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ADDITIVE, DOMINANCE AND EPSTATIC EFFECTS CONTROLLING RESISTANCE TO (*SESAMIA CRETICA* LED) IN MAIZE.

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ABSTRACT: ***Five inbreds of maize were chosen for this investigation. P_1, P_2, F_1, F_2, BC_1 and BC_2 were studied under natural and artificial infestation for resistance to pink stem borer (S. cretica led) at Sakha Agricultural Research Center in 2001 season. The percentage of resistant plants indicated that over and partial dominance controlled both the resistance and susceptibility to pink stem borer under artificial infestation. While, over and partial dominance conditioned the susceptibility for nine crosses under natural infestation due mainly to the insect preferring for high F1s plants. The genetic components effects revealed that dominance and additive (A) x dominance (D) effects represent the major portion and conditioning the resistance to pink stem borer under natural and artificial infestation. While, additive, A x A and D x D effects were low in magnitude and could be negligible. The artificial infestation emphasized the natural infestation whereas they gave the same results and natural infestation would be suitable for studying the genetic analysis of resistance to pink corn borer. Inbred Sd-7 was the most tolerant to this insect .The results concluded that the single crosses with high values of D or A x D effects would be valuable for releasing new inbreds more resistant to obtain high resistant single crosses to pink corn borer with high yielding ability production***

***Key words:** Six population and heterosis.*

INTRODUCTION

Sesamia cretica led is considered that most serious borer infesting maize. This insect attacks maize plants shortly after emergence, developing the whorl leaves and sometimes killing the growing point causing dead heard. The use of borer resistant maize varieties is an ideal method for controlling this pest. Breeding methods used to develop crop cultivars resistant to insects are determined by two factors: 1-mode of reproduction in the crop species and 2-kind of gene action that conditions resistance in the most plant to the insect (Russel, 972). Metawei (1996) and Galal *et al* (1997) indicated that over dominance gene action played a major role in conditioning the susceptibility of *S. cretica* led. Also, EL-Naggar *et al* (2000a) reported that additive variance was less important than non-additive ones under natural infestation and the opposite was true under artificial infestation for percentage of infested plants. Moreover EL-Naggar *et al* (2000b)

concluded that both additive and non-additive gene effects have equal importance in controlling dead heard, but additive played a great part than non-additive gene effects in controlling percentage of infested plants.

The objective of the present investigation is to determine the genetic variance components and type of gene action which controlling the resistance to *S. cretica* in maize under natural and artificial infestation in Sakha region.

MATERIALS AND METHODS

The present study was conducted at Sakha Agriculture Research Station to identify the type of gene action and components of genetic parameters controlling the resistance to *S. cretica* in maize. This study included 5 inbred lines of maize i.e., Sd-7, Sd-34, G-628, Sk-7041 and Sk-8084. All possible combination among 5 inbreds was done to obtain diallel set in 1999 season. The F_2 generation, Bc_1 and Bc_2 were made in 2000. Whereas in 2001season the six generation i.e. P_1, P_2, F_1, F_2, BC_1 and BC_2 were tested in two experiments, Firstly, natural infestation experiment was sowing at the beginning of April in 2001 season according to Ahmed and Kira (1960) to assure maximum natural infestation. The randomized complete block design with 4 replications was used. Plot size was one row, 2m length, 70cm apart, 20cm between hills and 3 seeds/hill were left without thinning. The second experiment of artificial infestation was sown 20 May 2001 to coincide with the time of minimum natural infestation and also to coincide with the time of lagging eggs in the laboratory with the ideal growth stage for artificial by *S. cretica*, where techniques were used to artificially infest plants from each genotypes by newly-hatched larva of *S. critica* .The infested plants were recorded and percentages of resistance were transformed by arcsine Sneddecor and Cochran (1967). Statistical analysis was done according to Gamble (1962) to estimate additive, dominance and epistatic effects as follows.

Additive gene effect (A) = $\overline{BC}_1 - \overline{BC}_2$

Dominance gene effect (D) = $\overline{F}_1 + 2\overline{BC}_1 + 2\overline{BC}_2 - ½\,\overline{P}_1 - ½\,\overline{P}_2 - 4\overline{F}_2$

Additive x Additive (AA) = $2\overline{BC}_1 + 2\overline{BC}_2 - 4\overline{F}_2$

Additive X Dominance (AD) = $½\,\overline{P}_2 + \overline{BC}_1 - ½\,\overline{P}_1 - \overline{BC}_2$

Dominance x Dominance (DD) = $\overline{P}_1 + \overline{P}_2 + 2\overline{F}_1 + 4\overline{F}_2 - 4\overline{BC}_1 - 4\overline{BC}_2$

Heterosis relative to mid-parent estimated as following formula:

$$\text{Heterosis relative to mid-parent} = \frac{\overline{F}_1 - \overline{M}.p.}{\overline{M}.P.} x100$$

Potence ration (p) was estimated as outlined by Smith (1952) as criteria for explaining nature and degree of dominance as shown in the following equation:

$$\text{Potence ratio} = \frac{\overline{F_1} - \overline{M}.P.}{\frac{1}{2}(\overline{P_1} - \overline{P_2})}$$

RESULTS AND DISCUSSION

Means of P_1, P_2, F_1, F_2, BC_1 and BC_2 for resistance %, heterosis relative to Mid-parent% and Potence ratio to pink stem borer for 10 single crosses under artificial infestation are presented in table (1). Means of parents ranged from 48.4 to 68.6 with an average of 59.04 the most tolerant resistant parent were Sd-7 and Sk-7041 while the susceptible parent was found by G-628. Means of single crosses for resistance to this insect ranged from 50.0to 70.6 with an average of 58.6. The single cross Sd-7 x Sk-8084 exhibited high tolerant to pink corn borer .F_2S were found to be less than F1s which ranged from 43.2 to 64.2 with an average of 55.93. This is expected and due mainly to segregating in F_2. Heterosis percentage relative to Mid-parent ranged from –26.52 to 18.46%with an average of (-0.3). Five out of 10 single crosses exhibited positive heterosis toward tolerance to this insect. Over and particle dominance exhibited in 3 and 2 single crosses respectively toward resistance. Meanwhile one and four single crosses toward susceptibility. These results showed that over dominance slightly predominating of resistance to pink stem borer.

Table (2) gives additive, dominance and epistatic effects controlling the resistance percentage to pink corn borer in 10 single crosses under artificial infestation. With respect to additive and dominance gene effects, the results indicated that dominance effect was major portion of genetic variability in ten single crosses, while additive effects were low in magnitude for all single crosses. Regarding the epistatic effects, the results emphasized that additive x dominance epistatic represented high values of epistatic effects with an average of 60.91 for the Single Crosses A X A or D x D have low values involving five out of ten single crosses per each with negative values which equal zero and could be negligible. These results are in agreement with those obtained by EL-Naggar *et al* (2000a) who reported that additive variance was less important than non-additive under natural infestation for percentage of infested plants. While, EL-Naggar *et al* (2000b) concluded that additive played a great part than non-additive gene effects in controlling percentage of infested plants.

Table (3) shows means of P_1, P_2, F_1, F_2, BC_1 and BC_2 for resistance percentage to pink corn borer in 10 single crosses under natural infestation. Means of parents ranged from 35.4 to 62.1 with an average of 46.84. the inbred Sd-7 was most tolerant under natural and artificial infestation as well as artificial infestation, while inbred Sd-34 was found to be susceptible. On the other hand the means of F1s were less than their parents due mainly to preferring of Moths to tall plants, large leaf area and narrow leaf angle to F_1S, (Metawi, 1996 and Galal *et al.*, 1997), While the means of F_2 were less than F_1S crosses due to segregation of inbreeding.

The results obtained for F1 andF2 under natural infestation were the same as shown under artificial infestation. Heterosis relative to mid-parent ranged from –24.14 to 12.36 with an average of –12.33. Over and partial dominance presented in six and three single crosses toward susceptible, while over dominance toward resistance was observed in one single cross only.

Table (4) gives additive, dominance and epistatic effects controlling the resistance percentage to pink corn borer in 10 Single Crosses under natural infestation. High values of genetic effect was obtained for dominance genetic effects, also the A x D effects represent the major part of epistasis. These results indicated that the genetic component effects under the natural infestation gave the same results obtained under artificial infestation. The results concluded that dominance (D) and additive by dominance (A x D) effects conditioned the resistance to pink stem borer in maize under the natural or artificial infestation and emphasized that the natural infestation was suitable and could be substitute the artificial infestation .The single crosses with high values of dominance or A x D effects would be valuable and effective for releasing new inbreds more resistant to obtain high resistant single crosses to pink stem corn borer with high yielding ability production.

Table (1): Means of P_1, P_2, F_1, F_2, BC_1 and BC_2 for resistance%, hetrosis relative to mid-parent% and Potence ratio (P.R) to pink corn borer for 10 single crosses under artificial infestation.

Single crosses	P_1	P_2	F_1	F_2	BC_1	BC_2	Heterosis %	P.R.
Sd-7x Sd34	68.6	60.1	64.6	54.1	64.1	56.4	0.31	0.05
Sd-7x G-628	68.6	48.4	53.0	52.7	66.8	66.1	-9.40	-0.54
Sd-7x Sk-7041	68.6	67.5	50.0	61.1	55.0	55.0	-26.52	-32.91
Sd-7x Sk-8084	68.6	50.6	70.6	56.5	63.8	63.1	18.46	1.22
Sd-34x G-628	60.1	48.4	52.1	64.2	55.0	48.6	-4.05	-0.38
Sd-34x Sk-7041	60.1	67.5	67.2	61.1	53.6	60.2	5.33	0.92
Sd-34x Sk-8084	60.1	50.6	64.6	43.2	59.4	59.4	16.71	1.94
G-628x Sk-7041	48.4	67.5	54.7	56.0	55.0	54.9	-5.69	-0.34
G-628x Sk-8084	48.4	50.6	51.3	58.2	65.7	55.7	3.64	1.64
Sk-7041x Sk-8084	67.5	50.6	57.9	52.2	50.0	50.5	-1.95	-0.14
X	61.9	56.18	58.60	55.93	58.84	56.99	-0.32	

Table (2): Additive (A), dominance (D) and epistatic effects controlling the resistance percentages to pink corn borer in 10 single crosses under artificial infestation.

Single crosses	A	D	AA	AD	DD
Sd-7xsd-34	7.70	93.45	24.60	72.05	-7.7
Sd-7xG-628	0.70	118.10	55.00	59.20	-97.8
Sd-7xsk-7041	0.00	26.15	-24.40	68.05	40.5
Sd-7xsk-8084	0.70	107.40	27.80	60.30	-21.2
Sd-34xG-628	6.40	8.35	-49.60	60.65	55.1
Sd-34xsk-7041	-6.60	46.70	-16.80	57.20	51.2
Sd-34xsk-8084	0.20	134.55	69.20	55.55	-63.3
G-628xsk-7041	0.10	40.95	-4.20	58.05	9.7
G-628xsk-8084	10.00	60.20	10.00	59.50	-51.2
Sk-7041xSk-8084	-0.50	58.55	-7.80	58.55	40.7
X	1.87	69.44	7.98	60.91	-4.4

Table (3): Means of P_1, P_2, F_1, F_2, BC_1 and BC_2 for resistance percentage to pink corn borer in 10 single crosses under natural infestation

Single crosses	P_1	P_2	F_1	F_2	BC_1	BC_2	Heterosis M .P	P .R
Sd-7xsd-34	62.10	35.40	42.90	37.80	44.20	49.00	-12.00	-0.44
Sd7xG-628	62.10	44.60	43.10	46.00	48.20	36.70	-19.21	-1.17
Sd7xsk-7041	62.10	44.70	42.20	48.20	49.10	43.80	-20.97	-1.29
Sd-7xsk-8084	62.10	47.40	41.60	31.10	42.70	50.20	-24.02	-1.79
Sd-34xG-628	35.40	44.60	33.90	40.90	35.30	49.20	-15.25	-1.33
Sd-34xsk-7041	35.40	44.70	45.0	37.00	42.40	40.00	12.36	1.06
Sd34xsk8084	35.40	47.40	39.80	35.60	46.50	46.50	-3.86	-0.21
G-628 xsk-7041	44.60	44.70	33.87	36.30	39.30	61.30	-24.14	-215.6
G-628xsk-8084	44.60	47.40	45.40	37.60	40.30	30.60	-1.30	-0.43
Sk-7041xsk-8084	44.70	47.40	39.20	33.50	41.50	40.80	-14.88	-5.07
$\bar{X}$	48.85	44.83	40.70	38.40	42.95	44.81	-12.33	

Table (4): Additive (A), dominance (D) and epistatic effects controlling the resistance percentage to pink corn borer in 10 single crosses under natural infestation.

Single crosses	A	D	AA	AD	DD
Sd-7xsd34	-4.80	91.45	35.20	43.95	-38.30
Sd-7xG628	11.50	37.65	-14.20	64.85	37.30
Sd-7xsk7041	5.30	43.90	-7.00	58.70	12.40
Sd-7xsk8084	-7.50	110.35	61.40	47.25	-54.50
Sd-34xG628	-13.90	34.70	5.40	26.10	-26.60
Sd-34xsk7041	2.40	57.15	16.80	42.45	-11.50
Sd-34xsk8084	0.00	77.40	43.60	41.40	-67.20
G-628xsk7041	-22.00	89.82	56.00	22.65	-100.16
G-628xsk8084	9.70	35.40	-8.60	55.70	49.60
Sk-7041xsk8084	0.70	68.45	30.60	46.75	-24.70
$\bar{X}$	-1.86	64.63	21.92	44.98	-22.37

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تأثيرات الإضافة والسيادة والتفوق المتحكمة فى المقاومة لثاقبة الذرة القرنفلية (*Sesamia cretica*) فى الذرة الشامية .

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الملخص العربى

اختـــيرت خمســـة سلالات من الذرة الشامية لدراسة ستة عشائر ($P_1, P_2, F_1, F_2,$ BC_1 and BC_2) تحـــت ظـــروف العـــدوى الطبيعـــية والصناعية لثاقبة الذرة القرنفليـــة (*Sesamia cretica* led) بمحطـــة البحوث الزراعية بسخا موسم ٢٠٠١ وشملت نسبة المقاومـــة للنباتات على السيادة الفائقة والجزئية والقابلية للإصابة بثاقبة الذرة القرنفلية تحت ظروف العدوى الصناعية وعلى أية حال فإن السيادة التفوقية والجزئية والقابلية للإصابة لـــ ٩ هجن تحت ظروف العدوى الطبيعية لوحظ أن هناك تفضيل لنباتات الجيل الأول (F_1's) .

و يتضـــح من دراسة المكونات الوراثية أن التأثيرات تعكس أن السيادة (D) والإضافة x السـيادة (A x D) يلعـــبان دور كبير فى المقاومة لثاقبة الذرة القرنفلية تحت ظروف العدوى الطبيعية والصناعية بينما التأثير الإضافي (A) و (A x A) و (D x D) قليل القيمة أو قد يكون عديم الأهمية .

أعطت العدوى الصناعية والطبيعية نفس النتائج وتعتبر العدوى الطبيعية مناسبة لدراسة التحليل الوراثى لمقاومة دودة الذرة القرنفلية.

تعتـــبر سلالة سدس – ٧ أكثر تحملا للإصابة لهذه الحشرة وأوضحت النتائج أن الهجن الفـــردية ذات القـــيم التأثيرية للسيادة او السيادة x الإضافة والآتية من سلالات أكثر مقاومة تعطى مقاومة للهجن الفردية الناتجة لثاقبة الذرة القرنفلية وكذلك للقدرة الإنتاجية العالية.