

EVALUATION OF SOME EXOTIC SORGHUM LINES FOR THEIR RESISTANCE TO *SESAMIA CRETICA* LED. INFESTATION AND YIELDING POTENTIAL

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Abstract

The objective of the present study was to evaluate 13 exotic sorghum lines and Dorado (check variety) for their resistance to infestation by the pink stem borer *Sesamia cretica* under natural and artificial infestation and yielding potential during 2010 and 2011 seasons. The results revealed that two lines (ICSR-92003 and ICSB-88005) were resistant to *S. cretica* under natural infestation and one line (ICSR-92003) was under artificial infestation. Line ICSR-92003 possessed high resistance to this insect (18.62% infested plants and 3.39% dead hearts) with high yielding potential (24.08 ardab/feddans), followed by line ICSV-273 possessed moderate resistance to this insect (26.60% infested plants and 7.81% dead hearts) with high yielding (23.14 ardab/feddans). The tallest line was ICSV-273 (207cm), while earliest flowering lines (days to 50% heading) were BTX2-1, BTX409, BTXTSC20, ICSB-88015 and ICSR-92003 (70, 70, 70.5, 71 and 71 days, respectively). The heaviest grains was obtained from lines ICSR-93004, ICSR-93001 and ICSR-92003 (38.98, 37.62 and 36.88 gm, respectively). The correlation coefficient between plant infestation percentage of *S. cretica* and yield was negative significant (-0.5363*) and between dead hearts percentage of this insect and yield was negative significant (-0.6034*). Line ICSR-92003 proved high resistance to *S. cretica* and high potentiality, while lines ICSV-273 and ICSR-93001 showed moderate resistance to this insect and relatively high potentiality.

INTRODUCTION

Grain sorghum (*Sorghum bicolor* (L.) Moench) grows in about 350 to 400 thousand feddans in Middle and Upper Egypt. It was cultivated for a long time ago for bread making and recently for many other purposes such as green forage or grains for feeding cattles and livestock and as row material for industries.

The pink stem borer *Sesamia cretica* Led. is the most important pest of sorghum in Egypt. It is widely spread all over the country and attacks also other crops such as maize and sugarcane. It attacks young sorghum plants shortly after emergence devours the whorl leaves and may kill the growing plants, causing dead heart symptoms. It is also capable of infesting older plants showing leaf feeding

symptoms and occasionally making excavating tunnels into the stems (Tantawi *et. al.*, 1984, Tantawi *et. al.*, 1991 a&b, Al-Naggar *et. al.*, 2000 a&b, and El-Saadany *et. al.*, 2000). Yield losses by this insect pest are mainly attributed to the decrease in number of plants per unit area at harvest because of the large number of dead hearts, increase in plant lodging causing head drops and predisposing infested plants to disease organisms. The optimal method of controlling this insect is through host-plant resistance. This method does not increase cost, does not require special equipment and does not cause environmental pollution (Tantawi *et. al.*, 1984, Leuschner *et. al.*, 1985, Rana *et. al.*, 1985, Sechu-Reddy, 1985, Srivastava, 1985, Taneja *et. al.*, 1987, Tantawi *et. al.*, 1991 a and El-Serwy and Saba, 1993).

The present work aims for screening thirteen sorghum lines and Dorado (check variety) for their resistance to infestation by the pink stem borer *S. cretica* (under natural and artificial infestation conditions) and yielding potential.

MATERIALS AND METHODS

Field experiments were conducted at Sids Agricultural Research Station, Beni-Sweif Governorate during two sorghum growing seasons (2010 and 2011).

Thirteen lines of sorghum and Dorado (check variety) were obtained from sorghum Research Department, Field Crops Research Institute (FCRI), ARC and used in this study (Table 1).

Table 1. Sorghum lines tested .

Entry No.	Name and pedigree	Grain color	Origin	Entry No.	Name and pedigree	Grain color	Origin
1	BTX2-1	Yellow	Texas (USA)	8	ICSR-92003	Yellow	ICRISAT (India)
2	BTX409	Yellow	Texas (USA)	9	ICSR-93001	Yellow	ICRISAT (India)
3	BTX631	White	Texas (USA)	10	ICSR-93002	Yellow	ICRISAT (India)
4	BTXTSC20	Yellow	Texas (USA)	11	ICSR-93004	Yellow	ICRISAT (India)
5	ICSB-37	Yellow	ICRISAT(India)	12	ICSV-273	Yellow	ICRISAT (India)
6	ICSB 88005	Yellow	ICRISAT(India)	13	88V1080	Yellow	Texas (USA)
7	ICSB 88015	Yellow	ICRISAT(India)	14	Dorado(check variety)	Yellow	Nebraska (USA)

Two field evaluation experiments were carried out. One was conducted under natural infestation of the pink stem borer *S. cretica* during two seasons (2010 and 2011) and the other one was conducted under artificial infestation conditions during 2011 season.

The grains were sown on 30-6-2010 and 28-6-2011 for natural infestation and sown on 30-5-2011 for artificial infestation conditions. The randomized complete blocks design (RCBD) with three replicates was used. The experimental plot was four rows of 6m length and 60 cm width, with a distance of 20cm between hills and two plants per hill. No pest control was carried out in both years.

Ten plants from each plot were artificially infested with newly hatched larvae of *S. cretica* produced from Corn Borer Research Lab (CBRL), Maize Research Section, ARC, Giza, Egypt. Each plant received 8 neonate larvae of the pink stem borer which were mixed with maize cob grits and placed into the whorl of the plants (20 days ago from planting date) using the Bazooka as mechanical dispenser (according to Mihm, 1982). Two shots of Bazooka were used on each plant; each shot delivered 4 larvae.

Data recorded:

In the field under natural infestation:

The following traits were measured after 30 and 45 days from planting date.

1- Percentage of infested plants (IP%) as follows:

$$IP\% = \frac{\text{No. of infested plants / plot}}{\text{Total No. of plants / plot}} \times 100$$

Lines were classified according to their mean IP% into: resistance (Less than 35%), moderately resistance (35% to less than 70%) and susceptible (70% or above) according to Al-Naggar *et al* (2000b).

2- Percentage of dead hearts (DH%) as follows:

$$DH\% = \frac{\text{No. of dead hearts / plot}}{\text{Total No. of plants / plot}} \times 100$$

Lines were classified according to their mean DH% into : resistance (less than 7%), moderately resistance (7% to less than 15%) and susceptible (15% or more) according to Al-Naggar *et al* (2000b).

In the field under artificial infestation:

The following traits were measured after 15 days from artificial infestation.

1- Percentage of infested plants (IP%) as follows:

$$IP\% = \frac{\text{No. of infested plants / plot}}{\text{No. of artificially infested plants / plot}} \times 100$$

Lines were classified according to their mean IP% as the same ranks mentioned before , according to Al-Naggar *et al* (2000a).

2- Percentage of dead hearts (DH%) as follows:

$$DH\% = \frac{\text{No. of dead hearts / plot}}{\text{No. of artificially infested plants / plot}} \times 100$$

Lines were classified according to their mean DH% as mentioned before , according to Al-Naggar *et al*/(2000a).

As for the agronomic characters, plant height (cm), days needed for 50% heading, 1000-grain weight (gm) and grain yield per feddan (ardab) were also recorded.

The data were statistically analyzed according to Snedecor and Cochran (1981) and treatment means were compared by the least significant difference (L.S.D) at 5% level of probability.

RESULTS AND DISCUSSION

1- Field evaluation of sorghum lines resistance to *S. cretica* under natural infestation and yielding potential:

a- Means of attributes expressing resistance to *S. cretica*:

The obtained results for each of the thirteen exotic sorghum lines and Dorado (check variety) under natural infestation during 2010 and 2011 seasons and combined across the two years are presented in Tables (2 and 4).

a.1- Infested plants (IP):

The combined data across the two years indicated that, ten resistance lines were detected (ICSR-92003, ICSB-88005, ICSR-93004, ICSV-273, ICSR-93001, BTX409, BTX631, BTX2-1, ICSR-93002 and ICSB-37) with an average of (18.62, 24.13, 25.93, 26.60, 27.18, 29.47, 29.61, 31.10, 31.43 and 32.84%, respectively) and three moderately resistant lines (BTXTSC20, ICSB-88015 and 88V1080) with an average of (41.70, 47.68 and 53.37%, respectively) and also, the variety Dorado was moderately resistance with an average of 40.59%.

a.2- Dead hearts (DH):

Combined data across the two in the same table showed that, DH average across the two years ranged from 3.39% for ICSR-92003 to 20.85% for 88V1080. Combined data showed also that, two lines (ICSR-92003 and ICSB-88005) with an average of 3.39 and 6.39%, respectively, were considered as resistant to *S. cretica*, eight lines and Dorado variety were moderately resistant (ICSR-93004, ICSR-93001, ICSV-273, BTX2-1, BTX631, ICSR-93002, BTX409, ICSB-37 and Dorado variety) with an average of 7.42, 7.50, 7.81, 7.93, 8.90, 9.42, 11.25, 12.08 and 12.10%, respectively and three lines were susceptible lines (BTXTSC20, ICSB-88015 and 88V1080) with dead hearts average of 16.51, 20.46 and 20.85%, respectively.

b- Yield and yield components:

The performance of the lines evaluated in the two successive growing seasons and the combined analysis are presented in Tables 3 and 4. There were significant differences among the lines in all characters.

The tallest line was ICSV-273 (207cm) followed by ICSR-92003 and ICSR-93002 (170.8 and 170.0 cm, respectively). While earliest flowering lines (days to 50% heading) were BTX2-1 and BTX409 (70 days), followed by BTXTSC20 (70.5 days), ICSB-88015 and ICSR-92003 (71 days). 1000-grain weight, lines ICSR-93004, ICSR-93001, ICSR-92003 and ICSR-93002 were 38.98, 37.62, 36.88 and 35.58gm, respectively. These lines produced significantly heavier grains compared with the check variety (Dorado with 31.55gm). The results grain yield showed that lines ICSR-92003 and ICSV-273 had the first rank in this respect (24.08 and 23.14 ardab/fed., respectively) followed by lines ICSR-93001, ICSR-93004 and ICSR-93002 being 20.53, 19.72 and 18.09 ardab/fed., respectively. While the check variety produced 17.09 ardab/fed. These results are in agreement with those obtained by Latif (1999), Mourad *et al* (1999) and Mourad and Anton (2007).

2- Field evaluation of sorghum lines resistance to infestation by *S. cretica* under artificial infestation:

2.1- Infested plants (IP):

Data in Table (5) showed that, one resistance line (ICSR-92003) with an average of 32.67% infested plants, nine moderately resistant lines (ICSB-88005, ICSR-93004, ICSV-273, ICSR-93001, BTX2-1, BTX409, ICSR-93002, BTX631 and ICSB-37) with an average of (46.84, 47.00, 48.33, 51.67, 53.10, 58.33, 62.67, 63.00 and 63.33%, respectively) and four susceptible lines (Dorado, BTXTSC20, 88V1080 and ICSB-88015) with an infestation average of (71.67, 72.50, 72.67 and 76.00%, respectively).

2.2- Dead hearts (DH):

The results in Table (5) indicated that, one resistance line (ICSR-92003) with an average of 6.00%, four moderately resistant lines (ICSR-93004, ICSR-93001, ICSB-88005 and ICSV-273) with an average of (12.67, 13.33, 14.33 and 14.67%, respectively) and eight susceptibility lines (BTX2-1, BTX631, BTX409, ICSR-93002, ICSB-37, BTXTS20, ICSB-88015 and 88V1080) with an average of (18.33, 20.00, 20.67, 23.33, 25.00, 35.47, 40.00 and 46.67%, respectively) and also, the variety Dorado was susceptible with an average of 26.67%. Al-Naggar *et. al.*, 2000 a recorded maize genotypic differences resistance to the pink stem borer *S. cretica* under artificial infestation.

A short glance to the data in Table (4) reveals that, the correlation coefficient between infested plant percentage of *S. cretica* and yield was negative significant (-0.5363*). Also, the correlation coefficient between dead hearts percentage for this insect and yield was negative significant (-0.6034*). One line ICSR-92003 proved high resistance to *S. cretica* and at the same time higher grain yield (24.08 ardab/fed.) and two lines ICSV-273 and ICSR-93001 proved moderate resistance to this insect and relatively high grain yield (23.14 and 20.53 ardab/fed., respectively).

Table 2. Average of infested plants (IP) and dead hearts (DH) percentages under natural infestation with *S. cretica* during two successive growing seasons (2010 – 2011) and the combined analysis.

Entry No.	Lines name	IP						DH					
		2010		2011		Combined		2010		2011		Combined	
		%	Reaction	%	Reaction	%	Reaction	%	Reaction	%	Reaction	%	Reaction
1	BTX2-1	31.91d	R	30.28def	R	31.10d	R	8.34cde	M	7.51bcd	M	7.93cde	M
2	BTX409	27.83de	R	31.11cdef	R	29.47de	R	11.39cd	M	11.11abc	M	11.25cd	M
3	BTX631	30.84d	R	28.38ef	R	29.61de	R	8.96cde	M	8.83bcd	M	8.90cd	M
4	BTXTSC20	44.04bc	M	39.35bcd	M	41.70b	M	17.61ab	S	15.40ab	S	16.51ab	S
5	ICSB-37	30.58d	R	35.10bcde	M	32.84cd	R	12.60bc	M	11.56abc	M	12.08bc	M
6	ICSB-88005	26.23de	R	22.03fg	R	24.13ef	R	6.50de	R	6.28bcd	R	6.39de	R
7	ICSB-88015	51.19ab	M	44.17ab	M	47.68ab	M	21.38a	S	19.53a	S	20.46a	S
8	ICSR-92003	21.14e	R	16.10g	R	18.62f	R	5.38e	R	1.39d	R	3.39e	R
9	ICSR-93001	28.63de	R	25.72efg	R	27.18def	R	8.71cde	M	6.29cd	R	7.50cde	M
10	ICSR-93002	31.48d	R	31.38cdef	R	31.43de	R	10.11cde	M	8.72bcd	M	9.42cd	M
11	ICSR-93004	24.63de	R	27.22ef	R	25.93def	R	8.31cde	M	6.53bcd	R	7.42cde	M
12	ICSV-273	27.29de	R	25.91efg	R	26.60def	R	8.10cde	M	7.52bcd	M	7.81cde	M
13	88V1080	56.16a	M	50.58a	M	53.37a	M	22.05a	S	19.65a	S	20.85a	S
14	Dorado	40.81c	M	40.37bc	M	40.59bc	M	12.27bc	M	11.93abc	M	12.10bc	M
LSD 0.05%		7.68	-	9.85	-	8.70	-	5.51	-	8.94	-	5.13	-

R= resistant M= moderate S= susceptible

Means followed by the same letter (s) in each column within each treatment are not significant.

Table 3. Performance of thirteen exotic sorghum lines and Dorado (check variety) during two seasons (2010 – 2011) and the combined analysis.

Entry No.	Lines name	Plant height (cm)			Days to 50% heading			1000-grain Wt (gm)			Yield / fed. (ardab)*		
		2010	2011	Combined	2010	2011	Combined	2010	2011	Combined	2010	2011	Combined
1	BTX2-1	115.0e	125.0d	120.0f	70c	70bc	70e	29.07def	27.91cd	28.49def	10.57f	9.82efg	10.20gh
2	BTX409	127.3de	131.7d	129.5def	71bc	69c	70e	32.77cde	26.43d	29.60cde	12.63ef	8.18gh	10.40gh
3	BTX631	125.0de	130.0d	127.5ef	75abc	73a	74abc	33.33cd	28.22cd	30.78cd	19.81bcd	9.70fg	14.76ef
4	BTXTSC20	148.3bc	136.7cd	142.5cde	71bc	70bc	70.5de	35.36bcd	27.19d	31.28c	10.38f	6.50h	8.44h
5	ICSB-37	126.7d	128.3d	127.5ef	77ab	74a	75.5ab	26.38f	25.79d	26.09fg	12.75ef	12.22de	12.49fg
6	ICSB-88005	145.0bcd	153.3bcd	149.2bcde	79a	74a	76.5ab	28.44ef	21.15e	24.80g	14.00def	11.00ef	12.50fg
7	ICSB-88015	158.3bc	150.0bcd	154.2bc	72bc	70bc	71cde	26.40f	26.24d	26.32fg	10.23f	7.02h	8.63h
8	ICSR-92003	165.0bc	176.7ab	170.8b	71bc	71abc	71cde	40.69a	33.06ab	36.88ab	27.32a	20.84a	24.08a
9	ICSR-93001	160.0bc	156.7bcd	158.3bc	74abc	73ab	73.5bcd	40.83a	34.40ab	37.62ab	22.01abc	19.05ab	20.53bc
10	ICSR-93002	173.3b	166.7bc	170.0b	75abc	71abc	73bcde	38.94ab	32.22b	35.58b	18.00cde	18.17b	18.09cd
11	ICSR-93004	148.3bcd	141.7cd	145.0cde	77ab	73ab	75ab	42.43a	35.52a	38.98a	20.99abc	18.45ab	19.72cd
12	ICSV-273	210.7a	203.3a	207.0a	79a	73ab	76ab	28.44ef	27.05d	27.75ef	25.88ab	20.39ab	23.14ab
13	88V1080	138.3cde	145.0bcd	141.7cdef	80a	74a	77a	26.07f	25.76d	25.92fg	13.85def	14.96c	14.41ef
14	Dorado	148.3bcd	149.0bcd	148.7cd	76abc	73ab	74.5ab	32.71cde	30.38bc	31.55c	19.89bcd	14.28cd	17.09de
LSD 0.05%		28.92	33.76	21.80	6.50	3.09	3.31	4.75	3.19	2.79	6.50	2.51	3.41

Means followed by the same letter (s) in each column within each treatment are not significant.

* Fed. = 4200 m² Ardab = 140 kg.

Table 4. Relationship between sorghum lines infestation with *S. cretica* and yield (Combined).

Entry No.	Lines name	Infestation with <i>S. cretica</i>				Yield/Fed. (ardab)*
		Infested plant		Dead hearts		
		%	Reaction	%	Reaction	
1	BTX2-1	31.10d	R	7.93cde	M	10.20gh
2	BTX409	29.47de	R	11.25cd	M	10.40gh
3	BTX631	29.61de	R	8.90cd	M	14.76ef
4	BTXTSC20	41.70b	M	16.51ab	S	8.44h
5	ICSB-37	32.84cd	R	12.08bc	M	12.49fg
6	ICSB-88005	24.13ef	R	6.39de	R	12.50fg
7	ICSB-88015	47.68ab	M	20.46a	S	8.63h
8	ICSR-92003	18.62f	R	3.39e	R	24.08a
9	ICSR-93001	27.18def	R	7.50cde	M	20.53bc
10	ICSR-93002	31.43de	R	9.42cd	M	18.09cd
11	ICSR-93004	25.93def	R	7.42cde	M	19.72cd
12	ICSV-273	26.60def	R	7.81cde	M	23.14ab
13	88V1080	53.37a	M	20.85a	S	14.41ef
14	Dorado	40.59bc	M	12.10bc	M	17.09de
LSD 0.05%		8.70	-	5.13	-	3.41
Correlation coefficient between Infested plant % and yield						-0.5363*
Correlation coefficient between Dead hearts % and yield						-0.6034*

R = resistant M= moderate S = susceptible

Means followed by the same letter (s) in each column within each treatment are not significant.

* Fed. = 4200 m² Ardab = 140 kg.

Table 5. Average infested plants and dead hearts percentages for thirteen sorghum lines and Dorado as a check variety under artificial infestation with *S. cretica* in 2011 season.

Entry No.	Lines name	Infestation with <i>S. cretica</i>			
		Infested plant		Dead hearts	
		%	Reaction	%	Reaction
1	BTX2-1	53.10cd	M	18.33de	S
2	BTX409	58.33cd	M	20.67de	S
3	BTX631	63.00bc	M	20.00de	S
4	BTXTSC20	72.50ab	S	35.47bc	S
5	ICSB-37	63.33bc	M	25.00cd	S
6	ICSB-88005	46.84de	M	14.33ef	M
7	ICSB-88015	76.00a	S	40.00ab	S
8	ICSR-92003	32.67f	R	6.00f	R
9	ICSR-93001	51.67cd	M	13.33ef	M
10	ICSR-93002	62.67bc	M	23.33de	S
11	ICSR-93004	47.00de	M	12.67ef	M
12	ICSV-273	48.33de	M	14.67ef	M
13	88V1080	72.67ab	S	46.67a	S
14	Dorado	71.67ab	S	26.67cd	S
LSD 0.05%		12.65	-	11.04	-

R = resistant

M= moderate

S = susceptible

Means followed by the same letter (s) in each column within each treatment are not significant.

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تقييم بعض السلالات المستوردة للذرة الرفيعة للمقاومة للإصابة بحشرة دودة القصب الكبيرة وكمية المحصول

أحمد الرفاعي عبد العظيم أحمد مراد 1 ، عادل محمد الراوي 2

- 1- قسم الذرة الرفيعة - معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية - جيزة - مصر .
2- معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي - جيزة - مصر .

تهدف الدراسة الحالية إلى تقييم ثلاثة عشر سلالة مستوردة للذرة الرفيعة بالمقارنة بالصنف التجاري دورادو من حيث مقاومتها لحشرة دودة القصب الكبيرة تحت ظروف العدوى الطبيعية والصناعية وكذلك المحصول خلال موسمي 2010، 2011.

بينت النتائج المتحصل عليها أن السلالتين ICSR-92003, ICSB-88005 كانتا مقاومتين لدودة القصب الكبيرة تحت ظروف العدوى الطبيعية وأن السلالة ICSR-92003 كانت مقاومة لهذه الحشرة تحت ظروف العدوى الصناعية. أظهرت السلالة ICSR-92003 مقاومة عالية لدودة القصب الكبيرة (18.62% نباتات مصابة و 3.39% قلوب ميتة) وكذلك تفوقت من حيث محصول الحبوب (24.08 أردب/فدان) بالمقارنة بالصنف التجاري (Dorado)، في حين أظهرت السلالة ICSV-273 مقاومة متوسطة لهذه الحشرة (26.60% نباتات مصابة و 7.81% قلوب ميتة) وكذلك تفوقت من حيث محصول الحبوب (23.14 أردب/فدان) بالمقارنة بالصنف التجاري.

كانت السلالة ICSV-273 الأعلى طولاً (207سم) بينما أبكر السلالات تزهيراً (لإحتياجها عدد أيام لتزهير 50% من النباتات) كانت ICSR-92003, ICSB-88015, BTXTSC20, BTX409, BTX2-1 (70، 70.5، 71، 71 يوم بالترتيب) وأن أعلى وزن للألف حبة جاء من السلالات-ICSR-93004, ICSR-93001, ICSR-92003, (36.88، 37.62، 38.98 جرام بالترتيب).

كما أظهرت النتائج وجود ارتباط معنوي سالب (-0.5363*) بين النسبة المئوية للإصابة بدودة القصب الكبيرة والمحصول وكذلك ارتباط معنوي سالب (-0.6034*) بين القلوب الميتة الناتجة عن الإصابة بدودة القصب الكبيرة والمحصول.

بهذا يمكن الإشارة إلى أن السلالة ICSR-92003 أظهرت مقاومة عالية لحشرة دودة القصب الكبيرة وكذلك أعطت أعلى محصولاً في حين أظهرت السلالتين ICSV-273, ICSR-93001 مقاومة متوسطة لهذه الحشرة وأعطت محصولاً عاليا نسبياً.