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Genetic and Phenotypic Correlations between the Annual Egg Production and Different Part Records in Fayoumi

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THE present study was done at the Poultry Breeding Research Farm, Faculty of Agriculture, Cairo University. Six generations of Fayoumi were used to estimate the genetic and phenotypic correlations between the annual egg production (A6) and different part-records (the actual number of eggs laid till certain ages : A1 (40 weeks), A2 (44 weeks), A3 (48 weeks), A4 (52 weeks) and A5 (70 weeks) ; and their three-days-a-week egg number 'a1, a2, a3, a4 and a5'), and also between the early egg production traits with the the total number of eggs laid till 52 weeks of age 'A4' .

All the phenotypic correlations were smaller than their corresponding genetic correlations. The pooled estimates of the genetic correlations were less than the comparable values estimated in the base population with respect to the early "A" traits (A1, A2 and A3) and higher with respect to A4 and A5.

The genetic correlations between the 'a' records and A6 were all less than the comparable figures calculated using the 'A' records in the base population. Full records gave more genetic progress in A6 than the comparable three -days-a-week records.

Some estimates of the genetic progress gained in A6 per generation by using part records relative to the gain attained by selection were given.

Genetic selection has been used successfuly in increasing egg production. Lerner and Cruden (1948) showed that because of the high genetic correlation between part year production and total annual production, selection for the latter based on the former would not diminish genetic progress as compared to selection based on complete records. The decreased generation interval due to the use of part records could actually increase the annual genetic-progress.

Maddison (1954) found that the genetic and phentoypic correlations between the partial record to the end of November and the full record were 0·591 and 0·691 respectively. The corresponding estimates between the partial record till the end of December and the full record were 0·697 and 0·719.

Morris (1963) pointed out that there was strong evidence that continuous selection for part-period egg production will provide steady gain in the character selected, but that this will eventually be achieved at the expense of the production period which follows the part - period.

Nordskog *et al.* (1967) selected for early (part) records and the percentage of egg production in two breeds of chickens (Leghorn and Fayoumi) over eight generations. The genetic correlations found between part and full records in the two breeds were considerably higher (0·88 and 0·89) than the phenotypic correlations (0·53 and 0·48). Also Kinney and Lowe (1968) reported a very high genetic correlation of 1.0 between rate of production to 40 weeks of age and rate of production to 70 weeks of age.

Genetic correlation estimates between total percent production and each of percent production to 40 weeks of age ; from 40 to 55 weeks of age and from 55 to 70 weeks of age were reported by Kinney *et al.* (1968). These estimates were 0·80, 0·99 and 0·87 respectively.

Saadeh *et al.* (1968) estimated genetic correlations between rate of lay to 260 and 500 days of age for various selected strains and crosses from sire covariance. The values ranged for 0·67 to 0·99 with an average of 0·93. The comparable estimates from dam components ranged from - 0.39 to 0.94 with a pooled value of 0·66.

Emsley (1973) reported estimates of genetic and phenotypic correlations between early percentage of production until 32-weeks of age (ERPR), until 60-weeks of age (PR60) and until 72 weeks of age (PR72). The values of r_g and r_p between (ERPR) and (PR60) were 0·86 and 0.69 and those between (ERPR) and (PR72) were 0·78 and 0·59. The corresponding values for correlations between (PR60) and (PR72) were 0·98 and 0·92.

Flock (1977) gave estimates of genetic and phenotypic correlations between part and total survivor egg production in 6 different 8-weeks periods. The values of the genetic correlations ranged from 0·36 to 0·97, the phenotypic correlations ranged from 0·32 to 0·96 . He concluded that egg production in adjacent periods is more closely correlated than in remote periods. Also, the genetic correlations are higher than the corresponding phenotypic correlations except for period 1.

Material and Methods

The present study was done at the Poultry Breeding Research Farm, Faculty of Agriculture, Cairo University. Six generations of Fayoumi were used to estimate the genetic and phenotypic correlations between the total egg production (A6) (the number of eggs laid during the year following sexual maturity) and several partial records to be shown presently.

The population of the first year was considered a randombred unselected population. Selection was directed towards increasing egg production using an index involving only the egg number till 48 weeks of age, and was practiced for five generations. Beside the estimates calculated each year, a pooled estimate for each correlation was calculated using the data collected over the six years.

The characters studied were :

1. The actual number of eggs laid till certain ages :

A1 till 40 weeks of age ;
A2 till 44 weeks of age ;
A3 till 48 weeks of age ;
A4 till 52 weeks of age ;
A5 till 70 weeks of age ;
A6 till 365 days from the first egg (full record).

2. Three-days-a-week egg number produced in the "A" periods. These were denoted by "a".

All data were corrected for hatch effect each year according to Harvey (1960). Hierarchical analyses of variance-covariance were applied (Henderson, 1953). Estimates of heritabilities of these traits were published elsewhere (together with the numbers of sires, dams and progeny (Ezzeldin and Mostageer, 1983). The standard errors of the genetic correlations were computed by Robertson's method (1959).

Reuslts and Discussion

Tables 1 and 2 show the genetic correlations (together with their standard errors) between the full record egg number (A6) and the other "A" and "a" traits. Tables 3 and 4 show the estimates of the phenotypic correlations (±S.E.) between the same traits.

The pooled estimates of genetic correlations between the full year record (A6) and the five other "A" traits (Table 1) ranged between 0·596 and 0·934. Except for A2 (the number of eggs laid till the age of 44 weeks) the value of the correlation increases with the increase in the length of the part-record and the standard error decreases. The estimates of the phenotypic correlations are lower than their comparable genetic correlations and ranged between 0·363 and 0·878. As expected, a gradual increase in the size of the phenotypic correlations by the increase in the length of the partial record can be observed. It could also be seen that the standard errors of the phenotypic correlation decrease with the increase of the size of the phenotypic correlations. VanVleck and Doolittle (1964) reported genetic correlation estimates among monthly and 500-day egg production (about 70 weeks, A5 here) ranging from 0·55 to 1·07; their estimates of phenotypic correlation ranged from 0·28 to

0.80. In similar studies, Lerner and Cruden (1948) and Oliver *et al.* (1957) found also that, without exception, the phenotypic correlations are smaller than the genetic correlations. The pooled estimate of the genetic correlation between A6 and A5 (number of eggs laid till 70 weeks of age), was very much closer to the phenotypic correlation between them (0.934 and 0.878), but such difference was much higher with respect to all the shorter partial records. The high genetic correlation between these two traits (A6 and A5) indicates that these measures are evaluating essentially the same source of genetic variation. Also the same conclusion was arrived at by Oliver *et al.* (1957) who reported an estimate of 0.966 for the genetic correlation between the number of eggs laid in 300 days production (about 44 weeks, A2 here) and the number of eggs in 365 days production.

TABLE 1. **The genetic Correlations (±S.E.) between A6 and the other ,A, egg number traits.**

	1974	1975	1976	1977	1978	1979	**Pooled**
A1	0.727	**	0.911	0.665	0.442	**	0.613
	±0.195		±0.100	±0.185	±0.342		±0.123
A2	0.810	**	0.998	0.752	0.579	**	0.596
	±0.132		±0.002	±0.142	±0.308		±0.109
A3	0.815	**	**	0.810	0.757	**	0.738
	±0.118			±0.114	±0.210		±0.075
A4	0.746	**	**	0.914	0.965	**	0.856
	±0.152			±0.054	±0.031		±0.043
A5	0.828	**	**	**	**	0.988	0.934
	±0.119					±0.009	±0.021

** more than 1.

It is of interest to note, that with respect to the genetic correlations, the pooled estimates are less than the comparable values estimated in the base population (in 1974) for A1, A2 and A3 and higher with respect to A4 and A5. A3 (the number of eggs laid till 48 weeks of age) was the criterion used in selection. The first three traits are genetically very highly correlated (the genetic correlation between any two of these traits in the base population was found to be higher than 0.96, and so was also the case in the pooled estimates). Selection, it seemed, had succeeded in loosening the genetic correlation between these three traits on the one hand and A6, *i.e.* A6 became less dependent on the trait of egg production selected for, and thus rendering A6 more dependent on the rest of its components, the eggs laid after 48 weeks of age or A4 and A5. For instance, the genetic correlation between A6 and the number of eggs laid during the period from 70 weeks of the pullets age till the end of the laying year was - 0·172 in the base population and was augmented to + 0·329 in the pooled estimate. The comparable phenotypic correlations, however, did not change much (0·466 and 0·499 respectively).

TABLE 2. **The genetic correlations (± S.E.) between A6 and the 'a' traits.**

	1974	1975	1976	1977	1978	1979	**Pooled**
a1	0.578 ±0.280	**	0.798 ±0.208	0.645 ±0.207	0.570 ±0.318	**	0.617 ±0.133
a2	0.720 ±0.195	**	0.925 ±0.072	0.802 ±0.130	0.826 ±0.167	**	0.656 ±0.112
a3	0.666 ±0.213	**	**	0.871 ±0.100	**	**	0.800 ±0.013
a4	0.610 ±0.229	**	**	**	**	0.847 ±0.213	**
a5	0.780 ±0.154	**	0.779 ±0.285	**	**	**	0.761 ±0.067
a6	**	**	**	**	**	0.842 ±0.165	**

** more than 1.

Using part records in selection to increase total egg production (A6 here) could serve to decrease the generation interval (*i.e.*, to increase the per annum genetic gain) and the amount of labor used. Decreasing the number of trapnesting days could further cut down the expenses of recording. The correlations between A6 and the "a" traits (the three-days-a-week record) are thus shown here (Table 2 and 4). The genetic correlations between the "a" records and A6 are all less than the comparable figures calculated using the "A" records in the base population (of 1974). However, the reverse could be seen with respect to the pooled estimates (except for A5 and a5). It is known that the genetic progress gained per generation by using part records relative to the gain attained by selection on A6 will be $r_g h_x / h_{A6}$ where h_x is the square root of the heritability of the part record x, and h_{A6} is the square root of the heritability of the full record A6. Using the pooled heritability values of the traits relevent published by Ezzeldin and Mostageer (1983) and the pooled genetic correlation values of this work, it could be seen that the amount of genetic progress using the four part records shown relative to the genetic progress gained by direct selection on A6 will be as follows :

A1 : 56% a1 : 45%
A2 : 65% a2 : 60%
A3 : 82% a3 : 69%
A4 : 99% a4 : 79%

TABLE 3. The phenotypic correlations (± S.E.) between A6 and the other 'A' egg number traits.

	1974	1975	1976	1977	1978	1979	**Pooled**
A1	0.311	0.472	0.124	0.469	0.315	0.346	0.363
	±0.029	±0.026	±0.039	±0.022	±0.037	±0.043	±0.013
A2	0.386	0.540	0.155	0.521	0.368	0.496	0.423
	±0.028	±0.024	±0.039	±0.021	±0.035	±0.037	±0.012
A3	0.480	0.584	0.164	0.568	0.451	0.650	0.493
	±0.025	±0.022	±0.039	±0.019	±0.033	±0.028	±0.011
A4	0.548	0.639	0.212	0.640	0.568	0.773	0.581
	±0.023	±0.020	±0.038	±0.017	±0.028	±0.020	±0.010
A5	0.800	0.870	0.446	0.932	0.819	0.791	0.878
	±0.012	±0.008	±0.032	±0.004	±0.013	±0.003	±0.003

TABLE 4. The phenotypic correlations (± S.E.) between A6 and the 'a' traits.

	1974	1975	1976	1977	1978	1979	**Pooled**
a1	0.292 ±0.030	0.458 ±0.027	0.120 ±0.039	0.432 ±0.023	0.297 ±0.037	0.305 ±0.044	0.340 ±0.013
a2	0.371 ±0.028	0.527 ±0.024	0.147 ±0.039	0.460 ±0.022	0.346 ±0.036	0.447 ±0.039	0.392 ±0.012
a3	0.457 ±0.024	0.569 ±0.023	0.152 ±0.039	0.476 ±0.022	0.427 ±0.033	0.574 ±0.033	0.450 ±0.012
a4	0.518 ±0.024	0.618 ±0.021	0.203 ±0.038	0.513 ±0.021	0.508 ±0.030	0.664 ±0.027	0.517 ±0.011
a5	0.763 ±0.014	0.849 ±0.009	0.402 ±0.033	0.832 ±00.09	0.783 ±0.016	0.933 ±0.006	0.789 ±0.005
a6	0.955 ±0.003	0.840 ±0.010	0.535 ±0.028	0.838 ±0.008	0.756 ±0.017	0.858 ±0.013	0.902 ±0.003

TABLE 5. The genetic correlations(± S.E.) between A4 and the other 'A' egg number traits.

	1974	1975	1976	1977	1978	1979	Pooled
A1	0.997	**	**	0.908	0.803	0.838	0.990
	±0.001			±0.053	±0.132	±0.451	±0.004
A2	**	0.980	**	0.952	0.858	**	0.963
		±0.018		±0.028	±0.106		±0.011
A3	**	**	**	0.973	0.939	**	0.988
				±0.016	±0.051		±0.033

** more than 1.

TABLE 6. The genetic correlations (± S.E.) between A4 and the 'a' traits.

	1974	1975	1976	1977	1978	1979	Pooled
a1	0.982	0.998	**	0.958	0.935	**	**
	±0.009	±0.002		±0.026	±0.052		
a2	**	**	**	**	0.968	**	**
					±0.029		
a3	0.994	**	**	**	**	0.675	0.856
	±0.003					±1.011	±0.043
a4	0.998	**	**	**	**	0.234	**
	±0.001					±1.098	

** more than 1.

TABLE 7. **The phenotypic correlations (±S.E.) between A4 and the other 'A' Egg number traits.**

	1974	1975	1976	1977	1978	1979	**Pooled**
A1	0.816	0.802	0.826	0.810	0.817	0.709	0.802
	±0.011	±0.011	∓0.013	±0.010	±0.014	±0.024	±0.005
A2	0.893	0.905	0.902	0.896	0.886	0.854	0.890
	±0.007	±0.006	±0.007	±0.006	±0.009	±0.013	±0.003
A3	0.965	0.967	0.968	0.959	0.950	0.958	0.960
	±0.002	±0.002	±0.002	±0.002	±0.004	±0.004	±0.001

TABLE 8. **The phenotypic correlations (±S.E.) between A4 and the 'a' traits.**

	1974	1975	1976	1977	1978	1979	Pooled
a1	0.788	0.749	0.803	0.733	0.764	0.658	0.748
	±0.012	±0.015	±0.014	±0.013	±0.017	±0.028	±0.006
a2	0.865	0.834	0.881	0.779	0.833	0.791	0.824
	±0.008	±0.010	±0.009	±0.011	±0.013	±0.018	±0.005
a3	0.932	0.883	0.942	0.797	0.891	0.867	0.874
	±0.004	±0.007	±0.005	±0.010	±0.008	±0.012	±0.003
a4	0.966	0.907	0.968	0.787	0.889	0.878	0.885
	±0.002	±0.006	±0.003	±0.011	±0.009	±0.011	±0.003

Clearly, full records give more genetic progress than the comparable three-days-a-week records. Reduction of the labor in trapnesting will, in fact, reduce the genetic gain seriousely.

It is now clear that, selecting on A4 will give the same amount of genetic progress in A6 attained by using the full record A6. That is to say that A4 could be taken as an early substitute of A6, except that it increases the "per annum" gain, since selection will take part early in the production life of the bird. A4 in turn is a character that should be sought also, for its own sake, since it determines the first cash income for the breeder, and the production of its last four weeks (A4-A3) will determine the number of chicks that can be hatched for the selected pullets. Tables, 5,6,7 and 8 show the genetic and phenotypic correlations of the early "A" and "a" traits with A4. The tables show that the genetic correlations between A4 and all the traits up to a4 (except a3 in some years) are almost 1 in all the years studied. But since A4 has higher heritability compared to the "A" traits of shorter periods (and also the "a" traits) (see Ezzeldin and Mostageer, 1983), direct selection will produce more genetic gain than any of the shorter part records.

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التلازم الوراثى والمظهرى بين انتاج البيض السنوى وانتاجه فى بعض الفترات فى الفيومى

زينب على عز الدين وأحمد مستجير

وزارة الزراعة وكلية الزراعة ــ جامعة القاهرة ــ مصر

أجريت هذه الدراسة فى مزرعة بحوث تربية الدواجن بكلية الزراعة ــ جامعة القاهرة ٠ تم استخدام ستة أجيال من دجاج الفيومى لقياس معاملات التلازم الوراثية والمظهرية بين ناتج البيض السنوى (أ ٦) وبعض الفترات العدد الفعلى من البيض الناتج حتى أعمار معينة : أ ١ (٤٠ اسبوع) ، أ ٢ (٤٤ أسبوع) ، أ ٣ (٤٨ أسبوع) ، أ ٤ (٥٢ أسبوع) أ ٥ (٧٠ أسبوع) وكذلك عدد البيض المسجل ثلاثة أيام كل أسبوع لنفس الفترات السابقة (ج١ ، ج٢ ، ج٣ ، ج٤ ، ج٥) كذلك بين انتاج البيض فى الفترات الأولى مع عدد البيض الكلى الناتج حتى ٥٢ أسبوعا من العمر (أ ٤) ٠

كانت كل قيم التلازم المظهرى أقل من التلازم الوراثى وقيم معامل التلازم للقيم المجمعة كانت أقل من مثيلاتها لقطيع الأساس بالنسبة للفترات الأولى (أ١ ، أ٢ ، أ٣) وأعلى بالنسبة لـ أ٤ ، أ٥ ٠

كانت كل قيم التلازم الوراثى بين « ج » وأ٦ أقل من القيم المناظرة لها والمحسوبة باستخدام « أ » فى قطيع الأساس ٠

أعطى ناتج البيض الكلى ربحا وراثيا أعلى فى أ٦ عن نظيره المسجل ثلاثة أيام فى الأسبوع ٠ تم عرض بعض قيم التحسين الوراثى المكتسب كل جيل فى أ٦ باستخدام الفترات المختلفة منسوبا للزيادة المتحصل عليها بواسطة الانتخاب ٠