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GENETIC EVALUATION OF THREE QUAIL LINES\ BY FULL DIALLEL CROSS DESIGN
II- EGG PRODUCTION

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ABSTRACT

A total of 1307 quail chicks were hatched in two lots (450 and 857 chicks), from three quail lines (White-W, Light brown-Lb and Dark brown-Db). The both sexes of each line mated as full diallel cross design, and 9 genotypes (WW, WLb, WDb, LbW, LbLb, LbDb, DbW, DbLb, DbDb) were resulted. The unsexed chicks from each genotype were reared during the growth period from (1-35 days old) in cages (with dimensions of 85X85X85 cm.) with two replicates. Then at 35 days old, the birds were sexed and redivided on the same cages with two replicate also, for each genotype separately as families (15 females and 5 males). The experiment was conducted at the Poultry Farm of Animal Production Dept., College of Agriculture, University of Duhok, Kurdistan region-Iraq. The trial aimed to evaluate the genetic background of three quail lines for egg production traits by using the full diallel cross design. The following genetic parameters were estimated; general combining ability (GCA), specific combining ability (SCA), heterosis (H%), reciprocal effect (R_E), maternal effect (M_E), genetic value (GV), heritability (h^2) and genetic correlation (r_g); on egg production (EP) traits (egg weight EW, egg number EN and egg mass EM). The main results from the present study could be summarized as follow: SCA resulted as significant differences for all EP traits. All genotypes didn't significantly differ in heterosis percentage for egg weight and egg number. Reciprocal effect resulted in a significant ($p\leq 0.05$) effect for all EP traits. As conclusion, it may use the Db line as dam for egg production traits.

KEY WORDS: Quail, diallel cross, genetic parameters, layer performance.

INTRODUCTION

The quail birds are valuable resources for meat and eggs due to their early sexual maturity age, high annual egg numbers (250–270 eggs), resistance to common poultry diseases and hard conditions, in addition to more persistence for egg production with high level up to 1.5 years (Murakami and Ariki, 1998). However, Piao et. al. (2004), reported that the eggs number in quail was insignificantly differed among different genetic groups at different periods. The full diallel cross design often utilizes the same parents as females and males which make the design a little complicated (Isik, 2009). Mahipal, et al. 2001, used diallel cross in three quail lines and showed that the variance due to GCA was more important for egg production and egg weight, but variance due to SCA was significant for age at first egg and reproductive traits. Analysis of combining ability for (4) quail lines (L1, L2, L3 and L4) using diallel crosses was conducted by (Drumond, et al. 2014 and 2015), they represented significant effect for GCA on weekly egg number and egg yield, while the SCA was insignificantly affecting weekly egg number, egg yield and egg weight characteristic. Amin, et al. (2013) estimated maternal effect in crossed of 2x2 diallel mating and used two local strains (Egg line and Meat line) and two crosses, they found that the maternal effect estimates had highly significant values and egg line was better as sire than meat line. Sezer, (2007) estimated the genetic and phenotypic parameters for some characteristics of Japanese quail and observed that the heritability of egg weight was high (0.83), he added that the heritability of all other characteristics of egg quality which related to the egg weight (size) trait, were high too. However, the heritability estimate of egg weight in Japanese quail was ranged from

0.18 to 0.68 (Koack, et al. 1995; Saatci, et al. 2006 and Khaldari, et al. 2010; Anang, et al. 2000; Dana, et al. 2011 and Hussen, et al. 2016). Moreover, heritability estimate of egg number was ranged from (0.09 to 0.48) in layers (Luo, et al. 2007 and Dana, et al. 2011). Hidalgo et al. (2011) suggested that in case of positive genetic correlation coefficients between EW and EN traits, the selection for one characteristic will improve another one, but in case of negative genetic correlation coefficients both traits should be involved in selection program.

(Lotfi, et al. 2012) estimated the genetic correlation between egg production characteristics and showed that the quail had high positive genetic correlation coefficients between egg weight at various weeks of age (0.88-0.99) and between egg number at different periods (0.98-0.99). This research aimed to investigate the genetic parameters of egg production traits using full diallel cross design.

MATERIAL AND METHODS

Place and design of Experiment:

A total of 1307 quail birds from two lots (450 and 857 chicks), were used in this research which included, White (W), Light brown (Lb) and Dark brown (Db) lines. The trial was conducted at the Poultry Farm of Animal Production Department, College of Agriculture, University of Duhok, Kurdistan region-Iraq.

The unsexed chicks from each genotype of the progeny were reared during the growth period from (1-35 days old) in cages (dimensions of 85X85X85 cm.) with two replicates. Then at 35 days old, the birds were sexed and redivided on the same cages with two replicate also, for each genotype separately as families (15 females and 5 males).

Environment and feeding

The progeny flock birds were hatched in two lots. The average temperature inside the house was (35 ºC) in the first week, then decreased gradually by (2 ºC) per week, up to 8 weeks old. The average relative humidity inside the rearing house was (31 %) during the whole study period (ranged from 21 % - 39 %). Light program included 23 hours/day for the first week of age, then modified to be 15 hours/day from the second week old until the end of trial (from 5 am to 8 pm lightness and from 8 pm to 5 am, darkness) Feed was offered *ad libitum* manually for both generations (lines and crosses), which included three rations; starter (2850 K. cal. ME/ kg & 26 % CP) from (0-4) weeks old, grower (2850 K. cal. ME/ kg & 21% CP) from (4-6) weeks old and layer or breeder (2737 K. cal. ME/kg & 15.7% CP) from 6 weeks old-end of the trial, respectively, according to (Lesson and Summers, 2005).

STUDIED PARAMETERS:

The following genetic parameters were studied for EP traits; and were estimated according to (Falconer, 1988 and Williams, et al. 2002) in the crosses (progeny) with avoiding sire effect:

General Combining Ability (GCA): The values of GCA for the lines were computed as the means of specific line for giving trait.

$GCA_i = \Sigma y_i / n$

Where: GCA_i= the GCA for line $_i$; yi = trait for a progeny from the specific line $_i$. n= the number of all progenies.

Specific Combining Ability (SCA): The values of SCA for the crosses were computed as the difference between average of cross with its reciprocal cross and average of GCA for both lines, for given trait according to the following formula:

$SCA_{AB} = [(AB + BA)/2 – (GCA_A + GCA_B)/2]$

Where: AB= the cross; BA= reciprocal cross.

Heterosis (H %): Hybrid vigor (heterosis) was computed on the basis of percentage of mid-parents for the given trait as following equation:

$H\ \% = \{F1-[(P1 + P2)/2] / [(P1 + P2) / 2] \times 100\}$

Where F1 = mean of the first generation and (P1 and P2) are the parents in diallel cross design.

Reciprocal Effect (R_E): Reciprocal effect was computed as half of the difference between the cross and its reciprocal cross for the given trait, according to the following formula:

$R_E = (yji – yij) / 2$

Where: yji = reciprocal cross; yij = the cross

Maternal Effect (M_E): Maternal effect was computed as the mean deviation of progeny for a particular dam, from mean estimated for a particular sire, according to the following formula:

$M_E = (\bar{y}.i – \bar{y}i)$

Where: $\bar{y}$.i = particular dam average; $\bar{y}$i = particular sire average.

Genetic Value (GV): Genetic value of a cross is representing the GCA of both parents (lines) and SCA

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of the same cross, and is calculated according to the following formula:

$GV_{(AB)} = GCA_{(A)} + GCA_{(B)} + SCA_{(AB)}$

Heritability (h^2): Heritability estimates were computed from the relationship between the average of the one-parent and the offspring (from regression coefficient), and from the variance components which were resulted from the effect of both GCA and SCA as random factors in ANOVA. So, it could summarize the computation of heritability as the following two equations:

$h^2_1 = 2b$; And $h^2_2 = 4\,(\sigma^2_{GCA} + \sigma^2_{SCA}) / \sigma^2_P$

$h^2 = (h^2_1 + h^2_2) / 2$

Where b= regression coefficient of offspring on parents; σ^2_P is a phenotypic variance of a trait, and it included additive, dominant and residual effects.

Genetic Correlation (r_g): Genetic correlations between some previous traits were calculated according to the geometric equation as follows:

$r_g = \sqrt{(CovZ2X1 * Cov\ Z1X2)} / \sqrt{(CovZ1X1 * Cov\ Z2X2)}$

Where: Z= the observations on parent; X= the observations on offspring; 1= the first trait; 2= the second trait.

Statistical analysis:

The experiment were designed as diallel cross within completely randomized design (CRD), and collected data was analysed using SAS (SAS Institute, 2010) software via mixed model for the effects of GCA and SCA as random factors in addition to the fixed effects of the replication (lot) was applied to analyse the previous studied traits in order to estimate the heritability according to the following model:

$Y_{ij} = \mu + R_i + GCA + SCA + e_{ij}$

Where: Y_{ijkl}: the observations of the studied trait; μ = overall mean; R_i: The effect of replication; GCA: the random effect of GCA; SCA: the random effect of SCA, e_{ij}: random error; i: lot (Replication); j: individual (bird). The differences between the means were analysed using Duncan multiple range test (Duncan,1955).

RESULTS AND DISCUSSION

General Combining Ability (GCA):

Table (1) illustrating the GCA values of egg number, egg weight and egg mass. The results showed that there are no significant differences among studied lines. However, pure W line gave the highest insignificant values of GCA at first and second weeks of laying for egg number (4.53 & 5.07 eggs), egg weight (10.10 & 10.46 gm) and egg mass (45.77 & 53.00 gm) respectively, compared with both brown (Lb and Db) lines.

Table (1). General combining ability for egg characteristic at first two weeks of laying period.

Period(wks.) / Lines	Egg number/hen.		Egg weight (gm)		Egg mass (gm)	
	W1	W2	W1	W2	W1	W2
W	4.53±0.29	5.07±0.17	10.10±0.01	10.46±0.46	45.77±2.99	53.00±2.00
Lb	4.25±0.34	4.56±0.24	9.92±0.08	10.36±0.13	42.14±3.69	47.37±3.15
Db	4.21±0.49	5.02±0.3	10.02±0.06	10.48±0.04	42.19±4.56	52.69±3.34
Sig.	Ns	Ns	Ns	Ns	Ns	Ns

Ns = Non-significant; values = means ± SE.

The present findings were in disagreement with that obtained by (Mahipal, et al. 2001) who showed that the variance due to GCA was more important for egg production and egg weight. In another study which reported by (Drumond, et al. 2014) on the layer performance of 4 strains of meat type quails using full diallel cross, resulted in a significant GCA for weekly egg number and egg yield.

Specific combining ability (SCA):

The SCA for egg number, egg weight and egg mass are presented in table (2). It can be observed that just EW trait resulted in a significant difference ($p \leq 0.05$) for SCA at the beginning of laying in the cross (W*Db), which means that Db line plays a role in laying large eggs because of its heavier BW, but Lb line as sire and dam reducing the egg weight in the next week.

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Table (2). Specific combining ability for egg characteristics of crosses at first two weeks of laying period.

Period(wks.) Cross	Egg number W1	Egg number W2	Egg weight W1	Egg weight W2	Egg mass W1	Egg mass W2
W*Lb	-0.12±0.01	-0.29±0.08	0.02±0.06ab	-0.01±0.02	-1.12±0.07	-3.11±0.68
W*Db	-0.04±0.07	0.08±0.01	0.23±0.11a	0.25±0.14	0.67±1.13	2.07±0.51
Lb*Db	0.47±0.47	0.31±0.37	-0.12±0.03b	-1.78±0.59	4.05±4.49	3.35±4.22
Sig.	Ns	Ns	*	Ns	Ns	Ns

Ns = Non-significant; *=significant at ($P \leq 0.05$); values = means ± SE. Means having different litters within each column differ significantly.

However, the SCA values for egg number and egg mass of (Lb*Db) cross were higher and insignificantly positive at the first two weeks of laying period (0.47 & 0.31 eggs) and (4.05 & 3.35 gm), respectively. The present results are in disagreement with that found by (Mekky, et al. 2008) who mentioned that SCA was a significant source for egg production among crossbreed groups during all studied the ages.

Heterosis (H%):

Table (3) presented the heterosis percentage of egg number and egg weight for the crosses and its reciprocal crosses during the laying period. The results showed significant differences among all genotypes for both studied traits. In respect to EN characteristic, the reciprocal cross (Db*Lb) showed positive significant heterosis superiority by about (25% and 42%) for the interaction between first and second weeks of laying, respectively, which may reflect the Lb dam and Db sire.

Table (3). Heterosis percentage for egg number and egg weight of crosses and reciprocal crosses during the first two weeks of laying.

Period (wks.) Genotype		Egg number W1	Egg number W2	Egg weight W1	Egg weight W2
Crosses	W*Lb	-27.02±0.68[b]	-20.34±1.55[c]	1.28±1.63[b]	0.83±1.32[b]
	W*Db	-0.77±7.81[ab]	25.62±9.95[ab]	8.09±2.07[a]	6.8±1.16[a]
	Lb*Db	-4.92±8.98[ab]	11.24±6.87[abc]	1.8±0.53[b]	3.83±1.46[ab]
Reciprocal Crosses	Lb*W	-8.18±18.37[ab]	-13.91±15.25[c]	1.1±0.69[b]	2.73±1.19[ab]
	Db*W	-25.97±7.24[b]	0.61±13.39[cb]	2.46±0.59[b]	5.32±0.87[a]
	Db*Lb	24.97±0.33[a]	41.82±3.03[a]	0.52±0.03[b]	2.72±1.53[ab]
Sig		*	**	**	*

*=significant at ($P \leq 0.05$); **=highly significant ($P \leq 0.01$); values = means ± SE. Means having different litters within each column differ significantly.

Regarding to EW characteristic, the cross (W*Db) surpassed positively and significantly all other genotypes in the first week of laying (8.10) and didn’t differ from its reciprocal (Db*W) in the second week of laying (6.8 and 5.3) respectively. The last result may mean that W line as sire interacted positively with the dam (Db) to produce heavier eggs. Also, its reciprocal cross affected by the sire (Db) in order to produce larger eggs, which reflect again the effect of Db line on the egg size when crossed with W line. These results are in agreement with that reported by (Minvielle, et al. 2000) who indicated that the heterosis from crossing of two lines from different origins which were selected for early egg production affected significantly by the crossing. However the heterosis percentage for the egg number and egg weight depends on the age at the first egg and rate of the egg laying (Moritsu, et al. 1997; Sato, et al. 1989 and Piao, et al. 2002).

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Reciprocal effect:

Table (4) presented the reciprocal effect on egg number, egg mass and egg weight during the first two weeks of laying periods. The results showed insignificant differences among the three genotypes in the first studied week for both egg number and egg weight traits. While EP traits affected significantly (p<0.05) by reciprocal cross in the second week. In respect to EN trait the reciprocal cross (Db*Lb) showed the highest positive significant value (0.65 egg) in the second week.

Table (4). Reciprocal effect on egg characteristics during first two weeks of laying.

Genotype / Period (wks.)		Reciprocal crosses: Lb*W	Db*W	Db*Lb	Sig.
Egg number	W1	0.48±0.48	-0.65±0.00	-0.35±0.40	Ns
	W2	0.18±0.45^{ab}	-0.6±0.12^{b}	0.65±0.20^{a}	*
Egg weight	W1	-0.07±0.07	-0.28±0.07	-0.08±0.01	Ns
	W2	0.05±0.03^{a}	-0.08±0.01^{b}	0.00^{ab}	*
Egg Mass	W1	4.55±4.51^{a}	-7.84±0.32^{b}	6.53±2.12^{a}	*
	W2	2.19±4.55^{ab}	-6.85±1.36^{b}	6.63±2.15^{a}	*

Ns = Non-significant; *=significant at (p≤0.05); values = means ± SE. Means having different litters within each row differ significantly.

Regarding to EW trait, the reciprocal cross (Lb*W) resulted in the highest value (0.05 gm) in the second week of laying. In respect to EM trait, it is significantly different among the genotypes in both studied weeks, in order to show the superiority for (Db*Lb) reciprocal cross, where it recorded the highest values (6.53 and 6.63 gm, respectively). While the reciprocal cross (Db*W) recorded the lowest values (-7.84 and -6.85 gm, respectively). Similar results were found by (Sharma, et al. 1992 and Mahipal, et al. 2001) who showed significant reciprocal crosses effects on body weight, age at first egg and egg weight traits.

Maternal effect:

The M_E on egg number, egg mass and egg weight is presented in table (5) It can be observed that all studied characteristics differed significantly among the studied lines, and Db line resulted in the best values. In other words the Db dam plays a positive role in egg production traits.

Table (5). Maternal effect for egg characteristics during the first two weeks of laying.

Period(wks.) / Line	Egg number W1	Egg number W2	Egg weight W1	Egg weight W2	Egg mass W1	Egg mass W2
W	-0.12±0.32^{b}	-0.28±0.38b	-0.23±0.002^{c}	-0.02±0.02^{b}	-2.19±3.22^{b}	-3.12±3.94^{b}
Lb	-0.55±0.05^{b}	-0.35±0.05b	0.03±0.02^{b}	-0.07±0.02^{b}	-5.46±0.49^{b}	-3.94±0.48^{b}
Db	0.67±0.27^{a}	0.63±0.33a	0.20±0.02^{a}	0.08±0.01^{a}	7.66±2.73^{a}	7.05±3.46^{a}
Sig.	*	*	**	**	*	*

*=significant at (p≤0.05);**=highly significant (*P≤0.01*); values = means ± SE. Means having different litters within each column differ significantly.

The present results are in disagreement with that found by (Barbato and Vasilatos Younken, 1991) who showed that maternal effects didn't change at earlier laying period. They added that the significant maternal effect at later ages may be due to the effect of endoplasmic inheritance which plays a role in determination of specific maternal effect among lines. Another author mentioned that the differences between two strains for egg size or egg contents should not be the only source for maternal effect (Sabri, et al. 2000).

Genetic value:

Genetic values for egg characteristics during the first two week of laying are shown in table (6). The results showed that there were no significant effects for crosses on egg number and egg mass. While egg weight appeared significant (p<0.05) GV in the first week, where the (W*Db) cross resulted in the highest value (10.35 gm) followed by W*Lb cross (10.07 gm), and the lowest GV was recorded for the Lb*Db cross (9.82 gm).

Table (6). Genetic value for egg characteristics during the first two week of laying.

Period(wks.) Cross	Egg number/hen		Egg weight (gm)		Egg mass (gm)	
	W1	W2	W1	W2	W1	W2
W*Lb	4.24±0.62	4.38±0.33	10.07±0.15[ab]	10.41±0.21	42.71±6.77	45.64±4.47
W*Db	4.52±0.65	5.36±0.45	10.35±0.15[a]	10.81±0.06	46.82±5.81	57.81±4.38
Lb*Db	4.74±1.23	5.08±0.87	9.82±0.01[b]	10.47±0.25	46.58±12.2	53.46±10.3
Sig.	Ns	Ns	*	Ns	Ns	Ns

Ns = Non-significant; *=significant at ($P \leq 0.05$); values = means ± SE. Means having different litters within each column differ significantly.

The last result indicates that Db dam play a positive role to increase the egg weight in its progeny that resulted from crossing it with W sire. Similar findings were obtained by (Razuki and AL-Shaheen, 2011) in chickens; they found that the genetic effects on egg number were insignificant, while it was significant on egg weight trait.

Heritability and genetic correlation:

The heritability, genetic correlation and phenotypic correlation coefficients within each studied line are represented in Table (7). In respect to heritability, which estimated directly from the relationship between parent and offspring, and indirectly from the random effects of both GCA and SCA. The results showed that the highest estimation values were recorded EN (0.53) and EW (0.51) in W line. All other estimations for other lines were moderate to small values. This result indicates that W line appears to have more additive genetic variance for the studied traits. Similar to the present results (Sato, et al. 1989) reported heritability estimation for egg characteristic which had high values ranging from (0.62 to 0.84). Also (Stino, et al. 1982) mentioned that the heritability estimation obtained by regression method was high for some egg characteristic. Generally, (Berwary, et al. 2015) found that heritability estimation for EM was (0.57), in J. quail birds. While, (Hussen, et al. 2016) recorded low heritability estimate (0.21) for EW characteristic in brown J. quail birds.

Regarding to genetic correlation estimation (Table 7), the results show that the correlation coefficients between EW and EN were negative for both W and Db lines, but the coefficient (-0.59) in Db line was significant ($P<0.05$), which reflect that Db line have a higher EW because it had higher body size, but W line had a smaller size.

Table (7). Heritability, genetic correlation and phenotypic correlation coefficients for some traits within studied quail lines.

Traits	Line	EN_{2weeks}	EW_{2weeks}
EN_{2weeks}	W	**0.53**	- 0.35
	Lb	**0.28**	-0.37
	Db	**0.37**	-0.4
EW_{2weeks}	W	-0.46	**0.51**
	Lb	NE	**0.32**
	Db	-0.59*	**0.21**

Heritability on the diagonal, phenotypic correlation above the diagonal and genetic correlation coefficients bellows the diagonal. *=significant at (P<0.05); NE = Non-estimated.

The present results disagree with that found by (Mielenz, et al. 2006) in the Japanese quail, and also disagreed with the results that were reported by (Hidalgo, et al. 2011) who mentioned that the genetic correlations between EW and EN at different weeks of laying ranged from negative to positive values (–0.28 to 0.45).

In respect to phenotypic correlation coefficients (Table 7), all coefficients were negative and moderate to relatively small, which may due to the effect of both genetic and environmental factors. Moreover, (Choprakarn, et al. 1998) reported negative phenotypic correlation between the egg weight and few egg characteristics. On the contrary, (Kul and Seker, 2004) mentioned Positive correlation coefficients between some egg characteristics.

CONCLUSION

It is concluded from results of this research that, SCA and reciprocal cross have had significant effect (*p<0.05*) among the studied genotypes for the studied traits, while the heterosis percentage for the same traits hadn't significant different (*p>0.05*) among the studied genotypes, in particular, Db line might be used as dam in crossing for egg yield.

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هەلسەنگاندنا بو ماوەیی بو سیسکا ب رێکا لێکداییێن دوورەهیی
2 - ساخاله تێن هیکا

پوختە
ڤێ ڤکولینێ دا،**1307** جیجەلوك هاتنە هەلهێنان د دوو جارا ل دهوکێ، ژ سێ جوران: سپی،قەهوایی یێ ڤەبوی و قەهوایی یێ توخ، بژبێ ئێك روژی ژ بو مەرەما لێکدانێ. ل پروژێ خودانکرنا پەلەوەرا ل پشکا بەرهەمێ گیانەوەری ل کولیژا چاندنێ زانکویا دهوك, هە رێما کوردستانێ,عراق.
ئەڤ سالوخەتێن هاتنە خواندن ل سەر هەر دوو نشا: ژیێ گهەشتنا رەگەزی, ساخلەتێن بەرهەمئینانا هێکا (کێشا هێکێ, ژمارا هێکا, بارۆستێ هیکێ), رێژا ژ نافچونێ, رێژا پیتاندن و دەرکەفتنا ژ هێکێ ئەڤ پیڤەرێن بوماوەی هاتن تەخمین کرن. شیانا گشتیا لێکدانێ(**GCA**),شیانا لێکدانا تایبەت (**SCA**) کاریگریا لیکدانا باب و بەرەبابا و هێزا دوو رهێ (**H%**), کاریگەریا ماکێ (**ME**), بهایێ خودانکرنێ, و بهایێ لێکدانێ, بهایێ بوماوەی, شیانا ڤەگوهاستنا بوماوەی, پێکڤەگرێدانا بوماوەی.گرنگترین ئەنجامێن هاتینە دیارکرن دڤێ ڤەکولینێ دا دیار کر کو شیانێن هاوکولکەیێن تابەت جیاوازێن بەر چاڤ هەبون بو سالوخەتێن بەرهەمێ هێکا. چ جیاوازیێن بەرچاڤ نەبون د ناڤ بەرا لاینێن ڤەکولینێ د هێزا دوورەگ بو سالوخەتێن سەنگا هێکێ و ژمارا هێکا. بەلێ کارتێکرنا دوورەهی لسەر وەکهەڤی بەروڤاژی یا بەرچاڤ بو. دیسان چ جیاوازیێن بەرچاڤ نەبون د ناڤ بەرا لاینێن ڤەکولینێ دا و کارتێکرنا بەهایێ پەروەردەیێ دا د هەمی ماوێ ڤەکولینێ دا. ئەنجامێ ڤەکولینێ دیار دکەن کو لاینێ قهوائیێ ڤەبوی وەك باب بو بەرهەم ئینانا بەرهەمێ هێکا.

التقييم الوراثية للسمان باستخدام التهجين ثنائي الأليل الكامل
2- إنتاج البيض

الخلاصة
تم فقس عدد **1307** صوصاً على دفعتين من ثلاثة خطوط للسمان الياباني (الأبيض والبني الفاتح والبني الغانق). أجريت التجربة في مزرعة الدواجن بقسم الإنتاج الحيواني في كلية الزراعة- جامعة دهوك، إقليم كوردستان، العراق. هدفت التجربة لتقييم الأساس الوراثي لثلاثة خطوط من السمان الياباني لصفات إنتاج البيض (وزن البيض و عددها وكتلتها) باستخدام التهجين ثنائي الأليل الكامل. وقد درست المعالم الوراثية التالية: قدرتي التوافق العامة والخاصة والتأثير الأمي والتهجين التبادلي وقوة الهجين، بالإضافة لتقدير القيمة الوراثية ومعامل التوريث لصفتي إنتاج البيض (وزن البيض و عددها وكتلتها) لم تختلف معنويا. سجلت قدرة التوافق الخاصة فروقا معنوية لصفات انتاج البيض. لم تختلف التراكيب الوراثية المدروسة فيما بينها معنويا لظاهرة قوة الهجين بالنسبة وزن البيض وعدده. لكن تاثير الهجين العكسي كان معنويا على خصائص إنتاج البيض. لم يكن التاثير الامي معنويا في التأثير على خصائص انتاج البيض. وقد استنتج الى انه يمكن استخدام الخط البني الغامض كامهات في حال إنتاج البيض.