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A DIALLEL ANALYSIS AMONG MAIZE INBRED LINES FOR RESISTANCE TO PINK STEM BORER AND GRAIN YIELD UNDER ARTIFICIAL INFESTATION AND NON INFESTATION

BY

Mosa, H. E and Amer, E. A .
Maize Research Section, FCRI, Sakha ARS, ARC, Egypt

ABSTRACT

Among the insects infecting the maize (*Zea mays* L.) in Egypt, pink stem borer is considered one of the most important, because it causes decreased in the yield special early sowing in April and delaying sowing in July. Eight diverse inbred lines were crossed in a half diallel in 2002 growing season to estimate heterosis and combining ability. The 8 parents and their 28 F_1's were evaluated in two experiments at Sakha Agriculture Research Station during the growing season 2003. Percentage of resistance to infested plants, percentage of resistance to dead hearts and grain yield under artificial infestation by pink stem borer(*Sesamia certica* Led) were analyzed in the first experiment, while grain yield under non infestation was analyzed in the second one. The variances for general combining ability GCA and specific combining ability SCA were significant for all traits. However, additive gene effects was preponderant for percentage of resistance to infested plants and percentage of resistance to dead hearts, while non additive gene effects overcome the additive gene effects for grain yield under infestation and non infestation with pink stem borer. The inbred L121 considered as a good combiner for percentage of resistançe to; infested plants and dead hearts, while inbred Sk6241 was a good combiner for grain yield under infestation and non infestation with pink stem borer. These two lines could be used in maize breeding program to make crosses have high yielding ability and resistant to damage with pink stem borer. The best single crosses showed desirable SCA effects for most studied traits were L121 x Sk7266, Gm1004 x Sk8249, Sk 6241 x Sk9115, Sk7266 x Sk8249, L121x Sk9115, Sk7266 x Sk9074 and Sk6241 x Sk9108.Highly significant correlations were detected between grain yield under infestation conditions and percentage of resistance to, infested plants and dead hearts. Also correlation coefficient between grain yield under infestation and non infestation with pink stem borer showed highly significant in positive direction. The highest cross revealed heterotic effect relative to commercial check S.C 155 were S.C Sk6241x Sk9108 for percentage of resistant to infested plants, dead hearts and grain yield under infestation condition and S.C L121xGm1004 for grain yield under non infestation.

INTRODUCTION

Depending on the goals of a breeding programme, various procedures and breeding schemes may be utilized to screen and identify maize germplasm having resistance to pink stem borers. Once resistant plants are idehtified, inbred lines of families may be used to produce hybrids or varieties possessing improved levels of resistance. Sources of resistance may also be developed for use in improving yield performance and stability in existing materials. Screening and breeding for improved resistance may be done using natural or artificial infestations. But most entomologists working on host plant resistance are convinced that artificial infestation is usually superior and far more efficient than other techniques for identifying resistant plants / genotypes (Ortega *et al.*, 1980 and Mihm 1983a,b). At present, there are few data on combining ability in maize for resistance to pink stem borer PSB, *S cretica* attack in Mid-East and Africa (prevalent regions). Motawei (1996) found that the combining ability (GCA and SCA) were not significant for resistance damage caused by the pink stem borer under artificial and natural infestation conditions. Butrón *et al.*, (1998) determined that the genetic control of field corn ears resistance to PSB was additive, although they found a dominant component in the cob. Butrón *et al.*, (1999) found that the variance of general combining ability (GCA) showed significant differences for yield under infestation and non infestation condition with PSB and yield loss. There were also significant differences among specific combining ability (SCA)and reciprocal effects for yield under non infested plants but not so for yield under infestation conditions and yield loss. Low correlation coefficient between SCA effects for yield under infested and non infested conditions showed that yield under infested is the best trait for evaluating the level of defense against pink stem borer attack. Al-Naggar *et al.*,(2000) revealed the absence of maternal effects in controlling resistance to *Sesamia cretica* under artificial infestation .Both additive and non additive gene effects have equal importance in controlling the percentage of dead hearts, but additive played a greater part than non additive gene effects in controlling the percentage of infested plants. Variances due to parents vs crosses were significant under artificial infestation indicating the presence of heterosis for the percentage infested plants and dead hearts. Galal *et al.*, (2002) revealed that dominance and additive x dominance gene effects represent the major portion and conditioning the resistance to pink stem borer under natural and artificial infestation, while, additive, additive x additive and dominance x dominance gene effects were low in magnitude and could be negligible. El-Shenawy *et al.*, (2002), Amer (2003) and Mosa (2003) found that the non additive gene effects controlled the inheritance of grain yield.

The objectives of this work were to estimates GCA and SCA effects, heterosis and identify superior genotypes of resistance to *S. cretica* in maize and high yielding ability.

MATERIALS AND METHODS

The experiments reported herein were carried out in 2002 and 2003 growing seasons at Sakha Agriculture Research Station. Eight diverse yellow maize inbred lines; L 121, Gm 1004, Sk 6241, Sk 7266, Sk 8249, Sk 9074, Sk 9108 and Sk 9115 were chosen for this study. Sources of these inbred lines are shown in Table (1).

Table (1): Sources of the studied inbred lines.

NO	Inbred line	Source
1	L 121	Introduced from USA
2	Gm 1004	Exotic, Subtropical
3	Sk 6241	Exotic, P X79-5264
4	Sk 7266	Exotic, Tep-5 x Ac 8045
5	Sk 8249	Exotic, DMR pop yellow 2612
6	Sk 9074	Exotic, DMR pop yellow 203
7	Sk 9108	Exotic, DMR pop yellow 149
8	Sk 9115	Exotic, DMR pop yellow 115

A half diallel cross set involving eight parents was made during 2002 growing season. Two experiments were conducted at the same place and time during 2003 growing season. In each experiment, the eight parental inbred lines and their 28 F_1 crosses and one check variety (SC155) were grown in randomized complete block design with two replications. Each plot consisted of one row of 2 m long and 80 cm width. Hills were spaced at 20 cm with three kernels per hill and thinned latter to one healthy plant per hill before the first irrigation giving plant density of 26000 plants / fad. The ordinary agricultural practices were done as usual in the production of maize during the growing season .All plants / plot after thinned in the first experiment 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). Sowing date in the two experiments were on 25 June. These sowing dates were intentionally chosen to coincide with the time of minimum natural infestation and also to coincide with the time of laying eggs in the laboratory with the ideal growth stage for artificial infestation by *S. cretica*. Data were recorded on: percentage of resistant to infested plants, percentage of resistant to dead hearts, the two traits were recorded in the infested experiment at 15 to 20 days after infestation.Grain yield per plot was transformed to Ard/Fad, after adjusting the data based on 15.5% moisture content and shelling percent of infested and non infested experiments. The ordinary analysis of variance for RCBD was firstly performed according to Snedecor and Cochran (1980).General and specific combining ability estimates were obtained by employing Griffing's (1956) diallel cross analysis designated as method 2 model 1 .Heterosis was also determined according to Paschal and Wileox (1975).

RESULTS AND DISCUSSION

Analysis of variance for percentage of resistance to infested plants, percentage of resistance to dead hearts and grain yield under infestation and non infestation with pink stem borer for eight inbreds and their F_1crosses are shown in Table 2. Highly significant genotypes mean squares were detected for all traits.

meaning the wide diversity between the parental materials used in this study. Significant parent (P) mean squares were found for percentage of resistance to dead hearts. Mean squares due to crosses (C) were highly significant for all traits except percentage of resistance to infested plants, Highly significant were found for P vs C, indicting that the

Table (2): Analysis of variance for percentage of resistance to infested plant, percentage of resistance to dead hearts and grain yield under infestation and non infestation with pink stem borer for eight inbred and F1 crosses.

Sources of variation	d.f	Percentage of resistance to infested plants	Percentage of resistance to dead hearts	Grain yield Ard/Fad under	
				Infestation	Non infestation
Replications	1	607.17	259.75	4.64	29.36
Genotypes	35	1135.22**	1245.29**	215.29**	242.65**
Parents(P)	7	862.12	747.35*	5.05	18.57
Crosses (C)	27	768.49	859.76**	66.20**	95.35**
P vs C	1	12948.63**	15140.18**	5712.4**	5788.31**
GCA	7	1411.57*	1690.81**	88.02**	176.47**
SCA	28	1066.13*	1133.91**	247.10**	259.19**
Error	35	489.97	297.04	17.99	24.12
GCA/SCA		1.32	1.49	0.37	0.68

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

F_1 mean values were significantly higher than parental means for all traits, which mean the presence of heterosis.

Mean performance of 8 inbred lines *per se* and their mean from 7 F_1's to other 7 inbred for percentage of resistance to infested plants, percentage of resistance to dead hearts and grain yield under infestation and non infestation with pink stem borer are presented in Table 3. The parental inbred lines L 121 and SK 9108 had the higher mean *per se* for percentage of resistance to, infested plants and dead heart caused by *S. cretica,* while the reverse was obtained for inbred line Sk8249 which showed the highest susceptibility. The inbred lines L 121 and Sk 6241 produced the highest mean from 7 F_1's to other 7 inbred for percentage of resistance to infested plants and percentage of resistance to dead heart. The inbred lines Sk9108 showed the highest mean *per se* for grain yield under infestation conditions, the inbred line Sk 6241 had the highest mean *per se* under non infestation conditions, while the inbred line Sk 9115 exhibited the lowest mean *per se* for grain yield under infestation and non infestation with pink stem borer. Line Sk 6241 and Sk 9108 produced higher F_1crosses for grain yield under artificial infestation, while the inbred lines L 121 and Sk 9108 produced higher F_1crosses under non-infestation. Mean over all crosses was higher compared with *per se* mean over all parents for the studied traits, indicating the superiority of F_1 hybrid in all traits over its parents,also indicating that the heterosis lead to increased insect resistance.

The yield reduction of *per se* mean over all the inbred parents under infestation compared to that under non infestation was 38.21%, while the yield reduction of mean over all crosses under infestation relative to non infestation with pink stem borer was 11.26%. El-Sherif and Mostafa (1987) found that yield reduction was relatively high in the inbred lines than that in single crosses. Lynch *et al.*, (1980) reported 2.9 and 5.8% yield reduction with artificial infestations of 1 and 8 egg masses per plant, respectively, at the whorl stage of plant growth.

Table (3): Mean performance of 8 inbred lines and their mean from 7 F_1s to other 7 inbreds for percentage of resistance to infested plants, percentage of resistance to dead hearts and grain yield under infestation and non infestation with pink stem borer.

Inbred line	Percentage of resistance to infested plants		Percentage of resistance to dead hearts		Grain yield Ard/Fad under Infestation		Grain yield Ard/Fad under Non infestation	
	Per se mean	Mean over 7 F_1s	*Per se* mean	Mean over 7 F_1s	*Per se* mean	Mean over 7 F_1s	*Per se* mean	Mean over 7 F_1s
L 121	50	72.20	75	91.98	4.84	26.32	6.23	33.41
Gm1004	18.25	55.37	25.39	80.65	4.46	25.05	10.03	30.24
Sk-6241	27.84	72.99	55.11	89.51	6.97	30.18	14.73	32.49
Sk-7266	10.10	51.40	28.28	62.07	6.45	20.75	6.46	23.01
Sk-8249	5.55	59.46	22.22	85.81	5.07	25.89	6.98	25.89
Sk-9074	49.16	60.47	57.5	78.98	5.24	27.18	10.49	32.89
Sk-9108	61.92	66.2	61.92	86.08	7.01	29.15	7.62	33.18
Sk-9115	20.20	62.94	48.48	77.87	2.19	29.08	5.76	29.67
Mean	30.37	62.62	46.73	81.61	5.27	26.7	8.53	30.09
r	0.565		0.530		-0.076		0.399	

r :correlation coefficient between *per se* means of the inbred parents and their means from 7 F_1's to other 7 inbreds.

The correlation coefficients (r) between *per se* means of the inbred lines and their mean from 7F_1's to other 7 inbred were not significant for all traits. However its positive for all traits except grain yield under infestation conditions. Butrón *et al.*, (1997) and Al-Naggar *et al.*, (2000) pointed out that field corn resistance to pink stem borer was transmitted from inbred to hybrids.

Heterosis percentage relative to high parent (H.P) and constant parent (C.P) are presented in Table 4. Fifteen crosses showed significant to highly significant heterotic effects over high parent (H.P) in positive direction for percentage of resistance to infested plants and percentage of resistance to dead hearts, while all crosses exhibited positive highly significant heterotic effects over high parent (H.P) for grain yield under infestation and non infestation. On the other hand, five crosses exhibited significant heterotic effects relative to constant parent for both percentage of resistance to infested plants and percentage of resistance to dead hearts, as well as nine and seven crosses for grain yield under infestation and non infestation, respectively. The highest cross that revealed heterotic effect relative to S.C.155 were SK6241xSK9108 for percentage of resistant to infested plants and dead hearts and grain yield under infestation conditions and L121xGm1004 for grain yield under non infestation. In general, the best crosses exhibited desirable heterotic effects relative to S.C.155 for all traits were Sk6241xSk9108, Sk6241xSk9115 and L121xSk9115.It could be concluded that the three crosses could be used as good hybrids for resistance to *S.certica* and high yielding ability in maize breeding program. Al-Naggar *et al.*, (2000) found that,out of 21F_1's, 20 and 5 crosses showed significantly negative (desirable) estimates of heterosis relative to high parent for percentage of dead hearts and percentage of infested plant, respectively.Many investigators reported high heteroses for grain yield of maize (Akhtar and Singh 1982, Abdel-Sattar *et al.*, 1999 and Mosa 2003).

Table (4): Estimates of heterosis % relative to high parent (H.P) and constant parent (C.P) for percentage of resistance to infested plants, percentage of resistance to dead hearts and grain yield under infestation and non infestation with pink stem borer.

Cross	Percentage of resistance to infested plants		Percentage of resistance to dead hearts		Grain yield Ard/Fed under Infestation		Grain yield Ard/Fed under Non Infestation	
	H.P	C.P	H.P	C.P	H.P	C.P	H.P	C.P
L121 x Gm1004	56.66*	39.03	25.92	29.35	358.26**	-17.66**	313.85**	29.59**
xSk 6241	54.54*	37.14	27.26	30.73	326.97**	10.46*	113.10**	-1.99
xSk 7266	70.0**	50.86*	33.33	36.96*	279.06**	-9.24*	290.40**	-21.26**
xSk8249	0.0	-11.25	25.92	29.35	345.75**	-16.10**	223.93**	-29.44**
xSk9074	6.94	-5.09	-13.89	-11.54	413.16**	-0.18	284.55**	25.94**
xSk9108	23.32	35.53	33.33	36.96*	235.76**	-12.65**	372.44**	12.39*
xSk 9115	70.0**	50.86*	26.66	30.11	619.62**	29.28**	491.17**	14.98**
Gm1004 x Sk6241	61.63**	-20.12	58.77**	19.84	252.36**	-8.83*	115.75**	-0.78
xSk 7266	-15.23	-72.54**	-20.04	-69.03**	100.0**	-52.11**	93.32**	-39.46**
xSk8249	313.43**	33.91	293.85**	36.96*	428.90**	6.12	170.78**	-15.20**
xSk9074	24.30	8.46	44.92**	14.13	387.40**	-5.19	164.25**	-13.45**
xSk9108	0.57	10.52	54.15**	30.73	334.66**	13.10**	287.83**	21.44**
xSk 9115	147.52**	-11.25	67.59**	11.28	598.43**	15.62**	151.44**	-21.26**
SK 6241 x Sk 7266	112.93**	5.21	29.59	-2.17	272.45**	-3.63	87.23**	-13.89**
xSk8249	159.41**	28.18	51.20**	14.13	265.09**	-5.56	65.17**	-24.03**
xSk9074	46.90*	28.18	54.57**	21.73	373.74**	22.56**	134.41**	7.80
xSk9108	53.42*	68.61**	61.49**	36.97*	433.38**	38.78**	158.45**	18.85**
xSk 9115	223.27**	59.74*	81.45**	36.96*	404.16**	30.43**	169.99**	24.16**
Sk 7266 x Sk 8249	580**	21.90	217.85**	23.12	256.74**	-14.58**	229.65**	-28.16**
xSk9074	42.65	24.47	41.30*	11.28	267.13**	-12.10**	184.08**	-6.96
xSk9108	-58.18*	-54.04*	-25.03	-36.41*	143.08**	-36.74**	181.75**	-32.96**
xSk 9115	75.29**	-37.14	-52.74**	-68.62**	183.10**	-32.21**	126.16**	-54.38**
Sk 8249 x Sk 9074	1.7	-11.25	30.43	2.72	386.64**	-5.34	175.21**	-9.86
xSk9108	4.97	15.37	37.27*	16.42	406.96**	5.90	302.49**	-4.24
xSk9115	72.87**	-38.01	50.61**	0.0001	444.37**	2.44	252.72**	-23.13**
Sk 9074 x Sk 9108	-11.17	-2.37	31.21	11.28	392.18**	22.86**	231.26**	8.49
XSk 9115	24.93	9.01	36.64*	7.61	330.41**	-16.18**	226.40**	6.89
Sk 9108 x Sk9115	35.46	48.88**	52.51**	29.35	385.30**	26.28**	325.98**	1.34

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

Regarding to Table 2,mean squares for both general and specific combining ability (GCA and SCA) were found to be significant for percentage of resistance to infested plants and highly significant for percentage of resistance to dead hearts and grain yield under infestation and non infestation with pink stem borer. 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 resistance to infested plants by pink stem borer and dead hearts where the ratio of GCA/SCA found to be more than unity for both traits. This result supports the findings of Butrón *et al.*, (1997) where they reported that general combining ability was more important than specific one for damage caused by pink stem borer. Al-Naggar *et al.*, (2000) found that additive gene effects played a much greater role than non additive gene effects in the genetic control of maize resistance to the pink stem borer. However non additive genetic effects were more important component in the expression of grain yield under infestation and non infestation with pink stem borer where the same ratio GCA/SCA was less than unity as pointed out in Table 2 . This result agrees with the findings of Turgut *et al.*, (1995), Butrón *et al.*, (1999), Geeth and Jayaraman (2000), El-Shenawy *et al.*, (2002), Amer (2003) and Mosa (2003).

Estimates of the general combining ability effects for the eight inbred lines are shown in Table 5. The inbred line L121 showed the best combiner lines for percentage of resistance to infested plants and dead hearts caused by *S.cretica*, this line could be used as donor of PSB resistance in maize breeding programme. The inbred line Sk6241 considered as good combiner for grain yield 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, while Sk9108 and Sk9074 exhibited favorable GCA effects for grain yield under infestation and non-infestation conditions, respectively.

Table (5): Estimates of GCA effects of the parental inbreds for percentage of resistance to infested plants, percentage of resistance to dead hearts and grain yield under infestation and non infestation with pink stem borer.

Inbred line	Percentage of resistance to infested plants	Percentage of resistance to dead hearts	Grain yield Ard/Fad under	
			Infestation	Non- infestation
L 121	10.622*	12.907**	-0.356	1.857
Gm 1004	-7.507	-4.947	-1.319	0.397
Sk-6241	6.746	7.197	2.773**	2.913**
Sk-7266	-11.913*	-17.37**	-3.928**	-5.380**
Sk-8249	-7.183	-1.97	-0.608	-3.256**
Sk-9074	2.248	0.302	0.331	2.344*
Sk-9108	8.804	6.157	2.060**	1.977
Sk-9115	-1.817	-2.269	1.048	-0.851
L.S.D g_i 0.05	9.39	7.31	1.80	2.08
0.01	12.63	9.84	2.42	2.80

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

Estimates of the specific combining ability effects for the F_1's are presented in Table 6. Four, six, eleven and nine crosses exhibited significant to highly significant SCA effects for percentage of resistance to; infested plants, dead hearts, grain yield under infestation and non infestation with pink stem borer, respectively. The best single crosses showed desirable SCA effect for most studied traits were L121xSk7266, Gm1004xSk8249, Sk6241xSk9115, Sk7266x Sk8249, L121xSk9115, Sk7266xSk9074 and Sk6241xSk9108. These crosses might be of interest in breeding program aimed to obtain new single crosses, inbred lines and synthetic varieties for resistance of damage caused by the pink stem borer and gives high yield.

Table (6): Estimates of SCA effects of 28 F_1's for percentage of resistance to infested plants, percentage of, resistance to dead hearts and grain yield under infestation and non infestation with pink stem borer.

Cross	Resistance to infested plants	Resistance to dead hearts	Grain yield Ard/Fad under	
			Infestation	Non infestation
L121 x Gm1004	19.749	12.611	1.916	13.949**
xSk 6241	4.436	1.477	5.402	1.312
xSk 7266	30.822*	30.595**	6.794*	3.432
xSk8249	-8.908	9.637	1.621	-1.305
xSk9074	-14.867	-22.499*	4.972	10.829**
xSk9108	1.469	7.063	-0.114	6.854
xSk 9115	20.726	10.48	12.189**	10.521**
Gm1004 x Sk6241	-9.708	11.376	1.159	3.162
xSk 7266	-20.574	-28.932*	-3.800	-0.939
xSk8249	34.675*	33.046**	8.573**	4.710
xSk9074	10.901	14.105	4.586	-0.327
xSk9108	5.506	20.371	7.787**	11.220**
xSk 9115	3.854	14.59	9.477**	0.362
SK 6241 x Sk 7266	8.983	7.733	5.171	4.74
xSk8249	17.19	4.235	1.331	-0.632
xSk9074	7.759	7.516	7.978**	3.96
xSk9108	23.981	12.773	10.61**	7.871*
xSk 9115	29.601*	21.19	9.379**	12.401**
Sk 7266 x Sk 8249	32.313*	35.371**	5.599*	6.333
xSk9074	24.334	24.45*	5.339	7.525*
xSk9108	-26.468	-16.226	-3.038	-0.437
xSk 9115	-6.324	-31.31	-0.798	-4.466
Sk 8249 x Sk 9074	-0.535	2.797	3.831	4.475
xSk9108	7.91	6.942	5.134	6.64*
xSk 9115	-11.549	3.38	5.22	3.418
Sk 9074 x Sk 9108	-11.521	0.918	8.762**	5.122
xSk 9115	5.528	6.66	-0.740	7.438*
Sk 9108 x Sk9115	21.432	16.68	8.969**	6.022
L.S.D Sij 0.05	28.8	22.43	5.52	6.39
0.01	38.74	30.16	7.42	8.59

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

Correlation coefficient between grain yield under artificial infestation by pink stem borer and other studied traits for genotypes are shown in Table 7. Highly significant correlations were recorded between grain yield under infestation conditions and percentage of resistance to, infested plants and dead hearts, indicating that the increased in percentage of resistance to infested plants or percentage of resistance to dead hearts caused by pink stem borer lead to increased in grain yield under infestation condition. Also means that the artificial infestation technique with pink stem borer could be valuable for prediction of combining ability of the best inbred lines and their superior hybrid combination for use in maize breeding programs to saving much efforts and costs to the breeder. Highly significant positive correlation coefficient was found between grain yield under infestation and non infestation with pink stem borer. Therefore, grain yield under infestation and non infestation conditions were related, then, it would be adequate to use the yield of non infested plants as an estimation of yield under infestation conditions. Or used grain yield under infestation conditions to select the genotypes with high yield when the insect attack is important. Butrón *et al.*, (1999) found that the low correlation coefficient between SCA effects for yield under infested and non infested conditions showed that yield under infested conditions is the best trait for evaluating the level of defense against pink stem borer attack.

Table (7): Correlation coefficient between grain yield under artificial infestation by pink stem borer and other studied traits for genotypes.

Trait	Grain yield under infestation conditions
Percentage of resistance to infested plants	0.74**
Percentage of resistance to dead hearts	0.752**
Grain yield under non infestation condition	0.887**

** significant 0.01 levels of probability.

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تحليل الهجن التبادلية لبعض سلالات الذرة الشامية لمقاومة دودة القصب الكبرى ولمحصول الحبوب تحت ظروف العدوى الصناعية وعدم العدوى.

حاتم الحمادى موسى ، عصام عبد الفتاح عامر
مركز البحوث الزراعية- معهد المحاصيل الحقلية – قسم بحوث الذرة الشامية

تعتبر دودة القصب الكبرى واحدة من أهم الحشرات التي تصيب الذرة الشامية في مصر حيث تسبب نقص في المحصول خاصة للزراعة المبكرة في شهر أبريل والزراعة المتأخرة في شهر يوليو. تم عمل التهجينات الممكنة لثماني سلالات بنظام التزاوج التبادلي ذات الاتجاه الواحد في موسم ٢٠٠٢ لتقدير قوة الهجين والقدرة علي الائتلاف. قيمت سلالات الأباء الثمانية والهجن ال ٢٨ االناتجة منها في تجربتين في محطة البحوث الزراعية بسخا في موسم ٢٠٠٣. التجربة الأولى تحت ظروف العدوى الصناعية بدودة القصب الكبرى وتم تحليل صفات: نسبة المقاومة للنباتات المعدية ، نسبة المقاومة للقلب الميت ومحصول الحبوب أردب/فدان. التجربة الثانية تحت الظروف الطبيعية وتم تحليل صفة محصول الحبوب أردب/فدان ويمكن أن نوجز أهم النتائج فيما يلي:-

١- كان تباين كل من الفعل الوراثي المضيف والغير مضيف معنويا لجميع الصفات المدروسة. ومع ذلك فان الفعل الوراثي المضيف كان الأكثر أهمية في وراثة صفة نسبة المقاومة للنباتات المعدية ونسبة المقاومة للقلب الميت، بينما الفعل الوراثي غير المضيف كان أكثر أهمية في وراثة صفة محصول الحبوب تحت ظروف العدوى الصناعية وعدم العدوى بدودة القصب الكبرى.

٢- أظهرت السلالة ١٢١ افضل قدرة عامة علي الائتلاف لصفات نسبة المقاومة للنباتات المعدية ونسبة المقاومة للقلب الميت بينما السلالة سخا ٦٢٤١ كانت ذات قدرة عامة علي الائتلاف جيدة لصفة محصول الحبوب تحت ظروف العدوى الصناعية وعدم العدوى بدودة القصب الكبرى. هذه السلالات يمكن الاستفادة منها في برنامج التربية لانتاج هجن عالية المحصول ومقاومة للإصابة بدودة القصب الكبرى.

٣- أظهرت الهجن الفردية التالية: سلالة ١٢١ ×سخا٧٢٦٦، جميزة ١٠٠٤ ×سخا ٨٢٤٩، سخا٦٢٤١ ×سخا٩١١٥ ، سخا٧٢٦٦ × سخا٨٢٤٩ ، سلاله ١٢١ ×سخا ٩١١٥ ، سخا٧٢٦٦ ×سخا٩٠٧٤ وسخا٦٢٤١ ×سخا٩١٠٨ أفضل قدرة خاصة علي الائتلاف لمعظم الصفات تحت الدراسة.

٤-يوجد تلازم عالي المعنوية وموجب بين صفة محصول الحبوب تحت ظروف العدوى الصناعية ونسبة المقاومة للنباتات المعدية ونسبة المقاومة للقلب الميت كما يوجد تلازم عالي المعنوية وموجب بين صفة محصول الحبوب تحت ظروف العدوى الصناعية وعدم العدوى بدودة القصب الكبرى .

٥- أظهر الهجين الفردي سخا٦٢٤١ ×سخا٩١٠٨ أعلى قوة هجين لصفات :نسبة المقاومة للنباتات المعدية ، نسبة المقاومة للقلب الميت ومحصول الحبوب تحت ظروف العدوى الصناعية بدودة القصب الكبرى كما أظهر الهجين الفردي سلالة ١٢١ ×جميزة١٠٠٤ أعلي قوة هجين لصفة محصول الحبوب تحت ظروف عدم العدوى بالمقارنة بهجين المقارنة هـ.ف١٥٥.