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GENETIC BEHAVIOR OF SOME IMPORTANT YIELD AND YIELD COMPONENT TRAITS OF WATERMELON ,*Citrluus lanatus ,thumb*.

El-Diasty, Z. M.*; Z. A. Kosba; M. M. Abd El-Rahman and A. M. El-Shoura****

*** Dept. of Genet. Fac. Of Agric; Mansura University. Egypt**

**** Horticulture Research Institute, Agric. Res. Cent. Egypt.**

ABSTRACT

Watermelon (citrullus lanatus. Thunb.) is an important vegetable crop grown in Egypt. This study was planned to obtain an information about the nature of heterosis , gene action and correlation among yield and yield component traits of water melon.These genetic information could be used to improve the productivity and quality of watermelon . A complete diallel crosses mating design was used among five watermelon varieties named as; Giza-1, Giza- 21, Charleston gray, Crimson sweet and Dulzero were performed. Different traits were number of fruit per plant ,total yield per plant in kilogram,total yield per plot in kilogram, average fruit weight ,fruit length , fruit daimeter and shape index.

The results reveald that the average means of the F_1 hybrids, F_{1r} reciprocal hybrids and overall F1 hybrids significantly exceeded the mid-parents , althought there was no single hybrids exceeded the means of the parental varieties for all studied yield and yield component traits .

The results also indicated that the magnitudes of the non-additive genetic variances including dominance were larger than their corresponding estimates of additive genetic variances for all studied traits.In the same time , the obtained values of additive genetic variances could not be neglected

The estimates of heritability in broad sense were larger in magnitudes than those estimates of heritability in narrow sense for all studied traits.

The results illustrated that both phenotypic and genotypic correlation coefficients values were closed to each other with respect to most pairs of studied traits. In this respect ,positive genotypic (rg) and phenotypic (rph) correlation and highly significant was present.It could be regarded that(N.F./P.) was significantly correlated (T.Y/P..), (T.Y/Pt.), (A.F.W kg), In general ,selection program specially reciprocal recurrent selection could be used to improve watermelon traits .

INTRODUCTION

Watermelon *(citrullus lanatus. Thunb*) is one of the most important economic vegetable crops grown in Egypt. Although ,very little genetical studies have been done on this plant quite a few authors did research work on other related vegetable crops . Therefore , this research was conducted to present answers through the investigation of hybrid vigor , heritability ,correlation coefficient and the nature of gene action associated with each of them.The obtained results could present an informatin for plant breeders through suitable breeding program. El-Doweny (1985).studied some F_1 hybrids of sweet melon . He suggested that fruit weight trait was affected by two factors .In melon , Shmuradova (1990) indicated that the highest estimated heterosis value over the better parent was 162.8 % for yieling which was regarded in cross (Desertnaya 5 x Early Gold). Kosba and El-Diasty (1991) studied heterosis in 12 F_1 hybrids obtained from four varieties of melon . They recorded that the estimated values of heterosis versus the mid-parents were significant for all studied yield traits .They also added that the esimated values of heterosis were 62.57 %for fruit diameter .While, the estimated values of heterosis against the better parent were 15.9 ,9.0,36.7,1.9,31.9 and 16.1 for thickness of flesh,taste,fruit weight,shape index,fruit diameter and fruit weight,respectively.Prasad and Singh (1992) in cucumber ,regarded that the values of heritability for number of fruits and yield per plant were low . In the same time,Awny (1992)recorded high values for both general and cpecific combining abilities on cucumber.Hatem et al. (1995).studied the genetic behavior of total fruits number in melon using a 4 X 4 partial diallel crosses .They claimed that genes with additive and non-additive effects were involved in the inheritance of this trait.The estimated ratio between GCA and SCA mean squares suggested that the additive gene effects played the major role in the inheritance of this trait . In squash,El-Gendy (1999) caculated the values of heritability and found that heritability in broad sense in F_1 hybrids were : 78.66; 89.76; 98.72; 94.02 and 97.05 for number of fruits per plant,average fruit wieght per plant,fruit length,fruit diameter and fruit shape index,in the F1hybrids ,respectively. She also cleared that the estimates of narrow sense heritability in F_1 hybrids were: 26.89 % ; 44.44 % ; 74.12 % ; 70.98 % and 86.26 and 75.94 % for the same obvious traits,respectively. Abd El-Rahman *et al* (2000) evaluated the F1 hybrids of pumpkin .They cleard that the narrow sense heritability estimates were 29.36 and 138.81 % for fruit weight and fruit shape index,respectively They also added that the broad sense heritability estimates were 32.66 and 67.16% for the same traits,respectively, Ferreira *et al* (2003).estimated genotypic and phenotypic correlations in seven watermelon varieties (Cultivars B9 ,Charleston gray,Crimson seet,New H.Midget,M7,P14andB13). They cleared that genotypic correlationswere observed between number of fruits per plant and fruit weight ; longitudal and transversal fruit diameter ,they also added that the incease in the number of fruits per plant was correlated with a reduction in fruit weight and fruit size . Abdein (2005) in squash indicated that most pairs of studied traits exhibited negative genotypic and phentypic correlation coefficients,while the following pairs of traits showed significant positive genotypic and phenotypic correlation .Number of fruits per plant and fruit length , fruit yield per plant and average fruit weight.

MATERIALS AND METHODS

In this investigation, five different varieties of watermelon were used . All these varieties belong to the specie *Citrullus lantatus, Thunb* Seeds of all varieties were obtained from the Vegetable Research Iinstitute, Agricultural Research Center, Ministry of Agriculture in Giza, Egypt. These varieties were: Giza-1, Giza-21, Charleston gray, Crimson sweet and Dulzera. These parental varieties varied with respect to the time of complete maturity and fruit characteristics. The five parental varieties were crossed among them to obtain 10 F_1 hybrids and 10 reciprocal F_1 hybrids (F_{1r}) through complete diallel crosses mating design.in the season 2005

The genetic materials which included five parental varieties, 10 F_1 hybrids and 10 F_1 reciprocal hybrids were evaluated in the growing season of 2006. The experiment was conducted in a field trail experiment at El-Baramoun Research station, Mansoura, Dakhalia governorate. The used experimental design was the randomized complete blocks design (R.C.B.D) with three replicates. Each plot was one ridge 10 m. length and 2 m. width. The distance between hills was 1.0 m. long apart. Therefore, each ridge contained 10 hills. all cultural practices were made as recommended for watermelon.

Data were recorded on the following traits:

1- number of fruits per plant.(N.F./P.)
2- total yield per plant.(T.Y./P.kg)
3- total yield per plot.(T.Y./Pt.kg.)
4- average fruit weight in kilogram(A.F.W.kg)
5- fruit length in centimeters.(F.L.cm).
6- fruit diameter in centimeters.(F.D.cm).
7- shape index .(Sh .I)

Analysis of variances were made to test the significance of differences among the five parental varieties. The differences between any two means were tested for significance using (L.S.D) at both 5% and 1% levels of significanceas outlined by Steel and Torrie (1960).

$L.S.D._{(5\%)} = t_{0.05\ EdF} \times S^{-}d$, $L.S.D._{(1\%)} = t_{0.01EdF} \times S^{-}d$ and

$$S^{-}d = \sqrt{\frac{E.M.S}{K} \times \frac{n_1 + n_2}{n_1\, n_2}}$$

Where :

Edf: is number of error degree of freedom
EMS: is error mean squre
n1: is number of genotypes involved in the first mean
n2: is number of genotypes involved in the second mean

Estimation of heterosis:

Heterosis values were calculated at the deviation of F1, F1 reciprocal and all $F_{1,1r}$ hybrids from the mid and the better parents as followes

1- Heterosis versus the mid- parents:

2- Heterosis against the better parents:

In this investigation five parental varieties were crossed among them according to complete diallel crosses mating design to produce 10 F_1 hybrids and 10 F_1reciprocal hybrids to determine general (GCA) and specific (SCA) combining abilities. The variances of reciprocal effects were also obtained. The procedures of the analysis of variances were made according to Griffing's method1 (1956) and outlined by Singh and Chaudharry (1985). Therefore, the form of the combining ability variances and the expectations of the mean squares are shown in Table 1.

D- Estimates of heritability:

The estimates of heritability in broad sense were determined according to the following equation:

a = heritability in broad sense ($h^2_{b.s}$) = $$\frac{O'^2A + O'^2D}{O'^2A + O'^2D + O'^2r + O'^2e/k}$$

b = heritability in narrow sense ($h^2_{n.s}$) = $$\frac{O'^2A}{O'^2A + O'^2D + O'^2r + O'^2e/k}$$

Table 1: The form of the analysis of combining abilities and exceptations of the mean squares

S.V	D.F	Ms	E.M.S
GCA	n-1	Mg	O'^2e +2(n-1)2/n. O'^2s: +2n O'^2g
SCA	n(n-1)/2	Ms	O'^2e +2(n^2-n+1)/n^2. O'^2s:
Reci.	n(n-1)/2	Mr	O'^2e +2 O'^2r
Error	(r-1)(9-1)	Me	O'^2e

Where:

n: is number of parents

O'^2g: is the variance of general combining ability

O'^2s: is the variance of specific combining ability

O'^2r: is the variance of reciprocal effects

O'^2e: is the error of variance

Mg, Ms, Mr amd Me: are the mean square of GCA, SCA, RE and error, respectively.

Genotypic and phenotypic correlations among pairs of studied traits were calculated according to Steel and Torrie (1960) and as outlined by Singh and Chaudharry (1985) as shown in Table 2.

The genotypic (rg) and phenotypic (rph) correlations for any pair of studied traits could be calculated according to the following equations:

Genotypic correlation (rg) =

Phenotypic correlation (rph) =

Where:

$\delta g_1 g_2$: is the genotypic covariance between any two traits

$\delta ph_1 ph_2$: is the phenotypic covariance between any two traits

$\delta^2 g_1$ and $\delta^2 g_2$: are the genotypic variance of the first and second trait, respectively.

$\delta^2 ph_1$ and $\delta^2 ph_2$: are the phenotypic variance of the first and second trait, respectively.

The significance of the (rg) and (rph) was tested by using the "t" test at 5 and 1% levels of significance as described by Cochran and Cox (1957) as follow:

Calculated "t" for genotypic correlation =

Calculated "t" for phenotypic correlation =

Table 2: The form of analysis of variance, covariance and the expectations of mean squares and mean products

S.V	d.f	M.S	Analysis of variance	M.P	Analysis of variance
Replications	(k-1)				
Genotypes	(g-1)	M_2	O'^2e - k O'^2g	MP_2	$\delta e_1 e_2 + k\delta g_1 g_2$
Error	(k-1)(g-1)	M_1	O'^2e	MP_1	$\delta e_1 e_2$

Where:
K: is number of replications.
g: is number of genotypes.
$O'^2g = (M_2 - M_1)/k$.
$\delta g_1 g_2 = (MP_2 - MP_1)/k$.
$\delta^2 Ph = (O'^2g + O'^2e)/k$.

RESULTS AND DISCUSSION

A-The mean performances of genotypes

The means of yield and yield component trairs were obtained for all parental varieties ,F1hybrids.F1r reciprocal hybrids and the results are presented in Table 3. The results illustrated that the values of the means indicated that the parental variety Charleston gray (P3) exhibited the highest number of fruits per plant ,total yield per plant, total yield per plot,average fruit weight and fruit length .On the other hand, Giza-1variety(P_1) gave the lowest means for the same traits .The results also indicated that the highest F_1 hybrid was (P_1 X P_3) with the mean of 4.33,23.87,238.9 and 5.97 for (N.F./P).(T.Y./P.).(T.Y./Pt)and (A.F.W.kg.), respectively.While, The F1hybrids (P1 X P2)was the lowest with the means of 13.9,139.0 and 4.2 for (T.Y./P.),(T.Y./Pt) and (A.F.W. kg). On the other hand , F1 hybrids (P2 XP5 was the lowest with the means 22.97 and 18.30 for (F.L cm)and (F.D.cm), respectively .Wherase,the highest F1r reciprocal hybrids was (P3 X P1)with the means 20.35,203.5 and 6.10 for (T.Y./P.) ,(T.Y/Pt.) .While,(P1 XP1) was the lowest with the means 11.82,118.2 and 4.0 for T.Y./P,T.Y./Pt and A.F.W kg . In the same time (P5 XP4)was the highest with mean of 3.67 for N.F./P

The values of heterosis was determined from the mid-parents and the better parent.In addition, the means ,ranges of F1 hybridsand F1r hybrids and the results ars presented in Table 4.

The estimated amounts of heterosis from the mid-parents ranged from 7.14%(F_{1r}) to 23.43% (F_1) for N.F./P. ; 23.68% (F_1r) to 43.30% (F_1) for T.Y./P ; 23.68% (F1r)to 43.30% (F_1) for T.Y.Pt. ; 18.49% (F_{1r}) to19.41 %(F_1) for A.F.W. kg ;-9.84%(F_1r) to –9.36%(F_1)FOR F.Lcm ;-12.05% (F_1) to –9.38%(F_{1r})forF.D.cm and-3.49% (F_{1r}) to 5.98% (F1) for Sh.I. On the other hand,The values of heterosis measured from the better parent and ranged from –9.910 % (F_{1r}) to 3.78% (F_1) for N.F.P ;-15.61% (F1r) to –2.22 % (F_1) for T.Y/P. ;-15.61 %(F_{1r}) to-2.22% (F_1)for T.Y./Pt. ;-5.85% (F1r) to-5.12% (F_1) for A.F.W.kg. ; -30.78% (F1r) to-30.41% (F_1) for F.Lcm ;-29.57% (F_1) to28.50% (F1r) for F.D.cm and –45.32% (F1r) to-39.96%(F1) for Sh.I .,,respectively . Many investegators found similar results among them ,El-Doweny (1985) ,Shamurada (1990) and Kosba and El-Diasty (1993)

Table 3: The means performances of five parental varieties$_1$ and F_{1r} hybrids for all studied Yield and yield component trait.

Gen.	N.F./P.	T.Y./Pkg.	T.Y./Ptkg.	A.F.W.kg..	F.L. cm	F.D cm.	Sh. I .L/D.
1	2.00	6.3	63	3.10	26.9	29.23	0.92
2	3.00	10.7	107	3.50	28.13	32.17	0.88
3	3.33	18.1	181	5.43	41.67	19.67	2.13
4	2.67	14.2	142	5.30	37.63	27.30	1.39
5	3.00	12.3	123	4.25	25.60	36.07	0.71
1X2	3.33	13.9	139	4.20	27.93	29.07	0.96
1X3	4.33	23.9	239	5.97	24.03	31.63	1.33
1X4	3.00	17.2	172	5.70	32.03	32.30	0.99
1X5	3.33	15.1	151	4.50	24.90	27.43	0.91
2X3	3.67	18.4	184	5.00	33.87	20.40	1.66
2X4	3.00	16.8	168	5.60	28.47	27.03	1.08
2X5	3.33	15.00	150	4.50	22.97	18.30	1.33
3X4	4.00	20.2	202	5.00	36.40	20.24	1.80
3X5	3.33	18.9	189	5.68	32.40	18.10	1.79
4X5	3.33	17.9	179	5.40	26.97	29.56	0.92
2X1	3.00	11.8	118	4.00	25.23	27.42	0.92
3X1	3.33	20.4	204	6.10	25.53	23.23	1.10
4X1	2.33	12.3	123	5.35	29.07	28.78	1.01
5X1	3.00	12.8	128	4.20	22.73	17.50	1.30
3X2	2.67	14.5	145	5.50	36.87	21.70	1.70
4X2	3.00	15.3	153	5.00	29.10	26.46	1.10
5X2	3.33	16.2	162	4.80	27.73	36.52	0.76
4X3	3.00	16.2	162	5.40	35.53	18.70	1.90
5X3	2.67	16.0	160	6.00	31.57	33.94	0.93
5X4	3.00	17.4	174	4.80	25.07	27.53	0.91
L.S.D0.05	1.33	7.01	70.14	0.540	2.83	2.536	0.104
L.S.D.0.01	1.78	9.38	93.85	0.722	3.79	3.394	0.140

Table 4: The means and the ranges of the parental varieties ,F1hybrids,F1r reciprocal hybridsand over all F1,1r hybrids and heterosis values versus the mid-parents and the better parent for all studied yield and yield component trait

	N.F./P.	T.Y./P	T.Y./Pt	A.F.W.kg.	F.L. cm	F.Dcm	Sh. I .L/D.
M.P	2.80	12.373	123	4.317	31.992	28.888	1.205
Range	2.00-3.33	6.283-18.133	62.8-181.3	3.10-5.433	25.60-41.67	19.67-36.07	0.710-2.127
F_1	3.456	17.730	177	5.155	28.997	25.406	1.277
Range	3.00-4.33	13.90-23.867	139.-238.6	4.20-5.967	22.97-36.40	18.10-32.30	0.907-1.800
F_{1r}	3.000	15.303	153	5.115	28.843	26.178	1.163
Range	2.67-3.33	11.81-20.350	118-203.5	4.00-6.100	22.73-36.87	17.50-36.52	0.760-1.900
$F_{1,1r}$	3.234	16.517	165	5.135	28.920	25.792	1.220
Range	2.67-4.33	11.87-23.867	118.2-238	4.00-6.100	22.73-36.87	17.50-36.52	0.760-1.900
H (F_1 MP)%	23.429**	43.296**	43.29**	19.412**	-9.362**	-12.053**	5.975*
H (F_{1r} MP)%	7.143**	23.681**	23.68**	18.485**	-9.843**	-9.381**	-3.485
H($F_{1,1r}$MP) %	15.500**	33.492**	33.49**	18.948**	-9.602**	-10.717**	1.245
L.S.D.0.05	0.525	2.717	27.166	0.209	1.098	3.606	0.040
L.S.D.0.01	0.690	3.635	121.157	0.280	1.469	2.592	0.054
H (F_1 B.P)%	3.784	-2.222	-2.220	-5.117*	-30.413**	-29.565**	-39.962**
H (F_{1r} B.P)%	-9.910**	-15.607**	-15.600**	-5.853*	-30.782**	-28.495**	-45.322**
H($F_{1,1r}$B.P) %	-2.883	-8.912**	-8.910**	-5.485*	-30.598**	-28.495**	-42.642**
L.S.D.0.05	1.070	5.202	52.717	0.400	2.102	6.906	0.077
L.S.D.0.01	0.987	6.960	69.600	0.536	2.812	9.239	0.104

***: significant at 0.05 level   **: significant at 0.01 level**

C-Genetic variances and heritability

Genetic parameters were determined and the heritability values in both broad and narrow senses were calculated for yield and yield component traits and the results are presented in Table 5 .

The results reavld that the magnitudes of genetic parameters indicated that non additive genetic variances were larger than those of the additive genetic variances for all studied traits except of Sh.I trait. Some traits indicated the importance of reciprocal variances. The estimated values of broad and narrow sense heritabilities indicated that the heritability values in broad sense were larger in magnitudes than their corresponding narrow sense estimates for all studied traits .These findings indicated the importance of non- additive genetic variances including dominance ,additive genetic variances and reciprocal effects , although the magnitudes of dominance were the larger .. The estimated values of heritability values in broad sense ranged from 45.09 % for (F.D.cm) to 97.27 % of (Sh.I). While, the estimated values of heritability in narrow sense ranged from 1.79 % to92.13% for the same traits Similar results obtained by Hatem *et al.* (1995), El-Gendy (1999) and Abd El-Rahman *et al*(2000)

Table 5 :The estimates of general combining ability variances(δ^2 g) ,specific combining ability(δ^2 s) and their standerd error ,heritability values in broad and narrow sense for all studied yield and yield componant traits

Gen.param.	N.F./P.	T.Y./Pkg	T.Y./Pt.kg	A.F.W.kg..	F.L. cm	F.D cm.	Sh. I .L/D.
δ^2 g	0.02	1.83	182.25	0.09]	6.00	0.40	0.56
δ^2 s	0.2	4.69	468.5	0.608]	29.3]	19.47	0.06
δ^2 r	-0.01	-0.83	-83.35	0.034	13.18]	14.09	0.03
h^2b %	52.92	61.61	61.61	91.75	74.44	45.09	97.27
h^2n %	6.91	26.96	26.969	20.10	21.51	1.79	92.13

Estimates of genotypic and phenotypic correlations:

The knowledge of degree and direction of correlation among differentyiels and yield component traits of watermelon is of great importanceto improve quality and productivity of it

Genotypic and phenotypic correlation coefficient provide a measure of this type of association among pairs of studied traits which may be used as a useful indicator in selection programs. Therefore ,genotypic and phenotypic correlation among studied traits were concluded and the results are presented in **Table 6.**

The results showed that the magnitudes of the genotypic correlations were almost similar or very close to the corresponding phenotypic correlations . These results were expected since the magnitudes of error covariances in the analysis of covariances were small if compared with the covariances of genotypic . The results appeared that the highest values of phenotypic correlation were obtained for (N.F./P X T.Y./P). (;N.F./P. X T.Y.Pt) and (T.Y./P XT.Y./Pt.).In the same traits, N.F./P showed significant and positive correlation with T.Y./P andT.Y/Pt..These values were 0.95 and 0.90 and 0.90 for genotypic correlation (rg) ;0.91and 0.90 forphenotypic correlation .Similar results were obtained by Ferreira *et al* (2003)and Abdein (2005).

Table 6: Genotypic (above diagonal) and phenotypic (below diagonal) correlations for all pairs ofyield and all studied yield componant rtaits .

Traits	N.F./P.	T.Y./P.kg	T.Y./Pt.kg	A.F.W.kg..	F.L. cm	F.D cm.	Sh. I .L/D.
N.F./P.		-0.95**	0.90**	0.25	0.55**	-0.11	-.035*
T.Y./P	-0.91**		0.93**	0.73**	0.43*	0.03	0.007
T.Y./Pt	0.90**	0.89**		0.66**	0.33	-0.08	0.08
A.F.W.kg..	0.22	0.68**	0.69**		0.55**	0.03	0.22
F.L. cm	0.49**	0.38*	0.30	0.49**،		-0.76**	0.75**
F.D cm..	0.08	0.05	-0.12	0.07	-0.70**		--0.68**
Sh. I .L/D.	0.30	0.009	0.04	0.18	0.70**	0.71**	

***:significant at 5% level of probability. **:significant at 5% level of probability**

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السلوك الوراثى لبعض صفات المحصول ومكوناته فى البطيخ

زكريـــامحمد الديســـطى*، زكريـــا عبــد المــنعم كســبه *، محمــد محمــد عبــد الــرحمن**

وعلاء محمد محمد الشورة**

*** قسم الوراثة – كلية الزراعة – جامعة المنصورة – مصر.**

*** * معهد بحوث البساتين – مركز البحوث الزراعية – مصر.**

يعتبر البطيخ من محاصيل الخضر الهامة التى تستخدم على نطاق واسع في مصر ولذلك فان تحسين صفات اصناف البطيخ له اهميه كبري٠ لتحقيق هذا الغرض وتم تصميم هذه التجربه لدراسه طبيعه السلوك الوراثي وقوه الهجين ومعامل التوريث وطبيعه الارتباط بين ازواج صفات مكونات المحصول في البطيخ لتحقيق هذا الغرض تم استخدام خمسه اصناف من البطيخ وتم التهجين بينها بنظام التهجين الدوري الكامل للحصول على ١٠هجن و١٠هجن عكسيه ٠٠٠ الاصناف هي جيزه -١ وجيزه-٢١ وشارلستون جراى وكرمسون سويت وديلازوراز وقد تم دراسه العديد من صفات المحصول وهى عدد الثمار للنبات والمحصول الكلى للنبات والمحصول الكلى للقطعه التجريبيه متوسط وزن الثمره بالكيلوجرام وطول الثمره وقطر الثمره وشكل الثمره

أوضحت النتائج أن متوسطات هجين الجيل الأول وهجين الجيل الأول العكسي ذات معنوية عالية وتفوقت على متوسط الآباء وبعض افضل الاباء.

اوضحت النتائج ايضا عدم وجود اب واحد او هجين واحد يتفوق على الاخريين

أوضحت النتائج أن التباين الغير تجميعى والذى يشمل السياده أكبر من التباين التجميعى لكل صفات المحصول التى تحت الدراسه.

اظهرت القيم المحسوبه لمعامل التوريث أن معامل التوريث في المدى الواسع أكبر من معامل التوريث في المدى الضيق وهذه النتائج متوقعه حيث ان قيم التباين السيادى عاليه لكل الصفات.

بينت النتائج وجود قيم ذات معنوية عالية موجبة لازواج الصفات التى تحت الدراسه حيث ان الارتباط بين عدد الثمار للنبات ومحصول النبات ومحصول القطعه التجريبيه

ونستخلص من هذا البحث امكانيه تحسين مواصفات اصناف لاالبطيخ التى استخدمت فى هذه الدراسه من خلال التهجين للحصول على هجن عاليه الانتاج ثم الانتخاب فى نسل هذه الهجن