GENETIC STUDIES ON EGG PRODUCTION IN DOKKI-4 CHICKENS

BY

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ABSTRACT

A total number of 355 Dokki-4 pullets were chosen randomly at sexual maturity from 3500 chicks produced from 34 sires mated to 87 dams in three consecutive hatches. Traits of egg production were studied in three periods starting from age at sexual maturity (each period was three months) as well as average number of days during which the first ten eggs were laid during each period in order to evaluate the efficiency of different methdos of partial recording. Heritabilities as well as genetic and phenotypic correlations between traits of egg production were estimated. Results obtained are summarized as follows:

1- The averages of age and body weight at sexual maturity were about 173 days and 1525 grams, respectively.

2- The averages of egg number per pullet at the first, second and third periods and total egg number were about 56, 59, 55 and 170 eggs, respectively. The respective numbers of days of the first 10 eggs laid during the same periods were about 16, 14, 16 and 15 days.

3- Differences due to sires and dams in all traits of egg production were significant.

4- The percent of variance due to dam (16.3%) was higher than that due to sire (12.2%) for age at sexual maturity, indicating that maternal effects are important for this trait. The percentages of variance due to sire for other traits were higher than those due to dam, indicating that sex-linked effects are considered as an important factor in determining egg production.

5- Estimates of heritability drived from dam (0.651) for age at sexual maturity was higher than that drived

from sire (0.488), while estimates for egg production traits drived from sires (estimates ranged from 0.270 to 0.467) were higher than those drived from dams (estimates ranged from 0.173 to 0.384).

6- Negative genetic and phenotypic correlations were obtained between total egg production and each of age and body weight at sexual maturity. While positive genetic and phenotypic relationships were estimated among total egg production and egg number of different periods. Negative association between total egg production and average number of days of the first 10 eggs were attained. This means that each method of partial recording could be effective in carrying out selection programmes and/or culling strategies at an early stage of egg production.

INTRODUCTION

Partial recording of egg production in pullets of chickens is used to enhance and to increase the efficiency of genetic selection as well as to shorten the generation interval. Results of many investigators showed that more genetic gain could be obtained in egg production when using partial recording (Obeidah et al., 1962; Nordskog et al., 1967; Kinney et al., 1968; Bohren et al., 1970; Sendhu & Dev, 1972; Emsley, 1973; Mostageer et al., 1978; Ezz El-Din & Mostageer, 1984 and Hanafi & El-Labban, 1984).

El-Hossari (1974), estimated the phenotypic and genetic correlations between egg production and age at sexual maturity in Fayoumi chickens. His findings suggested that selection to increase egg number might decrease body size only at sexual maturity, while selection to increase maximum body size at 12 months of age might had little effect on egg production. Al-Rawi (1980), in Leghorn and New Hampshire breeds found that associations between annual egg production and each of age at sexual maturity, period of first 10 eggs and egg number at the first 90 days were positive and significant. In addition, he concluded that keeping part year for egg layers was a good indicator and a reliable evaluation for egg performance.

The objectives of this study were to evaluate the efficiency of different methods of partial recording of egg production and to estimate heritabilities as well as genetic and phenotypic correlations among traits of egg production in Dokki-4 chickens.

MATERIALS AND METHODS

This study was carried out at the Poultry Research Farm at Inshas, Sharkia Governorate, Animal production Research Institute, Agriculture Research Center, Ministry of Agriculture. A total number of 3500 Dokki-4 chicks were produced from 34 sires mated to 87 dams in three consecutive hatches. At age of sexual maturity, 355 pullets were chosen randomly to study the production of eggs at different periods and to estimate genetic parameters for such traits. Eggs were collected individually per pullet during nine months starting from age at sexual maturity. The nine months were divided into three periods (first, second and third) each of which included three consecutive months. Traits included in this study were:

1- Age at sexual maturity (days).
2- Body weight at sexual maturity (grams).
3- Egg number per pullet during each period.
4- Numbers of days of the first 10 eggs laid during each period.
5- Total egg number.

All data were corrected for hatch effects. Estimates of variance and covariance components (needed for the calculations of heritabilities and correlations among traits) were computed according to the following model (Becker, 1984):

$$Xijk = \mu + Si + Dij + eijk$$

Where $Xijk$ = the observation of the K^{th} pullet of the j^{th} dam mated to the i^{th} sire, μ = an effect common all observations, Si = an effect of the i^{th} sire, Dij = an effect of the j^{th} dam mated to the i^{th} sire and $eijk$ = the random effect due to the k^{th} pullet of the j^{th} dam and i^{th} sire.

RESULTS AND DISCUSSION

Least square means:

The least square means (± standard errors) for traits of egg production are presented in Table 1. These results show that the pullets reached ASM at about 173 days with body weight of about 1525 grams. The egg number per pullet at the EP1, EP2 and EP3 and TEP were about 56, 59, 55 and 170 eggs, respectively. The respective number of NE1, NE2 NE3 and NEALL laid during the same periods were about 16, 14, 16 and 15 days.

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Table 1. Least square means (± standard errors) of egg production traits.

Trait	Abbreviation	Mean±SE
Age at sexual maturity (days)	ASM	172.8± 9.1
Body weight at sexual maturity (grams)	BWM	1524.9±122.6
Egg production per hen (eggs):		
First period	EP1	56.0±6.3
Second period	EP2	59.5±6.0
Third period	EP3	55.0±6.2
Nnmber of days of the first 10 eggs laid during:		
First period	NE1	15.8±2.1
Second period	NE2	14.4±1.9
Third period	NE3	16.0±2.6
Over-all mean	NEALL	15.4±1.6
Total egg production (eggs)	TEP	170.4±11.4

From these results, it is shown that the second period exceeded by 3 and 4 eggs than each of the first and third period and decreased by 2 days than the same two periods. It is logic to conclude that the high egg production during the second period may be due to that the ovary and oviduct of the pullet were reached their maturity and therefore, higher rate of egg production was obtained. During the first period, the ovary as well as the oviduct were premature, while during the third period the pullets were nearly reaching the end of egg production and consequently a relatively lower rate of egg performance is expected. Therefore, trap-nesting for selection and/or culling of pullets can be carried out at the end of the first period, i.e. about 12 weeks from sexual maturity and about 35 weeks from hatch date. Results obtained by Mostageer et al. (1978), showed that the highest annual efficiency of selection in Fayoumi could be obtained by selection of pullets during a 4-week period of between 40 and 44 weeks of age. Al-Rawi (1980), reported that age at sexual maturity, period of first 10 eggs, egg number during the first 90 days in Leghorn and New Hampshire breeds were 173 and 220 days, 21 and 23 days and 37 and 38 eggs, respectively. Abdel Gawad (1981), found that age and body weight at sexual maturity and annual egg production in Dokki-4 chickens were 190.4 days, 1445 grams and 172.4 eggs, respectively. In addition, Shawer et al., (1981) with five strains (Alexandria, Golden Montazah, Silver Montazah, Matrouh and White Leghorn) found that averages of age and body weight at sexual maturity and egg number in the first ninty days of laying ranged from 155.0 to 202.9 days from 1613.0 to 2005.8 grams and from 29.3 to 40.0 eggs, respectively.

Components of variance:

Results in Table 2 indicated that there were significant differences among sires and among dams in all traits of egg production. These results indicated that this flock of Dokki-4 has not been subjected to any intensive selection for a long time. Therefore, high genetic variabilities in egg production traits for this breed was expected. The percentages of variance due to sire were higher than those due to dam in all cases, except ASM in which the sire contributed by 12.2% of the variance compared to 16.3% for the dam (Table 2). Therefore, maternal effects were important for ASM (4.1%). Similar results were obtained by King & Henderson (1954); Van Vleck & Doolittle (1964); Abdel Gawad (1975) and Hanafi & El-Labban (1984).

Percentages of variance components due to sire versus due to dam for BWM, egg number for the three periods, number

Table 2. Estimates of the components of variance and percentages of variation for egg production traits.

Trait	Components of variance+			Percentages of components		
	σ^2_S	σ^2_D	σ^2_e	σ^2_S	σ^2_D	σ^2_e
ASM	10.3**	13.7**	60.2	12.2	16.3	71.5
BWM	1116.0**	955.5*	14406.4	6.8	5.8	87.4
EP1	4.201**	3.792**	31.532	10.6	9.6	79.8
EP2	3.634**	2.984**	35.066	8.7	7.2	84.1
EP3	4.080**	2.699*	33.889	10.0	6.6	83.3
NE1	0.301**	0.177	3.664	7.3	4.3	88.5
NE2	0.327**	0.294*	2.857	9.4	8.5	82.1
NE3	0.426**	0.273	5.602	6.8	4.3	88.9
NEALL	0.308**	0.199*	2.950	8.9	5.8	85.3
TEP	11.965**	7.408*	83.198	11.7	7.2	81.1

+ Degrees of freedom for sire, dam and remainder were 33, 53 and 268, respectively.

* Significant at P< 0.05; ** Significant at P< 0.01

of days of the first 10 eggs and TEP were 6.8% vs 5.8%, 9.8% vs 7.8%, 8.1% vs 5.7% and 11.7% vs 7.2%, respectively. From these results it is appeared that sires contributed more genetic variabilities than dams and therefore, sex-linked effects should be considered as an important factor in determining egg production. El-Hossari (1974), showed that sex-linkage effects were important in traits of egg production. In addition, Amer (1967), found that variance due to sires was much greater than variance due to dams with respect to egg weigth and egg production.

Heritability:

Heritability estimates along with their standard errors for traits of egg production are presented in Table 3. The estimates drived from dam (0.651) for ASM was higher than that drived from sire (0.488) and this is due to the high maternal effects. Abdel Gawad and El-Ibiary (1971), found that heritability for age at sexual maturity drived from dam (0.86) was higher than that drived from sire (0.31) in Leghorn breed. In addition, Abdel Gawad (1975), reported that heritability due to dam (0.44) was higher than that due to sire (0.31) in Dokki-4, indicating also that this might be due to high maternal effects.

In general, sire heritability estimates for other traits studied were higher than those of the dam (Table 3). This might due to sex-likage effects. The estimated values due to sire versus due to dam for BWM, egg number at different periods, number of days of the first 10 eggs and TEP were 0.271 vs 0.232, 0.392 vs 0.312, 0.323 vs 0.228 and 0.467 vs 0.289, respectively. The combined estimates of heritability (sire + dam) were moderate for BWM (0.251), egg number of different periods (0.352), number of days of the first 10 eggs (0.276) and TEP (0.378).

From above results, it seems that traits of egg production are influenced to greater extent by additive genes transmitted from sires than dams, while ASM is largely affected by maternal influences. Thus, improving egg production may be attained by the mating of pullets and cocks selected from sire and dam families characterized by early sexual maturity and high egg performance.

Oliver et al. (1957), reported that the heritability estimates based on sire component of variance were similar to those based on dam variance which indicating that maternal effects were not an important factor affecting productive traits. However, Amer (1967), estimated heritability for annual egg production in Fayoumi chickens based on sire

Table 3. Heritability estimates (± standard errors) for different traits studied.

Trait	Sire	dam	Sire + Dam
ASM	0.488±0.214	0.230±0.230	0.570±0.107
BWM	0.271±0.163	0.232±0.193	0.251±0.084
EP1	0.425±0.195	0.384±0.193	0.405±0.099
EP2	0.349±0.177	0.286±0.181	0.318±0.090
EP3	0.401±0.188	0.265±0.176	0.333±0.096
Average	0.392±0.187	0.312±0.183	0.352±0.095
NE1	0.291±0.162	0.171±0.167	0.231±0.085
NE2	0.376±0.184	0.338±0.189	0.357±0.094
NE3	0.270±0.158	0.173±0.168	0.222±0.083
NEALL	0.356±0.175	0.230±0.172	0.293±0.088
Average	0.323±0.170	0.230±0.174	0.276±0.088
TEP	0.467±0.201	0.289±0.117	0.378±0.110

(0.157), dam (0.123) and full-sibs (0.140) components of variance, indicating that sex-linked effects might be existed. Acharya et al. (1971), found that heritability based on full-sibs in White Leghorn for egg production at 100 days and 100-365 days were 0.15 and 0.23, respectively. Results obtained by Tiwana and Dev (1972), showed that heritability from sire (0.14) and dam (0.26) components at 100 days of production in White Leghorn were low. While higher heritability values from sire (0.64), dam (0.70) and full-sibs (0.67) for 90 days of production were reported by Singh et al., (1972).

Correlations:

Genetic and phenotypic correlation coefficients among TEP and different traits are presented in Table 4. Estiamtes of genetic correlations among TEP and each of ASM (-0.605) and BWM (-0.358) were negative and high which means that when the pullet reaches her sexual maturity at an early age, it has the ability to produce more number of eggs. Similar results were obtained by Acharya et al., (1969); Ezz El-Din (1977) and Hanafi & El-Labban (1984).

With respect to the associations between TEP and egg number at different periods (Table 4), the average estiamte of genetic correlation (0.474, 0.407 and 0.438 from sire, dam and sire + dam, respectively) and phenotypic correlations (0.601) were positive and generally high. These correlations indicate that genes which affect TEP may, also, affect egg production at different periods of partial recording. Ezz El-Din & Mostageer (1984) and Hanafi & El-Labban (1984) gave evidence for these results.

Relatively high and negative genetic (-0.412) and phenotypic (-0.468) correlation coefficients were estimated between TEP and number of days of the first 10 eggs. Thus, as the number of days during which the first 10 eggs is decreased, egg number would be increased.

From above reuslts, it could be pointed out that egg performance during the first 90 days (starting from sexual maturity) could be considered as a good indicator for the future egg production of the pullet and therefore, selecting and/or culling of pullets could be carried out at early stage, i.e. generation interval would decrease. However, Muir (1990), pointed that selection based on partial records versus to the whole record performance will have a reverse effects on persistency.

Table 4. Genetic and phenotypic correlations (± standard errors) among total egg production and other different traits.

Trait	Genetic correlation*			r_P
	r_S	r_D	r_{S+D}	
ASM	-0.563±0.210	-0.676±0.145	-0.605±0.173	-0.185±0.051
BWM	-0.374±0.309	-0.338±0.363	-0.358±0.183	-0.094±0.053
EP1	0.314±0.283	0.343±0.281	0.300±0.172	0.624±0.032
EP2	0.535±0.236	0.429±0.292	0.490±0.154	0.549±0.037
EP3	0.574±0.213	0.448±0.293	0.525±0.148	0.629±0.032
Average	0.474±0.244	0.407±0.289	0.438±0.158	0.601±0.034
NE1	-0.319±0.310	-0.480±0.342	-0.380±0.198	-0.439±0.043
NE2	-0.414±0.269	-0.394±0.284	-0.404±0.164	-0.310±0.048
NE3	-0.464±0.278	-0.443±0.356	-0.456±0.184	-0.618±0.033
NEALL	-0.401±0.273	-0.419±0.321	-0.407±0.174	-0.505±0.040
Average	-0.400±0.283	-0.434±0.318	-0.412±0.180	-0.468±0.041

* Where r_S, r_D and r_{S+D} are correlations computed from sire, dam and sire + dam components of variances and covariances.

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دراســـــات
وراثية على انتاج البيض فى دجـــاج دقى ـ٤

عبدالفتاح اللبـــان محمدحنفى سيدمحمود ماهرحسب النبى خليل

أجرى البحث على ٣٥٥ دجاجة اختيرت عشوائيا عند النضج الجنسى من ٣٥٠٠ كتكوت ناتجة من تزاوج ٣٤ عائله ابوية مع ٨٧ عائلة أميه فى ثلاث فقسات متتاليـــة . وقد درست صفات انتاج البيض خلال ثلاث فترات (كل فترة ثلاث شهور) تبدأ من عمـــر النضج الجنسى ، هذا بجانب عدد الايام التى وضعت فيها العشر بيضات الاولى فـــى كل فترة ، وذلك لتقييم كفاءة بعض طرق التسجيل الجزئى لانتاج البيض ، كذلـــك قدر كل من المكافىء الوراثى والارتباط الوراثى والمظهرى بين صفات انتاج البيـــض وقد امكن تلخيص النتائج كما يلـــى :-

١) كان متوسط كل من العمر ووزن الجسم عند النضج الجنسى ١٧٣ يوم ، ١٥٢٥ جـــرام على التوالى .

٢) كان متوسط عدد البيض لكل دجاجه لكل من الفترة الاولى والثانيه والثالثـــة وكذلك الانتاج الكلى (خلال تسعة أشهر) هو ٥٦ ، ٥٩ ، ٥٥ ، ١٧٠ بيضـــة على التوالى بينما كان متوسط عدد الايام التى وضعت فيها العشر بيضات الاولى لنفس الفترات السابقه هى ١٦ ، ١٤ ، ١٦ ، ١٥ يوم .

٣) وجدت هناك فروق معنوية بين العائلات الابوية وكذلك بين عائلات الامهات فـــى جميع الصفات انتاج البيض المدروسه .

٤) كانت النسبة المئوية للتباين الناتج من عائلات الامهات (٢٧ و ١٦ ٪) أعلى من ذلك الناتج من العائلات الابويه (١٩ و ١٢ ٪) عند النضج الجنسى وهذا دليل على أن هناك تأثيرا هاما للامومه لهذه الصفات ، بينما كانت النسبة المئوية للتباين الناتج من العائلات الابوية لباقى الصفات أعلى من ذلك الناتج من عائلات الامهات وهذا دليل على أن الارتباط بالجنس يعتبر عاملا هاما فى تحديد معدل انتاج البيض .

٥) وجد أن قيمة المكافئ الوراثى لصفة النضج الجنسى المقدرة من عائلات الامهات (٠ر٦٥١) أعلى من تلك المقدرة من العائلات الابوية (٠ر٤٨٨) بينما كانت قيم المكافئ الوراثى المقدرة من العائلات الابوية (تتراوح بين ٠ر٢٧٠ الى ٠ر٤٦٧) لباقى الصفات انتاج البيض أعلى من تلك المقدرة من عائلات الامهات (تتراوح بين ٠ر١٧٣ الى ٠ر٣٨٤) .

٦) كان هناك ارتباط وراثى ومظهرى سالب بين انتاج البيض الكلى وكل من عمر وورن الجسم عند النضج الجنسى ، بينما كان الارتباط الوراثى والمظهرى بين انتاج البيض الكلى وعدد البيض عند الفترات المختلفة موجباً . وكذلك وجد هناك ارتباط وكذلك وجد هناك ارتباط سالب بين انتاج البيض الكلى ومتوسط عدد الايام التى وضعت فيها العشر بيضات الاولى .

ومن هذه النتائج يمكن استنتاج أن طرق التسجيل الجزئى التى استخدمت فى هذا البحث ترفع من كفاءة الانتخاب أو الاستبعاد فى الاعمار المبكرة خاصة بعد نهاية الثلاث شهور الاولى من انتاج البيض .