sugar cane varieties differ widely in their susceptibility to borers infestation during different seasons.

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تقييم بعض أصناف قصب السكر المصرية الجديدة

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معهد بحوث المحاصيل السكرية – مركز البحوث الزراعية – الجيزة – مصر .

تحت الظروف المصرية امكن بنجاح اقامة برنامج تربية مثمر لقصب السكر وكان نتيجة لذلك انتاج عديد من الاصناف الاكثر موائمة للظروف الانتاجية المصرية. لذلك اجريت هذه الدراسة فى تجربة حقلية وباستخدام تصميم القطاعات الكاملة العشوائية بمحطة البحوث الزراعية بالمطاعنة محافظة قنا (التى تزرع أكثر من ٥٠٪ من اجمالى مساحة القصب) وذلك خلال المواسم الزراعية ٩٢ / ١٩٩٣ ، ٩٣ / ١٩٩٤ و ٩٤ / ١٩٩٥ محصول غرس وخلفة أولى وثانية لتقييم صفات الجودة التكنولوجية ودرجة المقاومة للثاقبات لستة أصناف قصب جديدة هى جيزة ٨٤ / ٤٧ ، ٨٤ / ٦٨ ، ٨٥ / ١٦٦، ٨٥ / ٢٣١ ، ٨٥ / ٢٥٨ والصنف التجارى جيزة تايوان ٩/٥٤ (س٩) كصنف مقارنة. وقد تم التحليل الأحصائى لكل موسم على حده ثم أجرى تحليل تجميعى للمواسم الثلاثة معا وتوضح النتائج مايلى:

١ – وجدت أختلافات واضحة بين الأصناف فى صفات الجودة التكنولوجية (البركس٪ – السكر فى العصير (البول) السكر ٪ قصب (الحلاوة) السكر المستخلص ٪ (ناتج السكر) معامل الجلوكوز و النقاوة ٪) فى محصول الغرس أو الخلفات أو البيانات التجميعية.

٢ – تفوقت الأصناف الستة الجديدة وبعضها تساوى مع الصنف التجارى المقارنة فى معظم صفات الجودة التكنولوجية المقاسة.

٣ – جميع الأصناف المستخدمة أظهرت تفوقا على صنف المقارنة فى صفة محصول السكر كيلو جرام/طن قصب ويمكن ترتيب الأصناف تنازليا كما يلى : ٤٧/٨٤ ، ٦٨/٨٤ ، /٢٥٨ ٨٥ ، ٢٣١/٨٥ ، ١٦٦/٨٥ ، ٣٧/٨٥ وجيزة تايوان ٩/٥٤ .

٤ – أظهرت الأصناف المستخدمة حساسية أقل للإصابة بالثاقبة (*Chilo agamemnon*) فى محصول الغرس (عدد السلاميات المصابة ٥,٨٪) عن محصول الخلفة الاولى (١٠,٧٦ ٪).

٥ – جميع الأصناف فى محصول الغرس وبعضا منها فى الخلفة الأولى كانت عدد السلاميات المصابة منها أقل من ١٠ ٪ (الحد الاقتصادى الضار) فيما عدا الأصناف جيزة ٦٨/٨٤ ، ٢٣١/٨٥، ٢٥٨/٨٥، فى محصول الخلفة الأولى حيث سجلت عدد السلاميات المصابة بالثاقبات فيها ١٠,٦٨ ، ١٥,٣٨، ١٧,٢٢٪ على الترتيب.