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GENETIC ANALYSIS OF SOME DROUGHT AND YIELD RELATED CHARACTERS IN SPRING WHEAT VARIETIES [*Triticum aestivum* L.]

El-Borhamy, H.S.
Wheat Res. Sec., Field Crop Res. Instit., Agric. Res. Center, Giza, Egypt.

ABSTRACT

Six genotypes of wheat [*Triticum aestivum l.*] representing different agronomic characters crossed in all possible combination, excluding reciprocals, in 2000/2001 season. The six parents and their 15 F_1 hybrids were evaluated during 2001/2002 growing season in the experimental from at Sakha Agric-Res. Stn, Kafer El-Sheikh Governorate. The studied traits were days to heading, days to maturity, plant height, no. of spikes/plant, kernel weight/spike, no. of grains/spike, grain yield/plant, leaf temperature , stomatal resistant and transpiration rate. The analysis of variance revealed highly significant differences among genotypes for all studied traits except no. of spikes/plant under stress environment. G.C.A and S.C.A mean squares were highly significant for all studied traits and the magnitude of G.C..A was greater than S.C.A mean squares, suggesting that additive genetic effects were predominant and played a major role in the inheritance of all traits. The genetic components i.e. additive and dominance were highly significant under stress environment for all traits.

Significant dominance type of gene action was detected for all studied characters, except for heading date and maturity date, the dominance component was larger in magnitude than the additive one and the average degree of dominance in these character revealed the existence of over dominance. The value (H_2/4 H_1) was approximately equal to its maximum value for heading date, maturity date and number of spikes/plant, whereas , it was deviated from 0.25 for other traits .Heritability estimates in broad sense were high. however high to moderate heritability values (in narrow sense) were detected for heading date, indicating that most of genetic variance might be due to additive genetic effects..

The genetic variance might be due to additive types of gene action, so selection could be useful in this respect. Narrow sense heritability values were low for all traits indicating that most of genetic variance might be due to non-additive genetic effects.

INTRODUCTION

Increasing grain yield of cereal crops is an important national goal to face the increasing food needs of Egyptian population. Wheat production in Egypt increased from 2.08 million ton in 1982/1983 to 6.42 million ton in 2001/2002 season, 209 % increase (statistical Data,2002,ARC,Giza)*

Drought is a major stress factor which limits crop production in most areas of a world. Wheat production under rain-fed or minimum irrigation condition become an objective in Egypt as well as many areas world wide due to increasing limitations of water supply. Breeding wheat cultivars within proved drought tolerance is challenged by in adequate screening and tolerance quantification procedures.

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Using yield components as a quantification and selection criterion should be superior to using yield under drought.

Sadiq *et al.* (1994) found highly grain yield proved to be the best indicator of drought tolerance. Yadav and Mishra (1993) found that positive associations were recorded between grain yield /plant and each of number of spikes/plant., number of spikelets /spike, and 1000-kernel weight. Many investigators reported significant differences among wheat cultivars in their response to the environmental conditions and, hence, their grain yield (Darwish 1998,El-Borhamy 2000 and Afiah 2002).The increase in soluble sugar by decreasing water supply may be due to the increase of chlorophyll and photosynthesis rate. It was also found that N application rate and decreasing of irrigation level are potential factors for increasing the water use efficiency (Nielsen and Halovrson 1991,Singh et al 1996 and Abo-Warda2002).

It is hoped that the present study helps wheat breeder for producing new genotypes of high yielding ability under stress irrigation .

MATERIALS AND METHODS

Six parental varieties of wheat representing wide range of variability in most of the studied traits were utilized for this study. Names, pedigree, and code number of these varieties are presented in Table(1).

Table (1):Name and pedigree of parental varieties.

No.	Variety	Cross name and pedigree	
1	Sakha 8	Indus 66/ norteno "S"	Pk 3418-6s-1sw-0s
2	Sakha 61	INIA / RL 4220 // 7C/ YR " S"	CM 15430-2s-5s-0s
3	Sakha 93	Sakha 92 / TR810328	S. 8871-1s-2s-1s-0s
4	Giza 163	T.aestivum / bon // cno /7c	CM 33009-F-15M-4y-2M-1M-1M-1y-0M
5	Giza 168	Mrl / buc // seri	CM 93046-8M-0y-0M-2y-0B
6	Sids 1	HD 2172 /pavon "S" // 1158-57/ Maya	Sd 46 – 4sd – 2Sd – 1Sd – 0Sd

Monthly average temperature and amount of rain shown in Table (2). Mechanical and chemical analysis of experimental farm are presented in Table(3).

Table (2): Monthly average of total rainfall during (2001/2002)at Sakha Agric.Res.Stn,Kafer El-Sheikh.

Month	Nov.2	Dec.2000	Jan.2001	Feb.2001	Mar.2001	Apr.2001	May.2001
Rainfall (ml)	–	0.56	0.90	0.50	–	0.17	–

Table (3): Meachanical and Chemical analysis of experimental farm during 2000/2001 at sakha Agriculture Research station.

Season	Mechanical analysis			Chemical analysis								Soil texture class
	Sand %	Silt %	Clay %	Ec	pH	Organic matter %	$CaCo_3$ %	N (ppm)	P (ppm)	K (ppm)		
2000/2001	18.0	38.3	43.4	1.4	8.5	2.1	1.33	14.9	20.0	260		Clay

Crossing among the parental material by means of diallel system was initiated at 2000/2001 season .In 2001/2002 season, half diallel set of crosses involving six parents and 15 F_1 hybrids were evaluated under stress environment. This experiment was fertilized and irrigated treatment, i. e, one irrigation and 30kg N/fed was added in two equal doses, the first was with seeding and the second with the first irrigation (after 40 days from seeding).The experiment was designed in randomized complete block design with three replications in the experimental farm at Sakha. Agric-Res. Stn, Kafer EL-sheikh Governorate . Each plot consisted of two rows, each row was 4m long and 30cm apart. Plants within row were 20cm apart. The dry method of planting was used in this concern. Observations were recorded on ten competitive plants per plot for number of days to heading, number of days to maturity, plant height (cm) no. of spikes/plant, kernel weight / spike, and grain yield / plant. Also, the three drought measurements leaf temperature (LT),stomatal resistance (SR) and transpiration rate (TR) were estimated at flowering date. The data were genetically analysis by the, procedures of Griffing (1956) and Hayman (1954),using the diallel cross analysis in order to estimate the following genetic parameters :

$\hat{D}$ = The additive genetic variance.

H_1 =Component of variation due to dominance effect of the genes.

H_2 =Dominance variance adjusted for a symmetric gene distribution among parents.

Where

$\hat{F}$ = Mean of covariance of additive and dominance effects over all arrays.

H_2= Dominance variance over all heterozygous loci as algebraic sum.

$\hat{E}$ = The expected environmental component of variation.

The estimates were used to calculate the following genetic parameters and ratios:

$(H_1/\hat{D})^{1/2}$ =d= The average degree of dominance where:

$d = 0$: Means no dominance.

$0 < d > 1$: Means incomplete dominance.

$\hat{D} = 1$: Means complete dominance.

$\hat{D} > 1$: means over dominance.

$H_2/4H_1$:Measures the means value of the product U and V (U and V are the frequencies of negative vs. Positive alleles in the parents, respectively). It has a maximum value of 0.25.

KD /KR $=\{(4D/H_1)^{1/2} + F) / (4D/H_1)^{1/2} - F)$ refers to the ratio of the total number of dominance to recessive genes in all parents.

Heritability (in broad and narrow senses) were calculated, according to Mather and Jinks (1982).

RESULTS AND DISCUSSION

The analysis of variance for drought measurements, growth, yield and yield components is presented in Table (4). Significant genotypes mean squares were detected for all the studied traits except no. of spikes / plant indicating wide variation among the genotypes used in the present study.

The mean squares for GCA, SCA combining ability and ratio between them for the studied traits under stress environment are presented in table (4).The mean squares associated with general and specific combining ability were significant for all studied traits. The results showed that, high GCA / SCA ratio, largely exceeding the unity were obtained for all studied traits except no.of spikes/ plant, leaf temperature and stomatal resistance , indicating that the largest part of the total genetic variability associated with those traits was of the additive type of gene action for the exceptional cases, however, non-additive type of gene action seem to be more prevalent. These results are in general agreement with those previously reported by Chowdhry *et al* (1996). Highly significant differences among genotypes under water stress treatments and their interaction for all the studied traits (yield and yield components) were reported by (Kheiralla 1994), Darwish (1998), and (El-Borhamy 2000).

Estimates of GCA effects ($\hat{g}_i$) for individual parents for each trait under stress environment are presented in table (5).

Highly significant positive ($\hat{g}_i$) values would be of interest for all studied traits except plant height, heading date, Maturity date, leaf temperature and transpiration rate.

The parental variety Sakha 8 expressed significant positive ($\hat{g}_i$) effects for kernel weight / spike and transpiration rate. However, it give significantly negative ($\hat{g}_i$) effects for heading date, maturity date and grain yield / plant

The parental CV. Sakha 61 expressed, significant desirable ($\hat{g}_i$) effects for leaf temperature, heading date, maturity date, and plant height .Meanwhile, it gave insignificant or significant undesirable ($\hat{g}_i$) effects for other traits.

The parental cv. Sakha 93 expressed significantly positive ($\hat{g}i$) effects for maturity date, kernel weight / spike, No. of grains / spike and transpiration rate however, it gave significant negative ($\hat{g}_i$) effects for heading date and stomata resistance.

The parental cv. Giza 163 expressed significantly positive ($\hat{g}_i$) effects for grain yield / plant, heading date, maturity date, and plant height and significant negative ($\hat{g}_i$) effects for stomata resistance., kernels weight/spike, and no.of grains / spike.

The parental cv. Giza 168 expressed, significant desirable ($\hat{g}_i$) effects for stomata resistance , transpiration rate, kernels weight / spike, no. of grains / spike and grain yield / plant . However, it gave insignificant or significant undesirable ($\hat{g}_i$) effects for other traits.

The parental cv. Sids1 seemed to be the best combiner for stomata resistance and transpiration rate. Meanwhile, it gave insignificant or significant undesirable ($\hat{g}_i$) effects for other traits..

Table (4): Mean square from analysis of variance, for general and specific combining ability of all studied traits

Source of variation	d.f	Heading date	Maturity date	Plant height	No.of spikes/plant	Kernels weight/spike	No.of grains/ spike	Grain yield/plant	Leaf temperature	Stomatal resistant	Transpiration. rate
Genotypes	20	34.215**	22.682**	73.61**	6.277	0.504**	125.663**	49.518**	1.53**	1.26**	0.49**
Rep	2	1.634	0.301	20.634	4.968	0.032	17.730	5.587	1.99	0.06	0.02
G.C.A	5	123.127**	63.227**	99.44**	2.694	0.810**	202.29**	71.819**	1.15*	1.11**	0.50**
S.C.A	15	4.578	9.167**	65.00**	7.472*	0.402**	100.11**	42.085**	1.63**	1.30**	0.49**
Error	40	4.168	2.984	11.88	3.451	0.028	6.880	12.895	0.49	0.02	0.01
G.C.A/S.C.A		26.895	6.897	1.529	----	2.014	2.020	1.706	0.705	0.835	1.020

Table (5) : Estimates of general combining ability effects for all parental studied.

Parent	Heading date	Maturity date	Plant height	No.of spikes/plant	Kernels weight/spike	No.of grains/ spike	Grain yield/plant	Leaf temperature.	Stomatal. resistant	Transpiration. rate
Sakha 8	-1.028**	-1.236**	-0.556	-0.111	0.068*	-0.347	-2.412**	0.031	-0.040	0.248**
Sakha 61	-1.486*	-1.903**	-2.014**	0.306	-0.077*	-3.222**	0.429	-.0335**	0.006	-0.010
Sakha 93	-1.444**	1.306**	-0.764	0.222	0.191**	2.778**	-0.104	0.228	-0.230**	0.066**
Giza 163	4.222**	2.472**	3.194**	-0.111	-.258**	-1.181*	2.117**	0.121	-0.297**	0.029
Giza 168	-1.236*	-0.278	-1.597*	0.264	0.199*	4.194**	1.480*	0.166	0.174**	-0.073**
Sids 1	0.972*	-0.361	1.736**	-0.569	-0.123**	-2.222**	-1.509*	-0.221	0.192**	-0.078**
L.S.D$_{(gi)}$ 0.05	0.768	0.650	1.298	---	0.063	0.987	1.352	0.250	0.057	0.038
L.S.D$_{(gi)}$ 0.01	1.028	0.870	1.737	---	0.085	1.339	1.809	0.331	0.076	0.051
L.S.D$_{(gi-gj)}$ 0.05	1.191	1.007	2.011	---	0.099	1.530	2.095	0.382	0.088	0.058
L.S.D$_{(gi-gj)}$ 0.01	1.593	1.348	2.690	---	0.132	2.047	2.803	0.507	0.117	0.078

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

Specific combining ability effects of the parental combinations computed for all traits are presented in Table (6). For maturity date , four crosses had significantly negative ($\hat{S}_{ij}$) effects . The best combinations were (P_1 x P_3), (P_2 xP_3), (P_4xP_5), and (P_4xP_6).

For Kernel weight / spike four crosses had significantly positive ($\hat{S}_{ij}$) effects . The best combination were (P_2xP_4), (P_3xP_4), (P_3xpP_5) and (P_4xP_6). For number of grains / spike four crosses had significantly positive ($\hat{S}_{ij}$) effects . The best parental combination were (P_2xP_4), (P_3xP_4), (P_3xP_5) and (P_4xP_6).

For grain yield / plant three crosses had significantly positive ($\hat{S}_{ij}$) effects. The best combinations were (P_1xP_4), (P_2xP_3) and (P_2xP_5).

The best parental combinations (P_1xP_2), (P_3xP_4) and (P_4xP_5) for leaf temperature, (P_1xP_2), (P_1xP_5), (P_2xP_3), (P_2xP_6) and (P_3xP_4) for stomatol resistance and transpiration rate.

In the previous crosses showing high ($\hat{S}_{ij}$) effects involving only one good combiner, such combinations would show desirable transgressive segregates , providing that the additive genetic system present in the good combiner as well as the complementary and epistatic effects present in cross, act in the same direction to reduce undesirable plant characteristics and maximize the character in view . Therefore, the previous crosses might be of prime importance in breeding program for traditional breeding procedures.

Genetic components:

Estimation of the genetic components of variation and the derived ratios for all studied characters are given in Table (7). The estimated value of the additive component ($\hat{D}$) was found to be significant for all characters, except for plant height, No. of spikes /plant and grain yield / plant . On the other hand, the dominance components (H_1 and H_2) were positive and significant for all studied characters. These results indicated that both additive and dominance components were observed and responsible for expression of these characters. Moreover, values of H_2 were relatively smaller than those of H_1,for most traits indicating that the positive and negative alleles, at the loci of the traits in question, are not equal in proportion of the parents.

The estimate of ($\hat{h}^2$) , which refers to the dominance effects over all heterozygous loci, was significant for all studied characters, except for no. of grains / spike and leaf temperature (Lt) indicating that the effect of dominance was due to heterozygosity. The F value was not significant for all the studied characters except for heading date , leaf temperature and stomata resistance table (7). This result indicated that there is equality of the relative frequencies of dominant and recessive alleles in the parents for all the non-significant traits.

The average degrees of dominance $(H_1/\hat{D})^{1/2}$ were more than one for all studied characters except heading date and maturity date. These results were in accordance with those of Alkaddoussi (1996) and Khalifa *et al* (1998) concerning the number of spike / plant . Also the present results agreed with those of Abd El-Aty and Katta (2002), Eissa (1989), Al Koddoussi *et al*. (1994) and Eissa *et al*. (1994) on the number of grains / spike.

Table (6) : Estimates of specific combining ability effects for all crosses.

Crosses	Heading date	Maturity date	Plant height	No.of spikes/plant	Kernels weight/spike	No.of grains/ spike	Grain yield/plant	Leaf temperature	Stomatal. resistant	Transpiration rate
1x2	0.387	2.012*	-0.208	-0.417	0.043	0.935	-3.364	-0744**	1.451**	-0.800**
1x3	-0.655	-1.863*	-1.458	0.000	0.135	2.601	-0.428	-0.607	-0.061	0.257**
1x4	-0.655	-0.696	1.250	2.667	-0.002	1.560	4.138*	-0.067	0.000	0.028
1x5	-1.530	-0.280	1.042	0.958	0.120	-5.482**	3.468	0.321	1.322**	-0.725**
1x6	-0.071	-1.196	2.708	0.125	0.022	-4.399**	-1.809	-0.226	-0.885**	0.087
2x3	-1.863	-.1863*	-1.667	0.250	-0.260**	-6.524**	4.148*	0.360	0.179*	-0.154**
2x4	1.470	-0.363	4.375*	1.917	0.556**	7.768**	-0.319	0.366	-0.190*	0.183**
2x5	-1.071	-0.613	0.833	0.875	-0.091	0.393	5.270**	-0.279	-0.697**	0.422**
2x6	-0.613	-1.196	4.167*	-0.958	-0.026	-0.190	1.193	-0.626	0.681**	-0.506**
3x4	0.095	2.429**	1.458	0.667	0.518**	5.435**	3.473	-1.563**	0.732**	-0.214**
3x5	-0.113	1.179	-2.083	-0.042	0.644**	11.06**	1.933	0.891	-0.498**	0.159**
3x6	-0.321	-1.071	-0.417	-0.875	-0.154	-2.190	1.379	-0.189	0.059	-0.103
4x5	0.220	-2.321*	5.625**	-2.708	-0.307**	-8.315**	2.323	-0.802*	-0.486**	0.153**
4x6	-1.988	-2.238*	5.625**	2.125	0.412**	6.101**	-0.581	0.418	-0.502**	-0.062
5x6	1.804	1.845*	3.750*	1.083	-0.042	1.060	-2.812	0.106	-0.013	0.091
L.S.D $_{(gi)}$ 0.05	----	1.786	3.565	1.921	0.175	2.712	3.714	0.728	0.169	0.112
L.S.D $_{(gi)}$ 0.01	----	2.390	4.770	2.570	0.234	3.629	4.969	0.966	0.224	0.149
L.S.D $_{(gi-gj)}$ 0.05	----	2.666	5.321	2.867	0.261	4.048	5.543	1.081	0.250	0.166
L.S.D $_{(gi-gj)}$ 0.01	----	3.568	7.119	3.836	0.354	5.417	7.416	1.435	0.332	0.221

Table (7): Estimate of genetic components of variation in a diallel wheat cross for the studied traits

Component	Heading date	Maturity date	Plant height	Kernels weight/ spike	No.of grains/ spike	Grain yield/plant	Leaf temperature	Stomatal .resistant	Transpiration rate
D^{*}	53.127**	18.629**	0.898	3.762**	4.014**	0.147	2.34*	7.83**	2.01*
H_1	2.500*	6.227**	4.146**	3.511**	5.058**	3.972**	2.61**	24.01**	3.04**
H_2	3.539**	6.860**	2.937**	3.384**	4.867**	3.457**	3.27**	18.46**	2.03*
h^{*}_2	5.830**	6.120**	8.527**	4.429**	0.823	7.235**	-0.06	2.21*	2.15*
F^{*}	-5.170**	0.553	0.519	1.110	1.039	-0.572	11.90**	2.26*	3.01
E^{*}	10.996**	4.395**	1.531	0.467	0.622	2.614**	0.47	0.01	0.0002
$(H^{\wedge}_1/D)^{1/2}$	0.346	0.921	3.424**	1.539	1.789	8.296**	2.33*	1.98*	2.276*
$(H_2/4H_1)$	0.216	0.246	0.158	0.215	0.215	0.194	0.11	0.19	0.207
(KD/KR)	0.488	1.082	1.519	1.611	1.429	0.270	6.18	2.53	2.082
r	-0.554	0.897	-0.797	-0.281	0.645	-0.860	0.85	-0.35	0.54
Heritability									
N.sense	0.839	0.612	0.438	0.353	0.354	0.391	0.31	0.43	0.41
B.sense	0.891	0.884	0.855	0.946	0.949	0.796	0.73	0.89	0.85

*** Significant at 0.05 level of probability.**

r Correlation coefficient between parental mean performance (y_r) and order of dominance (w_r= v_r).

The value $(\hat{H}_1/\hat{D})^{1/2}$ was less than unity for days to heading days to maturity , indicating the presence of partial dominance . Similar results were obtained by kheiralla and El-Defrawy (1994) , Nayeem (1994) and kheiralla *et al* (2001).

The average frequency of negative versus positive alleles in the parents was detected by the ratio $(\hat{H}_2 / 4\hat{H}_1)$. If the distribution of both positive and negative gene among the parents is equal (U = V=0.5), the ratio is expected theoretically to be 0.25. The values of $(\hat{H}_2 / 4\hat{H}_1)$, were less than one quarter, in all studied traits, except for days to maturity indicating that the positive and negative alleles were not equally distributed among the parents.

Heritability values in broad sense were relatively very high in all studied characters Table (7) . On the other hand, narrow sense heritability estimates were relatively low for most of the traits, ranged from 0.002 to 0.612 except for heading date confirming the importance of non-additive gene effects in these traits. These findings might fervor the hybridization procedure as the most effective way to improve these characters. These results were in agreement with those obtained by Hendawy (1994), Khalifa et al (1998) and Abd El-Aty and Katta (2002).

High value of heritability in narrow sense was obtained for heading date (0.839), indicating that most of the genetic variance might be due to the additive type of gene action. This is an indicator to the efficiency of selection procedure in identifying the superior genotypes, hence , selection in these characters in early generations might be effective . Similar results were obtained by, Hamada (1993), Ageez and EL-Sherbeny (1998) and Abd El-Aty and Katta (2002).

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لتحليل الوراثى لبعض صفات الجفاف وبعض الصفات المرتبطة بـــالمحصول فـــى أصناف القمح الربيعي.

هانى ســـعد عبد الحميد البرهامى
قســـم بحوث القمح ، مـــعهد بحـــوث المحاصيل الحقلية ، مركز البحوث الزراعية

أجريت هذه الدراسة فى المزرعة البحثية بمحطة البحوث الزراعية بسخا محافظة كفرالشيخ خـــلال الموسمين ٢٠٠٠/٢٠٠١م ، ٢٠٠١/٢٠٠٢م وقد استخدمت ستة أصناف من قمح الخبز المختلفة فى صفاتـها الو راثية فيما بينها أجريت كل التهجينات الممكنة بين الأباء للحصول على ٢١ هجينا فيمـــا عـــدا الـــهجن العكسية وذلك لدراسة القدرة العامة والخاصة على الائتلاف بالإضافة إلى تقديـــر المكونـــات الـــو راثيـــة لمحصول الحبوب بالنبات والصفات المرتبطة به وهى تاريخ طرد السنابل وتاريخ النضج الفسيولجى وطـول النبات وعدد السنابل / نبات ووزن حبوب السنبلة وعدد الحبوب فى السنبلة ومحصـــول الحبـــوب / نبـــات وبعض قياسات الجفاف مثل درجة حرارة الورقة ومقاومة الثغر ومعامل النتح

وقد تم تحليل البيانات طبقا لطريقة جريضنج سنة ١٩٥٦م ، هايمن سنة ١٩٥٤م وتـــم الحصـــول على النتائج التالية وجود اختلافات معنوية جدا بين التراكيب الو راثية تحت الدراسة مـــاعدا صفـــة عـــدد السنابل / نبات . كان التباين الراجع للقدرة العامة على الائتلاف معنويا لكل الصفات مـــاعدا صفـــة عـــدد السنابل/ نبات وكان التباين الراجع للقدرة الخاصة على الائتلاف معنويا لكل الصفات ما عدا صفـــة تـــاريخ التزهير بينما كانت النسبة G.C.A/ S.C.A أعلى من الوحدة لكل الصفات المدروسة عدا درجة حـــرارة الورقة ومقاومة الثغر.

أظهرت الأصناف سخا ٨ و سخا ٦١ قدرة عامة على التآلف عالية بالنسبة لصفـــة التبكـــير فـــى النضج وكذلك الصنف سخا ٩٣ بالنسبة لصفات عدد حبوب السنبلة ووزن حبوب السنبلة وبالنسبة للصنفيـــن جيزة ١٦٨ وسدس ١ أظهرت قدرة ســـالبة مرغوبة لصفة المقاومة الثغر ومعامل النتح.

أظهرت الهجن (سخا ٦١xجيزة ١٦٣) قدرة خاصة على التالف لصفتـــي وزن حبـــوب الســـنبلة وعدد حبوب السنبلة و(سخا ٨ X سخا ٦١) بالنسبة لصفات درجة حرارة الورقة ومقاومة الثغـــر وأيضـــا معامل النتح .

أوضحت النتائج أهمية كل من الجينات المضيفة وغير المضيفة فى وراثة جميع الصفات المدروسـة فكانت الجينات ذات الأثر الإضافي أكثر أهمية فى وراثة صفات تاريخ طـــرد الســـنابل وتـــاريخ النضـــج الفسيولجى بينما كانت الجينات ذات الأثر السيادى تلعب دور هاما فى وراثة صفات طـــول النبـــات وعـــدد السنابل/نبات ووزن حبوب السنبلة وعدد حبوب السنبلة و محصول الحبوب للنبات الفردى وكذلك قياســـات الجفاف مثل درجة حرارة الورقة ومقاومة الثغر ومعامل النتح حيث أظهرت سيادة فائقة.

كانت النسبة ($\hat{H}_2 / 4\hat{H}_1$)مساوية تقريبا لقيمتها القصوى لصفـــات طـــرد الســـنابل ، النضـــج الفسيولجى ، عدد السنابل / نبات بينما انحرفت عن القيمة (٢٥ ر) بالنسبة لباقى الصفات .

أوضحت النتائج أن درجة التوريث بالمعنى الواسع كانت مرتفعة بنيمـــا كـــانت درجـــة التوريـــث بالمعنى الضيق مرتفعة لصفة تاريخ طرد السنابل مما يدل على تأثر هذه الصفة بالفعل المضيـــف للجينـــات وكانت درجة التوريث بالمعنى الضيق منخفضة لصفات تاريخ النضج الفسيولجى وطـــول النبـــات وعـــدد السنابل /نبات ، ووزن حبوب السنبلة ، عدد حبوب السنبلة ، محصول حبوب النبات الفردى ، درجة حـرارة الورقة ، مقاومة الثغر ، وكذلك معامل النتح حيث تتتأثر هذه الصفات بالفعل السيا