GENETIC BEHAVIOR OF GOSSYPOL CONTENT, SEED TRAITS AND YIELD COMPONENTS IN AN EGYPTIAN COTTON CROSS

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ABSTRACT

The present investigation aimed to study the genetic behavior of gossypol content in seeds as well as seed traits and yield traits of cotton. In addition, correlation between gossypol percentage and four seed traits (seed index, seed size, fuzz colour and fuzz distribution) and multiple regression analysis were performed to determine the variables of high contribution to the total variance of gossypol content in seeds. The marterials used included the P_1, P_2, F_1, F_2 and F_3 generations for the cross Giza 45 x BBB line at Sakha Agric. Res. Station during 2014 through 2017 seasons. Over dominance was observed for all the studied traits, except for seed size and fuzz colour which showed partial dominance in the F_2 generation. Inbreeding depression was positive and significant for seed yield, lint yield and fuzz distribution, while it was negative and significant for gossypol %, seed index and lint index in the F_2 generation. Inbreeding depression in the F_3 generation was negative and significant for gossypol % and seed index, while it was positive and significant for fuzz distribution on seed and lint%. Scaling test indicated that C and D values deviated from zero for most studied traits, indicating the presence of non- allelic interaction. Additive gene effects were significant for most studied traits, except for seed cotton yield, lint yield and lint %. Dominance and epistasis genetic effects were important in the inheritance of most studied traits. Results indicated that additive and dominance as well as some types of epistasis effects played an important role in the inheritance for most studied traits. The relationships between seed index and seed size, seed size and fuzz distribution were positive and significant, while they were negative and significant between gossypol percentage and fuzz distribution, seed index and fuzz colour, seed size and fuzz colour. Fuzz distribution was the highest contributor for total variance of gossypol percentage in all generations. It could be concluded that fuzz distribution was the main trait responsible for most of the variance of the gossypol percentage.

Key words: cotton, gossypium barbadense, gossypol content, yield, type of gene action correlation coefficients, regression analysis.

1. INTRODUCTION

Improvements of yield, fiber quality and seed components of cotton varieties are considered the main goals of cotton breeders for both human and animal consumption. Cotton contains gossypol as a polyphenolic compound that is an integral part of the cotton plants self – defense system against insect pests. However, the compound is toxic to animals, which limits the usefulness of cotton seed as animal feed. Upland cotton seed usually contains from 0.6 to 2 % gossypol (Lusas and Jividen, 1987)**.** Mohamed (2003) reported that gossypol content for brown cotton seed is higher (5.33 mg /g) compared with both Giza 80 and Giza 89 (4.04 and 4.14%) respectively. Mohamed and Hegazy (2008) revealed that Giza 70 exhibited special behavior; it attained the highest content of gossypol in cotton seed. Mohamed (2015) reported the predominance of dominance genetic variance in the inheritance of the gossypol content. El–Disouqi *et al.* (2000) stated that additive gene effects were significant and positive for cotton seed yield and lint yield per plant. They also reported that epistatsis components were greater in magnitude than additive or dominance components for most studied traits. El–Disouqi and Zeina (2000) reported that the none allelic interactions govern most of the studied traits. Soliman (2003) found that all types of gene effects were significant for yield. Dominance and epistatic were higher in

magnitude than additive effects in some traits.

The epistatic component dominance x dominance was quite positive and highly significant. Over dominance appeared to be controlling most studied traits in the F_1 and the F_2 generations Abou El-Yazied *et al.*,(2008). Nazmey (2012) found that additive gene effects were positive and significant for lint index, seed and lint yield per plant, and that dominance x dominance epistatic effects played important role in the inheritance of all yield component traits. Sultan (2017) reported that the epistasis type of additive x additive was significant for seed and lint yield and seed index. The epistasis type of dominance x dominance was positive and significant for seed index, while it was negative and significant for lint percentage and lint index, indicating that both additive and non additive gene effects controlled the genetic system for seed and lint yield. Dominance effects were highly significant and positive for lint yield per plant, while they were negative for lint %, seed index and lint index.

The objectives of this investigation were: (1) to estimate heterosis, potence ratio and inbreeding depression, (2) to determine the different types of gene action of gossypol percentage and other studied traits, and (3) to study the relative importance of seed traits to gossypol percentage in seed.

2. MATERIALS AND METHODS

The field experiment was carried out at Sakha Agricultural Res. Station during the seasons from 2014 to 2017. Two genotypes, namely the cultivar Giza 45 (an extra long staple, extra fineness, strong lint and high fiber quality) and BBB line (an extra long staple line, characterized by high gossypol, earliness and high yield) belonging to *G. barbadense* L. were supplied by the Cotton Breeding Section of Cotton Res. Inst., ARC. Crosses between the two genotypes were made in 2014 season to produce the F_1 seeds, which were grown in the next season (2015) to produce selfed seeds of the F_2 progeny. In 2016 season, the F_2 seeds were planted to produce selfed seed of the F_3 progeny. In 2017 season the seeds of the five populations (P_1, P_2, F_1, F_2 and F_3) were grown for evaluation. Each plot consisted of three rows, each row was 4 m long, 60 cm apart and 20 cm between hills. Hills were thinned to one plant / hill. Standard cultural practices were applied through out the

growing seasons.

The measurements were recorded on ten guarded individual plants for the two parents,21 individual plants of the F_1, 90 individual plants of the F_2 and 60 individual plants of the F_3 populations for the following characters:

1-Gossypol percentage in powdered seeds by the method described by the A.O.A.C. (2000).
2-Seed size represented by three scores as follows: (a) 2 is small, (b) 3 is medium and (c) 4 is large.
3-Fuzz color represented by five scores as follows: (a) 2 is white, (b)2 .5 is grey dark, (c) 3 is brown dark, (d) 3.5 is dark and (e) 4 is green.
4-Fuzz distribution on seeds represented by six scores as follows: (a) 2 is absent, (b) 2. 125 is small fuzz ⅛, (c) 2.25 is fuzz ¼, (d) 2.50 is fuzz ½, (e) 2.75 is fuzz ¾ and (f) 3 is complete fuzz.

Measurement of seed characters (seed size, fuzz color and fuzz distribution) were transformed to its Log 10).

5- Seed cotton yield per plant (g)
6- Lint yield per plant (g)
7- Lint percentage (L %): Obtained from the formula: L% = (lint yield / seed yield) x 100.
8-Seed index (SI): Estimated as weight of 100 seeds in grams.
9- Lint index (LI): was calculated using the formula: (S I x L %) / (100 – L).

2.1. Genetic analysis

Data for the studied traits were used to estimate means and variances for P_1, P_2, F_1, F_2 and F_3 generations. Heterosis over mid-parent (MP %) and better parent (BP %), Potence ratio (PR) were estimated according to Smith (1952) and inbreeding depression (ID %) were calculated as follows:

$$\text{MP heterosis \%} = \left\{ \left(\frac{F_1 - MP}{MP} \right) \times 100 \right\}$$

$$\text{BP heterosis \%} = \left\{ \left(\frac{F_1 - B.P}{B.P} \right) \times 100 \right\}$$

$$\text{PR in } F_1 = \left[(\overline{F1} - MP) / 1/2 (P2 - P1) \right]$$

$$\text{P R in } F_2 = \left[2(\overline{F2} - MP) / 1/2 (P1 - P2) \right]$$

$$(\text{ID \%}) F_2 = \left[[(\overline{F1} - \overline{F2}) / \overline{F1}] \times 100 \right]$$

$$(\text{I D \%}) F_3 = \left[[(\overline{F1} - \overline{F3}) / \overline{F1}] \times 100 \right]$$

Statistical significance of heterosis and inbreeding depression were determined by t-test using the appropriate least significant difference (L.S.D.) as follows: L.S.D for: Mid–Parent heterosis = tα x $\sqrt{3MSE/2r}$

Better parent and inbreeding depression = tα x $\sqrt{2MSE/r}$

The population means and variances were used to compute the scaling tests C and D to estimate the type of gene effects according to Mather and Jinks (1971).

Estimates of genetic components were estimated for five populations (five parameters model) according to Hayman (1958) using the following formulae and the calculated variance of these parameters was used to determine (Sd) for each parameter.

$M = F_2$, $d = [(1/2\ P_1) - (1/2\ P_2)]$, $h = [1/6\ (4\ F_1 + 12\ F_2 - 16\ F_3]$

$L\ (d\ x\ d) = [1/3(16F3 - 24F2 + 8F1)]$

$I\ (a\ x\ a) = \left[(P1 - F2) + \frac{1}{2}(P1 - P2 + h) - \frac{1}{4}L\right]$

Where: M = Mean performance of F_2, d = additive effect, h = dominance effect, L=Dominance x Dominance interaction, I = Additive x Additive interaction.

Calculating correlation coefficient between gossypol percentage and four seed traits (seed index, seed size, fuzz color and fuzz distribution) and multiple regression analysis was carried out according to Draper and Smith (1966) to determine the best variables accounted for most variance of gossypol content in seed cotton. Data obtained were computed using Minitab software.

3. RESULTS AND DISCUSSION

Mean values of the studied traits, heterosis, potence ratio and inbreeding depression are presented in Table (1). The results indicated that the two parents exhibited significant difference for gossypol % and seed traits. The first parent (BBB line) exhibited higher values for gossypol %, seed size and fuzz distribution than the second parent (cultivar Giza 45), while the two parents differed for fuzz color. Non-significant differences existed between the two parents for seed yield, lint yield and lint %.

Concerning the F_1 generation means, seed cotton yield, lint yield and fuzz distribution were less than the means of Giza 45, while the other traits were intermediate between the two parents. Heterosis over mid parent was non-significant for all the studied traits. Moreover, negative and significant heterosis relative to the better parent was obtained for gossypol %, seed index and seed traits. Different results were obtained by El-Helw (2002) who reported positive and highly significant heterotic effect relative to the mid

parent for seed cotton yield/plant, lint yield and lint %.

Potence ratio (Table 1) revealed over dominance for seed cotton yield ,lint yield, lint % and fuzz distribution of the F_1 generation, while potence ratio was less than unity, indicating partial dominance for gossypol %, seed size and fuzz colour.

The F_2 generation showed the highest performance for gossypol %, fuzz color, lint % and lint index surpassed the higher parent (BBB line). It was less than the F_1 generation and second parent (Giza 45) for yield traits.

These results are in harmony with the values of F_2 potence ratio in Table (1) , indicating over dominance of the second parent (Giza 45) for seed and lint yield, lint % and fuzz distribution. Potence ratio (Table 1) revealed over dominance for higher gossypol percentage, seed index and lint index in the F_2 generation. Similar results were reported by El-Akheder (2001), who stated that over dominance controlled inheritance of seed cotton yield and lint yield.

Inbreeding depression was higher for seed and lint yield in the F_2 generation, while it was highly significant for gossypol %, fuzz distribution, seed index and lint index.

Concerning the F_3 generation, the data in Table (1) showed that the values of mean performance of F_3 generation were the highest for gossypol % and seed index surpassed from parent BBB line, while the fuzz distribution and fuzz color were intermediate between the two parents.

Mean performance of the F_3 generation for yield traits did not differ from the higher parent BBB line. These results are in harmony with inbreeding depression of the F_3 generation (Table1) with negative values, indicating that the F_3 generation surpassed the higher parent (BBB line), except for fuzz distribution and lint index.

3.1. Gene action and type of epistasis

Results of scaling tests C and D for the studied traits are presented in Table (2). Data showed that one or both of C and D were significant for all the studied traits, indicating the presence of non allelic interaction for all the studied traits (12 out 18). Scaling tests gave trends of significance of non allelic for all the studied traits, except for seed size and fuzz colour indicatingabsence of the non allelic interaction for these two traits.

Table (1): Mean performance, ± standard error, heterosis % relative to mid parent (MP), better parent (BP), potence ratio (PR) and inbreeding depression (ID) of parents, the F₁, the F₂ and F₃ generations in the cotton cross used.

Generations		Gossypol %	Seed size	Fuzz colour	Fuzz distribution	Seed cotton yield /Plant (g)	Lint yield / Plant (g)	Lint %	Seed index (g)	Lint index
P₁ (BBB)		0.32±0.04	60.2±0	30.1±0	47.7±0	103.4±18.89	36.24±6.38	34.95±1.33	13.65± 0.40	7.33±0.32
P₂ (G.45)		0.21±0.02	30.1±0	47.7±0	39.8±0	97.34± 12.81	34.97±4.66	35.82±0.64	11.52±0.18	5.84±056
F₁	Mean	0.23±0.01	43.97±0	41.0±1.91	38.89±1.06	86.1±9.27	31.94± 3.55	36.72±0.72	11.90±0.27	6.95±0.26
	MP	-12.50	-2.61	5.39	-11.12	-14.22	-10.29	3.77	-5.47	5.45
	BP	-26.67**	-26.96**	-14.06**	-18.48**	-16.73	-11.86	2.51	-12.83**	-5.27
	PR	-0.65	-0.08	-0.24	-1.23	-4.71	-5.77	-3.07	-0.65	0.48
F₂	Mean	0.75±0.11	45.98±0.96	52.2±8.05	34.98±0.46	70.99±3.52	26.29±1.35	36.83±0.37	13.31±0.12	7.79±0.11
	PR	18.88	0.11	-0.14	-4.44	-19.39	-29.33	-6.65	1.37	3.22
	ID	-222.68**	-4.57	3.62	10.04**	17.55**	17.68**	-0.31	-11.89**	-12.11**
F₃	Mean	0.85±0.03	47.07±0.78	44.30±1.02	34.24±0.34	103.55±5.62	35.80± 2.12	34.26±0.46	13.98±0.17	7.31±0.14
	ID	-266.67**	-7.04	-8.07	11.96**	-20.26**	-12.08**	6.69**	-17.49**	-5.21

*, ** Significant at 0.05and 0.01 levels of probability, respectively

Table (2): Scaling test values and gene effects for the studied traits in the cotton cross used.

Traits	Scaling test		Gene effects					Type of epistesis
	C	D	M Mean (F$_2$)	d (Additive)	h (Dominance)	L (Dom x Dom)	I (Ad x Ad)	
Gossypol %	1.99** ±0.46	1.37** ±0.25	0.75** ±0.12	0.05* ±0.02	-0.61** ±0.24	-0.83 ±0.93	-0.48 ±0.26	--
Seed size	5.69 ±6.55	6.00 ±3.66	45.98** ±0.96	15.05** ±0.00	-4.23 ±3.34	0.42** ±11.23	27.05** ±3.27	Duplicate
Fuzz colour	49.01 ±32.44	-4.99 ±16.61	53.20** ±8.05	-8.80** ±0.00	13.59 ±16.38	-72.00* ±64.85	-6.11 ±18.17	---
Fuzz distribution	-25.34** ±0.00	-20.52** ±0.00	34.98** ±0.46	3.95** ±0.00	4.59** ±1.47	6.43 ±4.96	17.36** ±0.00	Complementary
Seed cotton yield / Plant (g)	-88.98 ** ± 32.60	71.48** ± 32.79	70.99** ±3.52	3.03 ±11.41	-76.76** ±17.67	213.96** ±47.96	-56.43* ± 29.55	Duplicate
Lint yield /plant (g)	-29.92** ±11.92	19.41 ** ± 11.90	26.29** ±1.35	0.64 ±3.95	-21.59** ±6.70	65.77** ±18.27	-16.66* ±10.49	Duplicate
Lint %	3.11 ± 2.55	-7.38** ± 2.46	36.83** ±0.37	-0.44 ±0.74	6.77** ±1.51	-14.0** ±4.32	4.57* ±2.11	Duplicate
Seed index (g)	4.28** ± 0.84	4.12** ± 0.83	13.31** ±0.12	1.06* ±0.22	-2.72** ±0.53	-0.22 ±1.48	0.09 ±0.67	-
Lint index	4.09** ± 0.94	0.48 ±0.90	7.79** ±0.11	0.75* ±0.32	0.72* ±0.48	4.80** ±1. 36	1.85** ±0.83	Complementary

*, ** Significant at 0.05 and 0. 01 levels of probability, respectively

Data in Table (2) showed that the mean effects of the F_2 generation (M) were highly significant for all the studied traits, suggesting that these traits had quantitative inheritance. Results showed that the additive gene effects (d) were non-significant for seed and lint yield as well as lint percentage. It also indicated that additive gene effects were significant or highly significant for gossypol %, seed traits, seed index and lint index. The data in Table (2) showed that dominance gene effects (h)were highly significant or significant for all traits, except for seed size and fuzz color. Improvement of these traits could be achieved through recurrent selection (Singh and Naryaran, 2000). These results are in harmony with those obtained by Abou El-Yazid *et al.* (2008).

The type of epistasis dominance x dominance (L) was positive and significant for most studied traits, except for gossypol %, fuzz distribution and seed index. While additive x additive (I) was significant for seed size and fuzz distribution, seed yield, lint yield, lint % and lint index.

Data in Table (2) showed that duplicated epistasis for seed size, seed yield, lint yield and lint%; suggesting a duplicate interaction due to little heterotic effects. The results showed complementary type of epistasis for fuzz distribution and lint index, indicating a complementary nature between dominance and dominance x dominance due to increase of heterotic effects.

3.2. The relationship between seed characters and gossypol percentage

Table (3) showed that the relationship between gossypol % and fuzz distribution was negative with highly significant correlation.The same was true between seed index and fuzz color, between seed size and fuzz color and between fuzz colour and fuzz distribution for all generations as bulk. While there was a positive and significant correlation between seed index and seed size and also between seed size and fuzz distribution. Asghar and Iqbal (2012) did not find any relative contributor between gossypol and seed cotton yield.

3.3. The prediction of gossypol content in cotton seed

The multiple regression analysis presented in Table (4) revealed that four variables model is the best equation to determine the prediction of gossypol %, mean variance of the F_3 and all

generations as bulk were highly significant, while the equation determining for the two generations the F_1 and the F_2 showed that the four variables model of gossypol % prediction were not the best equation because they had non-significant values.

Table (5) showed the coefficients of determination of the best variables in the P_1, P_2, F_1 , F_2, F_3 and all generations as bulk. Regarding the two parents P_1 and P_2, seed index was considered to have direct effect on gossypol %, as it was responsible for 2.4% and 2.0 % reduction in gossypol % variance, while excluded variables were responsible for 97 % and 98% for the two parents , respectively.
The equation predictor for P_1 (BBB line) is:
$\hat{Y}$= 0.654 - 0.024 seed index
The equation predictor for P_2 (Giza 45) is:
$\hat{Y}$ = -0.02 + 0.02 seed index

For the F_1 generation, seed index was the highest contributor for gossypol % variance. It was responsible for % 0.3 reduction of the total gossypol % variance.The other contributors were seed size and fuzz distribution. which were responsible for % 0.2 of the total gossypol % variance. While fuzz color was a less contributor of total gossypol % variance as it was responsible for 0.01% of the total variance. Four contributors were responsible for reduction 0.07 % of the total gossypol % variance.
The prediction equation for the F_1 generation is:
$\hat{Y}$ = 0.226 +0.003 seed index + 0.002 seed size - 0.0001 fuzz color.

Regarding the two generations the F_2 and F_3, the results in Table (5) indicated that seed index was the highest contributor of the total gossypol variance. It was responsible for 9.2 % and 4% of the total variance for the F_2 and the F_3 generations,respectively. While fuzz distribution was the second contributor of total gossypol % variance. It was responsible 5.1% and 3.2 % of total variance for the F_2 and the F_3 generations, respectively.
The data in Table (5) showed that the variable of fuzz color was less contributor for gossypol % variance. It was responsible for 0.01% and 0.04% for the F_2 and F_3 generations, respectively. The four traits represented 14.9% and 8.3 % of the total gossypol % variance, while the excluded variables represented 85.1% and 91.7% for the F_2 and the F_3 generations, respectively.

Table (3): Correlation coefficients between gossypol % and seed traits.

Traits	Seed index	Gossypol %	Seed size	Fuzz colour
Gossypol %	0.039	-	-	-
Seed size	0.419**	-0.098	-	-
Fuzz colour	-0.227**	0.084	-0.268**	
Fuzz distribution	0.089	-0.272**	0.347**	-0.343**

*, ** Significant at 0.05 and 0. 01 levels of probability, respectively

Table (4): Analysis of variance for multiple linear regression for all generations.

Variance	P_1		P_2		F_1		F_2		F_3		All generations	
	MS	df	M.S	df	MS	df	MS	df	MS	df	MS	df
Regression	0.009	1	0.001	1	0.001	4	1.49	4	0.113*	4	3.015**	4
Residual	0.012	8	0.003	8	0.0004	16	1.17	85	0.033	55	0.568	186

*, ** Significant at 0.05 and 0. 01 levels of probability, respectively

Table (5): Coefficient of determination predicted for gossypol percentage in cotton seed and seed traits in all generations.

	P_1 (BBB)	P_2 (G.45)	F_1	F_2	F_3	All generations as bulk
Constant	0.654	0.020	0.226	3.57	2.07	2.23
Variables	P_1 (BBB)	P_2 (G.45)	F_1	F_2	F_3	All generations as bulk
Seed index	-0.024	0.020	0.003	-0.092	-0.041	-0.006
Seed size	----	----	0.002	0.005	0.006	0.012
Fuzz colour	----	----	0.0001	-0.001	0.004	-0.001
Fuzz distribution	----	----	-0.002	-0.051	-0.032	-0.055
Total of variance	0.024	0.020	0.007	0.149	0.083	0.074
Excluded variables	0.976	0.98	0.993	0.851	0.917	0.926

The prediction equation for F_2 generation is:$\hat{Y} = 3.57 - 0.092$ seed index $+ 0.005$ seed size $- 0.0008$ fuzz color $- 0.051$ fuzz distribution.

The predicted equation for the F_3 generation is:
$\hat{Y}\% = 2.07 - 0.041$ seed index $+ 0.006$ seed size $+ 0.0038$ fuzz color $- 0.0316$ fuzz distribution.

Concerning all generations as bulk, the data in Table (5) showed that fuzz distribution was the highest contributor for the total gossypol % variance. It was responsible for 5.5% for total gossypol % variance.

Second contributor was seed size.It was responsible for 1.20 %, seed index was the third contributor. It was responsible for 0.6% for the total variance of the total gossypol %, while fuzz colour was the forth contributor. It was responsible for 0.07% of the total gossypol % variance. The four variables responsible for 7.4 % of total variance, while the excluded variables represented 92.6 % of the total variance of gossypol %. Moreover, there were other variables, which were responsible for gossypol percentage in seeds. The predicted equation for all generations as bulk is:
$\hat{Y} = 2.23 - 0.0057$ seed index $+ 0.0118$ seed size $- 0.0007$ fuzz color $- 0.055$ fuzz distribution.

Conclusion

From the results presented in this study, it could be concluded that additive and dominance as well as some types of epistasis effects played important roles in the inheritance of most studied traits. Negative and significant correlations were obtained between gossypol % and fuzz distribution, seed index and fuzz colour, seed size and fuzz color. It could be concluded that fuzz distribution was the highest contributor for total variance of gossypol percentage in all generations.

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السلوك الوراثي لمحتوى الجوسيبول في بذرة القطن وصفات البذرة ومكونات المحصول فى هجين من القطن المصري

عزيزة محمد محمد سلطان

معهد بحوث القطن – مركز البحوث الزراعية – مصر

ملخص

يعتبر ارتفاع نسبة الجوسيبول في بذرة القطن من أهم المشاكل التي تواجه استخدام البذرة كعلف للحيوانات كما أن نسبة الجوسيبول المرتفعة لها أهمية للمقاومة للحشرات لذلك تهدف هذه الدراسة لمعرفة السلوك الوراثي لنسبة الجوسيبول في البذرة وبعض صفات البذرة - صفات المحصول- وقوة الهجين - درجة السيادة - الانخفاض الراجع للتربية الداخلية- الفعل الجيني -الارتباط بين نسبة الجوسيبول في البذرة وأربعة صفات للبذرة وهى (حجم البذرة ،لون الزغب على البذرة ،توزيع الزغب على البذرة ومعامل البذرة) وكذلك الانحدار المتعدد لأربعة صفات لنسبة الجوسيبول في بذرة القطن لتحديد أفضل المتغيرات المساهمة لأجمالي التباين .

أجريت هذه الدراسة على خمسة عشائر وهى الآباء والجيل الأول والجيل الثاني والجيل الثالث وذلك في هجين من القطن المصري و هو (جيزة 45 x BBB line) ، تم زراعة الخمسة عشائر كنباتات فردية في خطوط طول الخط 4 م وزرعت النباتات على مسافة 20 سم تمثل الزراعة العادية بمحطة البحوث الزراعية بسخا خلال أربعة مواسم من 2014الى2017.أوضحت النتائج مايلى:

1- وجود سيادة فائقة سواء سالبة أو موجبة لمعظم الصفات تحت الدراسة في الجيل الأول والثاني عدا نسبة الجوسيبول و حجم البذرة ولون الزغب ومعامل البذرة ومعامل الشعر في الجيل الأول بينما أظهرت حجم البذرة ولون الزغب في الجيل الثاني سيادة جزئية .

2- كانت قيم الانخفاض الراجع للتربية الداخلية معنوية وموجبة لصفتي محصول الزهر والشعر للنبات وتوزيع الزغب على البذرة بينما كانت معنوية وسالبة لصفات نسبة الجوسيبول في البذرة ومعامل البذرة ومعامل الشعر في الجيل الثاني ، كانت أيضا معنوية وموجبة لصفات توزيع الزغب على البذرة ونسبة التصافي بينما كانت معنوية وسالبة لصفات نسبة الجوسيبول في البذرة ومعامل البذرة.

3- أظهرت النتائج معنوية سواء موجبة أو سالبة لتأثير الفعل الجيني المضيف لكل الصفات المدروسة ماعدا محصول الزهر والشعر و نسبة التصافي.

4- كان التأثير السيادي معنوي سواء موجب أو سالب لمعظم الصفات المدروسة عدا حجم البذرة و لون الزغب

5- وجود تأثير معنوي للتفاعل بين العوامل الوراثية (السيادي x السيادي) عالي المعنوية وموجب لصفات محصول الزهر والشعر ومعامل الشعر وسالب لنسبة التصافي مما يؤكد أن الفعل الجيني للتفاعل السيادي x السيادي له دور في وراثة صفات المحصول ومكوناته وأيضا معنوي وموجب لصفات حجم البذرة وتوزيع الزغب.

6- كما توضح الدراسة أن الفعل الجيني للتفاعل (المضيف x المضيف) عالي المعنوية وموجب لصفات حجم البذرة وتوزيع الزغب ونسبة التصافي ومعامل الشعر وأيضا عالي المعنوية وسالب لصفات محصول الزهر .

7- أوضحت دراسة العلاقة بين نسبة الجوسيبول في البذرة وبين صفات البذرة وجود ارتباط سالب ومعنوي بين نسبة الجوسيبول في البذرة وتوزيع الزغب على البذرة ،وكذلك بين معامل البذرة ولون الزغب، وبين حجم البذرة و لون الزغب ،وبين لون البذرة وحجم البذرة وأيضا بين لون البذرة وتوزيع الزغب ، كذلك كان هناك ارتباط موجب معنوي بين معامل البذرة وحجم البذرة، وحجم البذرة وتوزيع الزغب.

8 –أوضح تحليل الانحدار المتعدد لأربعة صفات للبذرة وهى (معامل البذرة، حجم البذرة، لون الزغب، توزيع الزغب على البذرة) أن توزيع الزغب على البذرة أعلى مساهم لإجمالي التباين في نسبة الجوسيبول مقارنة بالعوامل الأخرى تحت الدراسة.