GENETIC ANALYSIS OF AGRONOMIC CHARACTERS AND RESISTANCE TO BORER FOR GENOTYPES IN CORN

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ABSTRACT

A half diallel cross between 9 inbred lines of maize (*Zea mays* L.) was evaluated under two environments (under artificial infestation conditions and normal conditions.) in RCBD with three replications. Highly significant genotypes, parents and crosses were detected for the borer traits. General and specific combining (GCA and SCA) were found to be significant for all studied traits. Additive gene effects seems to play an important role in the expression of percentage of infested plants by pink stem borer, dead hearts %, intensity of damage, yield losses and grain yield/ plant at infestation and non infestation, where the ratio of GCA/SCA found to be more than unity for all traits.

The parental inbred line number 6 showed the best combiner lines for percentage of resistance to infested plants and resistance to damage caused by *S. cretica*. Also, it considered as good combiner for grain yield/ plant under infestation and non infestation conditions.

The most desirable inter and intra allelic interactions were presented by combinations: P_1xP_3, P_1xP_4, P_1xP_5, P_2xP_3 and P_5xP_6 for infested plant%, P_1xP_5, P_1xP_8, P_2xP_7, P_2xP_9, P_3xP_5, P_4xP_7, P_5xP_6, P_5xP_7, P_7xP_8 and P_8xP_9 for dead heart%; P_1xP_3, P_1xP_4, P_1xP_5, P_1xP_8, P_1xP_9, P_2xP_3, P_2xP_7, P_3xP_5, P_4xP_7, P_4xP_9, P_5xP_6, P_5xP_7, P_7xP_8 and , P_8xP_9 for intensity of damage and P_8xP_9 for grain yield/ plant at infestation and P_1xP_6, P_1xP_7, P_2xP_3, P_2xP_6, P_3xP_5, P_3xP_9, P_4xP_8 , P_4xP_9, P_5xP_7, P_6xP_8, P_7xP_9 and P_8xP_9 for grain yield/ plant at non infestation.

INTRODUCTION

In Egypt, maize plants are severely attacked by different species of Lepidoptera pests, referred to as corn borers. The corn borers attacking maize in Egypt are; the pink stem borer Sesamia cretica Led. (Noctuidae), the European corn borer

(ECB) *Ostrinia nubilalis* Hubn (pyroustidae) and the purple-lined corn borer *Chilo Agamemnon* Bles. (Crambidae). *Sesamia cretica*, the most prevalent corn borer in Egypt attacks young maize plants after emergence, causing death of these plants (dead hearts) and its capable of damaging older plants causing drastic yield losses **(Simeada, 1985).** These losses are mainly attributed to the decrease in number of plants per unit area (Stand) at harvest because of the large number of dead hearts, increase in plant lodging, ear drops and predisposing infested plants to disease organisms.

One of the most important methods for controlling insect pests in the context of integrated pest control is to grow insect-resistant cultivars **(Ortega *et al*., 1980 and Pathak 1991).** The first step in designing an efficient breeding program for resistance to a certain insect are to identify sources of resistance and to determine how plant behavior under insect attack is transmitted from the original parents to the improved cultivars **(Pathak and Othieno 1992).** Considerable efforts have been devoted to identifying and developing corn germplasm with resistance to damage by the pink stem borer *Sesamia cretica* **(Al-Naggar *et al*., 2000 ; Saafan, 2003 and Soliman, 2003).** Many F_1 crosses exhibiting significant heterosis values for resistance to *Sesamia cretica* were identified by some investigators, suggesting superiority of heterozygotes over homozygotes in this regard **(Al-Naggar *et al*., 2000 and Saafan, 2003).** It has been reported that both additive and non-additive gene action are responsible for the inheritance of resistance to *Sesamia nonagrioides* and *Ostrinia nubilalis* **(Velasco *et al*., 2002). Scott *et al*., (1967) and Sadehdel *et al*., (1983)** showed that the magnitude of non-additive was greater than that of additive gene action in controlling maize resistance to the second generation of European corn borer (ECB). On the other hand, general combining ability (GCA) was more important than specific (SCA) in the inheritance of resistance to *Sesamia spp.* **(Tususz and Koe, 1995)**; *Ostrinia nubilalis* **(Metawi, 1996);** Fall armyworm and southwestern corn borer **(Williams *et al.*, 1997b);** Asian corn borer **(Shieh *et al*., 1999);** Southwestern corn borer **(Williams *et al*., 2002)** and African stalk borer **(Andre *et al*., 2003).** The objectives of this work were to estimate GCA and SCA effects and identify superior genotypes resistance to *S. cretica* in maize and high yielding ability.

It is hoped that the present study may help maize breeders to produce new hybrid varieties having higher yielding potential.

MATERIALS AND METHODS

The experimental work of this study was carried out at the Experimental Research Station of Moshtohor, Benha University, Qalyubiya Governorate, Egypt during the two successive seasons 2009 and 2010.

A total of nine (*Zea mays* L.) inbred lines varying in the resistance to corn borer were used to establish the experiment materials for several characters among inbred lines under study. These lines were selected on showing clear differences in their reaction to corn borer *Sesamia cretica* and other desirable plant aspects. The plant materials were selected with a wide range of diversity for several traits. The designation, pedigree and origin of these inbred lines are presented in table (1).

Table (1): The Designation, pedigree and origin of the studied nine inbred lines.

Designation	Pedigree	Origin
P_1	TL07A-1903-144	Mexico
P_2	TL07A-1903-145	Mexico
P_3	TL07A-1903-146	Mexico
P_4	TL07A-1903-166	Mexico
P_5	TL07A-1903-167	Mexico
P_6	TL07A-1903-238	Mexico
P_7	TL07A-1903-141	Mexico
P_8	203	Produced by Prof. Dr Ali EL- Hosary in Egypt
P_9	TL05B-6903-144	Mexico

In the first early summer season 2009, seeds of the nine inbred lines were split planted in 1st, 10th and 20th May to avoid differences in flowering time and to secure enough hybrid seed. All possible cross combinations without reciprocals were made between the nine inbred lines by hand method giving a total of 36 crosses seeds.

In the second summer, season 2010, two experiments were undertaken in two environments (under artificial infestation conditions and normal conditions.) at the Agricultural Research and Experimental Station of the Fac. of Agric., Moshtohor. Each experiment included the nine inbred lines and 36 crosses as well as Single cross Giza 166 were sown on 29th of May. A randomized complete block design with three replications was used. Each plot consisted of two ridges of six m length and 70 cm width. Hills were spaced by 25 cm with three kernels per hill on one side of the ridge. The seedlings were thinned to one plant per hill. The dry method of planting was used. The first irrigation was given after 21 days from sowing. The plants were then irrigated at intervals of 10-15 days. The cultural practices were followed as usual for ordinary maize field in the area.

All plants/ plot after thinned artificial infestation conditions were artificially infested by newly hatched larvae of the pink stem borer *S. cretica* artificially reared in the corn Borer Res. Lab., Maize Res. Sec., ARC, Giza, Egypt. Infestation was done using the Bazooka as a mechanical dispenser, such that each plant receives approximately 6-8 larvae at the early whorl stage of plant development (25 days after sowing). Data were recorded on:

1. **Percentage of susceptible plants (SP %):**

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

2. **Percentage of dead hearts (DH %):**

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

3. **Intensity of damage (ID):**

Six-class rating scale according to Al-Naggar *et al.* **(2000b)** was used for evaluating the amount of plant injury in maize caused by *S. cretica* larvae attack. The description of this scale is as follows:

Class 1: No visible injury on plants (no symptoms).

Class 2: Plants with holes less than 0.5 mm in diameter across partially or fully unfolded whorl leaves.

Class 3: Several folded and unfolded whorl leaves with relatively Wider round holes.

Class 4: Several folded and unfolded whorl leaves with relatively larger round and/or elongated holes accompanied with small yellowish-green pellets of frass aggregated in the whorl.

Class 5: Plants with relatively larger round and/or elongated Irregular holes, evident distortion of the leaves (most leaves have long holes), withering of whorl and accumulation of comparatively large size pillets of frass in the whorl or on the ground around the stem.

Class 6: Plants with dead hearts.

The intensity of damage (ID) value for each plot was calculated as follows:

$$ID = \frac{ID_1 + ID_2 + \ldots\ldots\ldots\ldots\ldots\ldots + ID_n}{N}$$

Where ID_1, ID_2, …….. ID_n denote intensity of damage of the tested infested plant No. 1, NO. 2, ………. No. n and N= number of artificially infested plants. Genotypes were classified according to their ID into: resistant (less than 1.6), intermediate (from 1.6 to less than 2.6) and susceptible (2.6 or above).

Data on percentage of susceptible plants and percentage of dead hearts were adjusted by adding a constant number (0.5) to each percentage and totals were transformed into square roots for the purpose of statistical analysis.

Grain yield / plant were calculated after adjusting the data based on 15.5% moisture content. the percentage yield loss by each genotype was calculated as follows: yield loss % = 100x (1-(yield in infected plot ÷ yield in uninfected plot)) according to **Kumar and Gershon (1994)**

The ordinary analysis of variance for RCBD was firstly performed according to **Snedecor and Cochran (1989).** General and specific combining ability estimates were obtained by employing **Griffing's (1956)** diallel cross analysis designated as method 2 mode l on the other hand method 4 mode l was used for yield losses and grain yield/ plant.

RESULTS AND DISCUSSION

Analysis of variance for percentage of infested plant %, dead heart %, intensity of damage, grain yield/ plant under infestation and non infestation with pink stem borer and yield losses % for grain yield for the F_1 crosses are shown in Table 2.

Table 2: Observed mean squares from analysis of variance, GCA and SCA mean squares for all studied traits.

S.O.V.	d.f.	Infested Plant %	dead heart	Intensity of damage	yield losses	grain yield / plant	
						infestation	non infestation
Rep	2	10.05	0.10	0.01	562.65*	67.21	98.70
Genotypes	44	7.39**	7.71**	0.13**			
parent	8	10.72**	12.94**	0.24**			
Cross	35	6.57**	6.55**	0.10**	2070.48**	980.14**	1306.35**
Par.vs.cr.	1	9.26	6.41**	0.28**			
Error	88	3.08	0.09	0.01	171.14	44.75	47.79
GCA	8	3.70**	2.78**	0.04**	1168.56**	917.33**	654.65**
SCA	36	2.19**	2.52**	0.04**	548.41**	151.72**	370.50**
Error	88	1.03	0.03	0.00	57.05	14.92	15.93
GCA/SCA		1.69	1.10	1.03	2.13	6.05	1.77

* and ** significant at 0.05 and 0.01 levels of probability, respectively.

Highly significant genotypes, parents and crosses were detected for the borer traits, indicating that the wide diversity between the parental inbred lines used in this study. Also, highly significant were detected for yield loss and grain yield/ plant.

Mean performance of inbred lines and their F_1 crosses for infested plant, dead heart, intensity of damage at infestation condition and yield losses and grain yield/ plant at infestation and non infestation for F_1 only are presented in Table. 3.

For infested plant, the parental line No. 6, the crosses p1xp3, p1xp4, p1xp5, P2x3, p4xp6 and P5xP6 showed superiority over the check hybrid SC 166 for the highest resistance to infested plants caused by S. cretica. While, the reverse was obtained for inbred line No. 1, 4 and the crosses P_1 x P2 and P3xP8 in this trait which showed the highest susceptibility.

As for dead hearts %, the inbred lines No. 1, 3, 6, 8 and 9 produced the highest mean percentage of resistance to dead heart. Also, the crosses p_1 x p_5, p_1 x p_8, p_2 x p_9, p_3 x p_5, p_4 x p_7, p_5 x p_7, p_7 x p_8 and p_8 x p_9 showed the highest mean percentage of resistance to dead heart and did not differed from SC 166.

Concerning intensity of damage, the parental inbred No. 6 expressed highest scale for resistance. Meanwhile, the crosses p_1 x p_3, p_1 x p_5, p_1 x p_9, p_2 x p_3, p_3 x p_5, p_3 x p_6, p_4 x p_7 and p_5 x p_6 gave the highest mean scale for resistance to intensity of damage and showed significant high mean values than the check hybrid SC 166.

As for yield losses the crosses P_1xP_3, P1xP9, P_2xP_9, P_3xP_6, P_3xP_8 and P_5xP_9 exhibited the best crosses which grain yield / plant of these crosses did not affected by damage of borer. At the same time, these crosses showed superiority over the check hybrid SC 166 for this trait.

Concerning grain yield/ pant twenty eight and thirteen hybrids had significant superiority over the check hybrid SC 166 in the artificial infestation condition and insect control condition, respectively. The fluctuation of hybrids from environment to another was detected for most traits. These results would be due to significant interaction between hybrids and environments.

The crosses P_1xP_6 and P_8xP_9 at the infestation and P_1x P_6, P_2xP_6, P_6xP_8 and P_8xP_9 at the non infestation had superior increased in grain yield/ plant.

Table 3: Mean performance for all studied traits.

Trait / Genotype	infested plant		dead heart		intensity of damege		yield losses	grain yield / plant	
	trans.	origen	trans.	origen	trans.	origen		infestation	non infestation
P1	10.02	95.00	0.71	0.00	2.12	4.00			
P2	8.52	72.20	2.96	8.33	1.83	2.86			
P3	6.31	55.53	0.71	0.00	1.61	2.11			
P4	10.02	100.00	4.13	16.67	2.12	4.00			
P5	9.28	86.66	5.80	33.33	2.23	4.50			
P6	4.91	33.30	0.71	0.00	1.39	1.44			
P7	5.52	44.43	4.70	21.67	1.70	2.40			
P8	8.19	68.86	0.71	0.00	1.95	3.33			
P9	8.01	66.63	0.71	0.00	1.65	2.22			
1x2	9.67	93.33	4.33	18.33	2.07	3.80	90.58	6.92	73.73
1x3	5.25	38.33	2.64	6.67	1.49	1.73	-5.96	46.08	44.17
1x4	5.47	32.37	3.67	13.07	1.58	2.02	48.71	27.28	52.37
1x5	4.97	36.10	0.71	0.00	1.46	1.64	49.51	30.39	60.20
1x6	6.54	43.87	3.40	11.10	1.66	2.25	35.86	77.60	121.00
1x7	8.08	66.67	5.03	25.00	2.08	3.83	60.54	27.33	69.33
1x8	9.23	85.00	0.71	0.00	1.71	2.45	58.08	25.83	61.77
1x9	6.71	50.00	2.96	8.33	1.53	1.85	3.67	47.17	49.43
2x3	4.29	25.00	2.68	6.67	1.53	1.86	66.42	33.00	98.67
2x4	5.79	46.00	4.03	15.83	1.86	2.97	55.51	39.25	88.23
2x5	8.77	77.37	6.21	38.07	2.03	3.64	38.47	41.86	68.43
2x6	6.61	45.53	4.27	17.73	1.74	2.55	61.86	45.72	119.77
2x7	7.20	52.77	2.45	5.53	1.66	2.25	58.05	25.53	60.67
2x8	8.39	76.37	2.16	4.17	1.91	3.15	46.18	39.86	74.47
2x9	8.16	66.67	0.71	0.00	1.69	2.36	-29.49	66.53	53.17
3x4	8.08	66.67	2.96	8.33	1.91	3.17	49.64	36.55	73.10
3x5	7.30	54.43	0.71	0.00	1.52	1.80	30.96	66.08	95.80
3x6	6.06	50.77	2.35	5.07	1.48	1.69	-1.12	64.22	64.47
3x7	8.64	74.43	4.98	24.43	1.87	3.02	71.37	16.67	57.77
3x8	9.67	93.33	2.38	5.20	1.88	3.05	-15.70	74.72	64.60
3x9	7.39	55.00	2.67	6.67	1.68	2.32	37.92	56.00	90.43
4x5	6.31	55.53	3.81	14.07	1.75	2.58	55.43	34.11	76.80
4x6	5.16	36.47	3.91	15.03	1.68	2.33	37.88	55.97	90.17
4x7	5.56	42.20	0.71	0.00	1.54	1.91	57.03	26.30	62.83
4x8	9.03	81.90	4.03	15.83	1.99	3.47	61.62	35.39	92.53
4x9	7.62	61.67	2.96	8.33	1.63	2.15	58.22	39.75	96.97
5x6	4.65	30.53	2.12	4.03	1.50	1.75	28.37	51.29	71.60
5x7	7.79	61.10	0.71	0.00	1.60	2.05	61.29	32.00	84.50
5x8	8.39	70.83	2.96	8.33	1.73	2.50	39.57	40.83	67.20
5x9	8.49	72.50	2.99	8.67	1.75	2.57	-4.24	67.50	64.77
6x7	6.12	51.67	3.90	15.00	1.76	2.62	56.62	36.17	82.80
6x8	8.70	76.67	3.70	13.33	1.90	3.10	52.65	51.72	109.63
6x9	8.54	73.80	4.08	16.17	2.01	3.55	31.86	68.47	101.27
7x8	7.04	49.97	0.71	0.00	1.66	2.25	52.64	21.33	44.97
7x9	6.28	54.43	4.88	23.33	1.85	2.93	47.40	44.83	85.40
8x9	7.63	58.33	0.71	0.00	1.65	2.25	29.65	81.42	116.83
SC. 166	8.15	66.66	0.71	0.00	1.78	2.67	74.39	18.75	73.20
Lsd 5%	2.01		0.16		0.30		28.24	10.85	11.21

Regarding to Table 2 mean squares for general and specific combining (GCA and SCA) were found to be significant for all studied traits. It is evident that, both additive and non additive gene effects were involved in determine the performance of single progeny. However, additive gene effects seems to play an important role in the expression of percentage of infested plants by pink stem borer, dead hearts %, intensity of damage, yield losses and grain yield/ plant at infestation and non infestation, where the ratio of GCA/SCA found to be more than unity for all traits. These results agrees with the findings of **Turgut *et al*. (1995), El-Shenawy *et al.* (2002), Amer (2003), Mosa (2003) and Amer and Mosa (2004).**

General combining ability effects:

Estimates of general combining ability effects for the nine inbred lines are presented in table 4.

The parental inbred line p_3 gave significant positive $\hat{g}_i$ effects for grain yield/plant at infestation and ranked the third best inbred line for this trait. meanwhile, it gave significant negative $\hat{g}_i$ effects for yield losses. however, it exhibited either significant undesirable or insignificant $\hat{g}_i$ effects for other traits.

The parental inbred line number 6 showed the best combiner lines for percentage of resistance to infested plants and resistance to damage caused by *S. cretica*. Also, it considered as good combiner for grain yield/ plant under infestation and non infestation conditions. This line could be used in maize breeding program to make crosses having high yielding ability and resistance to damage with pink stem borer.

For intensity of damage, the parental inbred lines No. 3, 6 and 9 exhibited significant negative ($\hat{g}_i$) effects for this trait.

The parental inbred line No. 8 exhibited significant negative ($\hat{g}_i$) effects for; dead heart % indicating that this inbred line could be considered as a good combiner for developing genotypes which escape from corn borer. Also, it showed significant positive effects ($\hat{g}_i$) for grain yield / plant at infestation. However, it exhibited either significant undesirable or insignificant $\hat{g}_i$ effects for other traits.

Table 4: Estimates of GCA effects of the parental materials for percentage of infested plant %, dead heart %, intensity of damage, grain yield/ plant under infestation and non infestation with pink stem borer and yield losses % for grain yield.

Traits / Parent	Infested Plant %	dead heart	intensity of damage	yield losses	Grain yield / plant	
					infestation	non infestation
g1	0.23	-0.27**	0.03	1.82	-8.98**	-12.57**
g2	0.23	0.45**	0.06**	8.48**	-7.55**	2.45
g3	-0.37	-0.46**	-0.09**	-13.53**	5.98**	-4.42**
g4	-0.03	0.59**	0.06**	13.69**	-8.13**	1.86
g5	0.16	0.36**	0.02	-4.12	1.80	-4.38**
g6	-1.02**	0.12*	-0.09**	-3.46	14.24**	20.11**
g7	-0.52	0.45**	-0.01	19.53**	-17.33**	-10.24**
g8	1.01**	-0.82**	0.07**	-0.51	2.80**	1.72
g9	0.31	-0.41**	-0.04*	-21.89**	17.17**	5.47**
L.S.D gi 0.05	0.57	0.10	0.04	5.35	2.73	2.82
L.S.D gi 0.01	0.75	0.13	0.05	7.08	3.62	3.74
L.S.D gi-gj 0.05	0.85	0.15	0.06	8.02	4.10	4.24
.S.D gi-gj 0.01	1.12	0.19	0.08	10.62	5.43	5.61

* and ** significant at 0.05 and 0.01 levels of probability, respectively.

The parental inbred line No. 9 showed significant negative ($\hat{g}_i$) effects for yield losses. Also, it showed significant positive ($\hat{g}_i$) effects for grain yield/ plant at infestation condition. While, the parental inbred line No. 6 showed significant positive ($\hat{g}_i$) effects for grain yield/ plant at non infestation condition . The parental inbred lines No. 1, 2, 4 and 5 seemed to be a poor combiner for all the studied traits.

Specific combining ability:

Specific combining ability effects $\hat{S}_{ij}$ for the studied 36 hybrids were computed for all the studied traits (Table 4). The most desirable inter and intra allelic interactions were presented by combinations: P_1xP_3, P_1xP_4, P_1xP_5, P_2xP_3 and P_5xP_6 for infested plant%, P_1xP_5, P_1xP_8, P_2xP_7, P_2xP_9, P_3xP_5, P_4xP_7, P_5xP_6, P_5xP_7, P_7xP_8 and P_8xP_9 for dead heart%; P_1xP_3, P_1xP_4, P_1xP_5, P_1xP_8, P_1xP_9, P_2xP_3, P_2xP_7, P_3xP_5, P_4xP_7, P_4xP_9, P_5xP_6, P_5xP_7, P_7xP_8 and , P_8xP_9 for intensity of damage, P_1xP_3, P_1xP_9, P_2xP_9, P_3xP_6, P_4xP_6, P_4xP_7 and P_5xP_9 for yield losses, P_1xP_6, P_1xP_7, P_2xP_4, P_2xP_9, P_3xP_5, P_3xP_8, P_4xP_7 and P_8xP_9 for grain yield/ plant at infestation and P_1xP_6, P_1xP_7, P_2xP_3, P_2xP_6, P_3xP_5, P_3xP_9, P_4xP_8 , P_4xP_9, P_5xP_7, P_6xP_8, P_7xP_9 and P_8xP_9 for grain yield/ plant at non infestation. These crosses may be prime importance in breeding programs either towards hybrid maize production or synthetic varieties composed of hybrids which involved the good combiners for the traits in view.

Table 4: Specific combining ability for all studied traits.

crosses	Infested Plant %	dead heart	intensity of damege	yield losses	grain yield / plant	
					infestation	non infestation
P1xP2	1.87 *	1.37 * *	0.24 * *	39.25 **	-20.49 * *	6.35
P1xP3	-1.95 *	0.59 * *	-0.20 * *	-35.28 **	5.15	-16.34 * *
P1xP4	-2.07 *	0.57 * *	-0.25 * *	-7.83	0.45	-14.43 * *
P1xP5	-2.77 * *	2.17 * *	-0.34 * *	10.78	-6.36	-0.35
P1xP6	-0.02	0.77 * *	-0.03	-3.53	28.41 * *	35.97 * *
P1xP7	1.02	2.07 * *	0.31 * *	-1.84	9.71 * *	14.65 * *
P1xP8	0.65	0.98 * *	-0.14 *	15.74 *	-11.92 * *	-4.88
P1xP9	-1.18	0.86 * *	-0.21 * *	-17.29 **	-4.95	-20.97 * *
P2xP3	-2.91 * *	0.10	-0.19 * *	30.44 **	-9.37 * *	23.14 * *
P2xP4	-1.75	0.20	-0.01	-7.69	10.99 * *	6.42
P2xP5	1.03	2.62 * *	0.20 * *	-6.91	3.67	-7.13 *
P2xP6	0.06	0.92 * *	0.03	15.82 *	-4.91	19.71 * *
P2xP7	0.15	1.23 * *	0.14 *	-10.99	6.47	-9.04 *
P2xP8	-0.18	0.25	0.03	-2.82	0.67	-7.20 *
P2xP9	0.28	2.12 * *	0.08	-57.1 **	12.97 * *	-32.25 * *
P3xP4	1.14	0.05	0.19 * *	8.46	-5.23	-1.83
P3xP5	0.17	1.98 * *	0.17 * *	7.59	14.37 * *	27.11 * *
P3xP6	0.12	0.09	0.09	-25.16 **	0.07	-28.71 * *
P3xP7	2.18 *	2.20 * *	0.22 * *	24.34 **	-15.92 * *	-5.06
P3xP8	1.70	0.88 * *	0.14 *	42.7 **	22.00 * *	-10.19 * *
P3xP9	0.11	0.75 * *	0.05	32.31 **	-11.08 * *	11.89 * *
P4xP5	-1.16	0.07	0.08	4.84	-3.50	1.82
P4xP6	-1.13	0.42 * *	0.04	-13.37 *	5.92	-9.30 * *
P4xP7	-1.23	3.12 * *	-0.26 * *	-17.21 **	7.83 *	-6.28
P4xP8	0.71	1.47 * *	0.11	7.41	-3.23	11.46 * *
P4xP9	0.00	0.00	-0.14 *	25.4 **	-13.23 * *	12.14 * *
P5xP6	-1.83 *	1.14 * *	-0.19 * *	-5.07	-8.68 *	-21.62 * *
P5xP7	0.80	2.88 * *	-0.17 * *	4.86	3.60	21.63 * *
P5xP8	-0.12	0.64 * *	-0.12	3.17	-7.70 *	-7.63 *
P5xP9	0.67	0.25	0.02	-19.25 **	4.60	-13.82 * *
P6xP7	0.32	0.55 * *	0.11	-0.47	-4.68	-4.56
P6xP8	1.37	1.63 * *	0.16 * *	15.59 *	-9.26 * *	10.31 * *
P6xP9	1.91 *	1.58 * *	0.39 * *	16.19 *	-6.87 *	-1.81
P7xP8	-0.79	1.70 * *	-0.16 *	-7.41	-8.07 *	-24.01 * *
P7xP9	-0.86	2.05 * *	0.15 *	8.73	1.06	12.68 * *
P8xP9	-1.02	0.85 * *	-0.13 *	11.02	17.51 * *	32.15 * *
LSD5%(sij)	1.83	0.32	0.12	12.99	6.64	6.86
LSD1%(sij)	2.40	0.42	0.16	17.21	8.80	9.09
LSD5%(sij-sik)	2.69	0.47	0.18	19.64	10.04	10.38
LSD1%(sij-sik)	3.54	0.61	0.24	26.02	13.30	13.75
LSD5%(sij-ski)	2.55	0.44	0.17	17.93	9.17	9.47
LSD1%(sij-ski)	3.36	0.58	0.23	23.75	12.14	12.55

* and ** significant at 0.05 and 0.01 levels of probability, respectively.

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التحليل الوراثى للصفات الحقلية ومقاومة الثاقبات للتراكيب الوراثية في الذرة الشامية

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الملخص العربى

أجرى تقييم الهجن الناتجة من التهجين النصف دائرى لتسعة سلالات من الذرة وذلك فى تحت بيئتين مختلفتين (تحت ظروف العدوى الصناعية بالثاقبات و تحت الظروف العادية) فى تصميم قطاعات كاملة العشوائية بثلاث مكررات. كانت متوسطات التباين لكل من التراكيب الوراثية و الاباء و الهجن معنوية فى كل الصفات الخاصة بالثاقبات. و كانت التباينات للقدرة العامة والخاصة على التآلف معنوية لكل الصفات تحت الدراسة. وكانت النسبة بين القدرة العامة والقدرة الخاصة أكبر من الوحدة لكل الصفات تحت الدراسة.

أظهرت السلالة الأبوية رقم ٦ قدرة جيدة عامة على التوافق لصفة نسبة النباتات المقاومة للأصابة بالثاقبات و المقاومة للقلب الميت و ايضا اظهرت تلك السلالة قدرة عامة على التالف لصفة المحصول تحت ظروف كل من العدوى و الظروف العادية. أعطت الهجن التالية قدرة خاصه على التآلف P_3xP_1 و P_4xP_1 و P_5xP_1 و P_3xP_2 و P_5xP_6 لصفة المقاومة عدد النباتات المصابة و P_1xP_5 و P_2xP_9 و P_3xP_5 و P_4xP_7 و P_5xP_7 لصفة المقاومة للقلب الميت و P_1xP_4 و P_1xP_5 لصفة المقاومة لشدة الاصابة و P_3xP_5 و P_3xP_8 و P_4xP_7 و P_8xP_9 لصفة المحصول تحت ظروف العدوى و P_1xP_6 و P_1xP_7 و P_2xP_3 و P_2xP_6 و P_3xP_5 و P_3xP_9 و P_4xP_8 و P_4xP_9 و P_5xP_7 و P_6xP_8 و P_7xP_9 و P_8xP_9 لصفة المحصول تحت ظروف العادية المقاومة الكيماوية للثاقبات.