

Genetical Studies on some Economical Traits of Chickens in the Subtropics

M. A. M. Kicka, F. K. R. Stino, and G. A. R. Kamar

Department of Animal Production, Faculty of Agriculture,
Cairo University, Giza, Egypt.

THE PERFORMANCE of some purebreds and their reciprocal crosses under the subtropical conditions of Egypt was investigated. Results indicate that crossing native breeds with tempered improved breeds would improve age at sexual maturity, weight at sexual maturity, adult body weight, egg production, egg weight, egg mass, fertility and hatchability. Also crossing two of the native pure breeds together improved the productivity of their crosses in most characteristics studied.

A new phenomenon that is called maternal effect associated heterosis was obvious in fertility and hatchability when crossing the two native breeds. This phenomenon was characterized by a highly significant heterosis when the female line had the higher fertility or hatchability.

The phenomenon of heterosis or hybrid vigour is well known from crossing different breeds and varieties of both animals and plants. It is characterized in poultry by improvement in most economic traits. The extent to which this condition is obtained depends upon the combining ability of the strains that are used.

Breed differences are obvious in most economical traits in chickens. Results of numerous cross-breeding experiments have been reported. Warren (1927) found hybrids to be definitely superior to either parental breed. Nordskog and Ghostly (1954) compared strain crosses, crossbreds, and pure strains; their results favoured strain crosses and crossbreds over the pure strains. Similar results were obtained by King and Bruckner (1952) and Ragab *et al.* (1965).

Subtropical countries possess native breeds of low productivity, crossing them with tempered improved breeds is sought generally as a means for increasing productivity. In this experiment two of the native Egyptian breeds of chickens, the Fayoumi and the Waite Baladi, were crossed together and with Rhode Island Red. This was done to study different production traits of these pure breeds and their reciprocal crosses under the subtropical conditions of Egypt.

Material and Methods

The breeds and crosses in this study and their general management were the same as reported by Stino, (1974). They were Fayoumi (F), White Baladi (B), and Rhode Island Red (RIR), and their six reciprocal crosses. In discussing the crosses, the male abbreviation will be listed first, *i.e.*, FR means Fayoumi male x Rhode Island Red female. The pure breeds were kept in three closed flocks since the 1960's at the Faculty of Agriculture, Cairo University. Chicks were hatched in January and were raised intermingled.

About fifty pullets and five roosters from each breed or cross were housed at five months of age in similar laying houses allowing one-fourth square metre per bird. The birds received *ad lib.* feed and water. Their ration contained 17% protein and 2800 K. Cal/kg ME. They received 18 hr of light daily. All environmental and managerial conditions were kept similar for all groups. Data were collected individually on age at sexual maturity (age at first egg); weight at sexual maturity; weight at 12 months; and January egg production, egg weight, and egg mass (at which time all groups were in production for at least two months). Between 200 to 400 eggs were incubated from each group to produce F_0 ; they were incubated in four different hatches to measure fertility and hatchability. Statistical analyses were carried out according to Steel and Torrie (1960).

Results and Discussion

Age at sexual maturity

Heterosis was apparent in age at sexual maturity since almost all crosses reached sexual maturity earlier than their parents (Table 1). Crossing the two native breeds also resulted in earlier sexual maturity. This heterosis might be due to the increase in the amount of inbreeding in the three parental pure breeds. The RIR females reached sexual maturity later than all other breeds and crosses. This is due to their heavier body size and the expected association with later sexual maturity. However this also might be due to the decline in reproductive fitness of the small flock of the RIR strain kept at the Faculty of Agriculture with no attempted selection.

Weight at sexual maturity

B pullets had the lowest body weight at sexual maturity (Table 1). Maternal effect was apparent in this characteristic. The RIR birds and the crosses with an RIR mother were the heaviest at sexual maturity. Similar results have been reported earlier (Badreldin *et al.*, 1959).

Weight at 12 months of age

RIR birds were the heaviest at 12 months while the native breeds were the lightest (Table 1). This difference was highly significant ($P \leq 0.01$). The crosses between the RIR with both F and B resulted in progeny with adult weight intermediate between both parents. This would indicate that this characteristic is mostly governed by additive genes. The only exception was the RF cross where the progeny resembled the F line more than the RIR breed, indicating the presence of a maternal effect. The cross BF showed heterosis in adult body weight over both parental lines. However its reciprocal FB was almost similar in weight to both parental lines.

Egg number

There was no significant difference in January egg number between the RIR females or any of the crosses resulting from an RIR mother (Table 1). They laid more eggs than the other breeds and crosses. When RIR females were mated to either of the two native breed males, the F_1 crosses produced

more eggs than their reciprocals. This would indicate a maternal effect associated with this trait. Earlier results of Badreldin *et al.*, (1959), indicated no maternal effect associated with this characteristic. The F_1 crosses of the two native breeds laid more eggs than their parents. The BF cross especially showed a very significant heterosis over its reciprocal cross and laid as many eggs as the RIR.

It should be pointed out here that since some of these breeds and crosses reached sexual maturity earlier than the others, they should be at different stages of egg production during January. This can be one reason for the difference in egg production. However, pullets with almost the same age at sexual maturity should be at about the same point on the egg production curve.

Egg weight

Crossing RIR, which had the heaviest egg weight, with F, which had the lightest egg weight, resulted in progeny with intermediate egg weight with no difference between the reciprocal crosses (Table 1). However crossing RIR with B, which had also the lightest egg weight, resulted in a progeny with the egg size almost like that of the RIR. This might be due to the presence of some epistatic genes in the B breed which complement only those of the RIR breed or *vice versa*. When B males were mated to F females, their F_1 cross laid heavier eggs than both parents indicating heterosis.

Egg mass

The highest egg mass (as a function of egg number and weight) was that of the RIR breed (Table 1). On the other hand, B and F pullets gave the lowest egg mass. These differences were highly significant ($P \leq 0.01$). When RIR females were mated to an F or B male, their F_1 cross laid a significantly higher egg mass than their reciprocal. This maternal effect is a carryover from that of the egg number. Meanwhile, when the F and B were crossed their crosses gave higher egg mass than their parents indicating heterosis.

Fertility

Table 2 shows that the F line had a significantly ($P \leq .01$) higher fertility than both the other two pure breeds. The fertility of the RF and RB crosses (to produce F_2) resembled that of the female line, indicating the presence of a maternal effect. Similar results were reported earlier by Ragab *et al.*, (1965). However the fertility of their reciprocal crosses, the FR and BR, was significantly ($P \leq .01$) higher than that of both parents indicating heterosis.

The FB cross fertility resembled that of the F line; however its reciprocal cross, the BF, had the highest overall fertility of all breeds and crosses. It appears that a type of maternal effect associated heterosis is present in this characteristic.

TABLE 1. Average age and weight at sexual maturity, weight at 12th month and January egg number, egg weight, and egg mass for the pure breeds and their crosses*

	No. of pullets	Age/sexual maturity day	Wt. at sexual maturity g	Wt. at 12th month g	January egg No.	Average egg Wt. g	January egg mass g
Breed or cross							
RIR*	42	285 a**	1250 ab	1790 a	14.0 a	51 a	717 a
BR	45	250 bc	1230 abc	1530 b	14.1 a	51 a	715 a
FR	38	233 bcd	1290 a	1530 b	13.6 a	49 a	662 b
RB	45	225 cd	1180 bcd	1540 b	12.1 bc	50 ab	598 cd
RF	58	230 cd	1150 cd	1380 c	12.0 c	49 b	587 cd
BB	44	261 ab	1130 d	1260 d	12.0 c	47 cd	567 de
FF	58	229 cd	1170 bcd	1290 d	12.2 bc	47 bc	570 cde
FB	51	220 cd	1150 cd	1300 d	12.8 b	47 cd	597 cd
BF	59	214 d	1170 bcd	1350 c	13.8 a	48 c	608 d

* Males are listed first, *i.e.*, FR means Fayoumi male \times Rhode Island Red female.

** Means within a column followed by different superscript differ significantly ($P \leq 0.01$) from each other (Duncan, 1955).

TABLE 2 Weighted average percent fertility and hatchability of the pure breeds and their reciprocal crosses over four hatches.

Breed	No. eggs set	Fertility average	Hatchability average
RIR	212	77.9 d*	66.8 e
BR	258	92.5 ab	81.7 cd
FR	212	92.3 ab	75.2 d
RB	290	78.4 d	80.2 cd
RF	289	87.6 c	79.7 cd
BB	253	79.9 d	79.3 cd
FF	283	89.0 bc	85.7 b
FB	313	89.4 bc	81.9 c
BF	363	94.2 a	89.0 a

* Mean within a column followed by different superscript differ significantly ($p \leq 0.01$) from each other (Duncan, 1955).

Hatchability

Hatchability in RIR and B eggs were significantly ($P \leq .01$) lower than in the F breed (Table 2). However, the hatchability of eggs from RB and BR crosses (to produce F_2) were higher than that of both parents indicating heterosis. On the other hand, the hatchability of the FR and RF crosses were intermediate between both parents indicating additive gene action. These results would indicate a better combining ability between the RIR and B breeds in this characteristic.

Eggs from the BF cross had the highest hatchability over all other breeds and crosses. Its reciprocal FB cross was intermediate between both parents. These results are also indicative of the presence of the maternal effect associated heterosis in this characteristic as well. This phenomenon has never been reported before. It might be due to carryover effects transmitted by the egg or to the presence of some genes on the W chromosome of the F breed that complement some genes on the Z chromosome of the B chickens. This also might be due to maternal effects transmitted by the egg contents and/or the ovum cytoplasm. This phenomenon should be further studied.

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دراسة وراثية على بعض الصفات الاقتصادية للدواجن في المناطق الحارة

مختار عبد الفتاح محمد قيقه ، فريد كمال رمزي استينو ومحمد جمال الدين قهر

كلية الزراعة - جامعة القاهرة بالجيزة

درست الصفات الانتاجية لبعض أنواع الدواجن الاصليه وكذلك خلطاتها العكسية تحت الظروف الجوية الشبة حارة لمصر . ولقد اثبتت التجارب ان خلط الأنواع المحلية مع الأنواع القياسية المحسنة أدى الى تحسين العمر والوزن عند النضج الجنسي والوزن الكامل وعدد البيض ووزن البيضة وكتلة البيض ونسبة الخصب ونسبة الفقس . كذلك فان خلط نوعين أصليين من الدجاج المخلى أدى الى تحسين انتاج الخليط في أغلب الصفات التي درست .

كذلك فلقد لوحظت ظاهرة جديدة أطلق عليها قوة الهجين المرتبطة بالام في كلا من صفتي نسبة الخصب ونسبة الفقس وذلك عندتهجين النوعين مع بعضهم . وهذه الظاهرة تتميز بظهور قوة الهجين بصورة عالية المعنوية عندما تكون سلالة الام التي ترتفع فيها نسبة الخصب أو نسبة الفقس .