CROSSBREEDING AND IMPROVEMENT OF THE FIRST YEAR RECORD OF EGG PRODUCTION IN THE FAYOUMI CHICKENS

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ABSTRACT.—Crossbreeding the Egyptian Fayoumi chickens with three standard breeds, namely the White Leghorn, the Rhode Island Red and the Barred Plymouth Rock, resulted in marked improvement in egg production. Such improvement was the highest in crosses between the Fayoumi and the Barred Plymouth Rock. The differences were statistically significant. Whenever the sire was from a higher laying breed than the dam, the resulting crossbred pullets laid more eggs than the reciprocal cross. These differences may indicate that certain sex-linked genes are involved in the inheritance of egg number. Spring hatched pullets laid fewer eggs than the fall hatched group and the differences were highly significant. In general, Fayoumi crosses seemed better adapted to Egyptian conditions and laid more eggs than the standard breeds or their crosses. Furthermore, the local (Egyptian) consumer apparently prefers the taste of eggs and meat of Fayoumi and its crosses to that of the standard breeds and their crosses.

In the last few decades, the sharp increase in the human population of Egypt has imposed a great demand for more market eggs. Crossbreeding poultry for egg production was suggested as an efficient method for a quick increase in home production (Hutt, 1949; Jull, 1952), especially at the small farmer's level. This method of breeding has been fully studied in the world's great centers of egg production, yet in many countries this question still attracts the attention of the poultry breeder. In such studies the main objective is to discover those breeds and/or varieties which combine best. A few such trials were done on the Egyptian strains of chickens from the standpoint of egg production (Assem, 1951; Mostafa, 1958; Abdel-Gawad, 1955, 1961). The present study is an attempt to evaluate the effect of crossbreeding the Egyptian Fayoumi chickens with three standard breeds based on the first year record of egg production.

MATERIAL AND METHODS

The present study was done on the University of Alexandria flock which included the indigenous breed Fayoumi as well as three standard breeds of chickens, the Single Comb White Leghorn, the Rhode Island Red and the Barred Plymouth Rock. The four breeds were crossed in all possible combinations; each cross, its reciprocal, and the purebreds were all produced simultaneously.

Crossing began early in the fall of 1958 and continued throughout the spring of 1959. Eight pens of females from each of the four breeds were used. Eight males from each breed were distributed at random among two pens of females from each of the four breeds. There were thus a total of sixteen combinations; six crosses, their six reciprocals, and four purebred controls.

The crosses will be referred to by two letters, the first of which stands for the sire's breed and the second for that of the dam. The breed abbreviations are "F" for the Fayoumi, "L" for the S.C. White Leghorn, "R" for the Rhode Island Red, and "B" for the Barred Plymouth Rock.

All parent stocks were hatched during the previous season (1957/58). The number of pullets in each pen differed according to breed; there were

eighteen Fayoumi, eighteen Leghorn and thirteen Rhode Island Red pullets in each pen occupied by these three breeds. Because of a shortage in mature Barred Rock pullets, pens of this breed contained only seven or eight pullets in the fall with the number increasing to fourteen during the spring hatches.

Eight hatches were produced, five in the fall and three in the spring. The fall chicks were hatched on November 14 and 21 and on December 5, 9 and 26, 1958. In the spring they hatched on April 10, 17 and 25, 1959.

All chicks were brooded for the first two weeks in starting electric battery brooders. They were then transferred to the floor of a permanent gas heated brooding house. After the brooding period, the females were transferred to rearing houses through the fourth month of age. There were 507 and 237 pullets from the fall and spring hatches, respectively. Before they reached the fifth month of age, each season's group was housed separately in a laying house equipped with trap nests.

All pullets were trap nested for the first laying year. Culling was limited to sick pullets or those removed because of accidents.

All the data were subjected to the analysis of variance and the F-test of significance. Any population with less than five pullets was excluded. The differences have also been tested by the least significant difference test.

Results and Discussion

Data on the total number of eggs

Table 1.—Total Number of Eggs in the First Year.

Population	Fall		Spring		Total		
	No. hens	Mean Eggs	No. hens	Mean Eggs	No. hens	Mean Eggs	± S.E.
FL*	38	134.9	23	113.9	61	127.0	± 2.9
LF	19	145.1	5	136.6	24	143.3	± 3.2
FR	32	159.1	15	141.7	47	153.6	± 2.8
RF	44	143.0	12	117.5	56	137.5	± 2.9
FB	9	185.4	2	101.5	11	171.1	± 4.8
BF	12	149.7	7	123.3	19	139.9	± 4.2
Fay. crosses mean	—		—		218	140.6	± 1.8
LR	24	160.2	2	97.5	26	155.3	± 3.1
RL	67	160.1	7	118.3	74	147.1	± 2.1
LB	8	150.6	1	98.0	9	144.8	± 4.3
BL	24	130.3	10	108.3	34	123.8	± 2.8
RB	15	161.5	18	118.1	33	137.8	± 2.9
BR	27	139.7	1	83.0	28	137.6	± 3.0
Standard bred crosses mean	—		—		204	138.9	± 2.9
Leghorn	10	142.5	16	141.3	26	141.8	± 2.6
Rhode I. R.	19	122.5	17	100.2	36	112.0	± 2.7
B.P.R.	7	110.1	13	67.5	20	82.5	± 4.2
Standard breed mean	—		—		82	114.2	± 2.5
Fayoumi	31	127.6	28	118.6	59	123.4	± 2.8
General mean	386	144.1± 1.1	177	115.8± 1.8	563	135.2	± 1.8

*First letter stands for male breed and second for female's.

laid in the first year are summarized in Table 1. The general mean was 135.2 ± 1.8 eggs for the 563 pullets raised in the present experiment. This was a low average if compared to the present day standards of laying in the domestic fowl. However, it was not much lower than the figures published on local flocks which were raised under similar conditions of husbandry (Assem, 1951, and Abdel-Gawad 1955 and 1961).

Two explanations may account for this low productivity. First, the present observations on egg number were the first recorded on the University flock since its founding, and there had been no chance for selection for this trait. Therefore, no information was available as to the egg production potential of the parental stocks of this flock.

The second explanation might be the low nutritional level of the feed these pullets received during their growing and production periods. The main difficulty in this respect was the scarcity and irregular supplies of animal protein and other feed supplements. However, it is evident that since we are interested in the relative merit of crosses and purebreds, it is justifiable to use the present data as all the populations secured had comparable environmental conditions.

Differences between these populations were found to be highly significant (Table 2), a fact which indicates that the breeds differed according to their combinability in the production of F_1's.

Comparing the Fayoumi breed with the other three standard breeds, the Fayoumi averaged 123.4 ± 2.8 eggs per year versus 114.2 ± 2.5 eggs for the other three breeds. But the difference was not statistically significant (Table 3). The Leghorn exceeded Fayoumi in this aspect as its mean was 141.8 ± 2.6 eggs, while the Fayoumi exceeded both the Rhode Island Red and the Barred Rocks, since the two later breeds averaged 112.0 ± 2.7 eggs and 82.5 ± 4.2 eggs respectively. Assem (1951) reported 156.4 eggs for the Fayoumi per year which is higher than that observed in our flocks. This difference between the two flocks could be due to strain and/or management.

While the annual egg production mean in the Fayoumi was 123.4 ± 2.8 eggs, its crosses with the standard breeds laid 140.6 ± 1.8 eggs on the average. Abdel-Gawad (1955) found similar results and concluded that the Fayoumi crosses were higher than the pure Fayoumi in egg production. She reported 164.2 eggs for RF cross and 152.7 eggs for Fayoumi pullets. Fayoumi crosses produced more eggs when the male was of the higher producing breed than the dam. Their means were 153.6 ± 2.8 and 171.1 ± 4.8 eggs for FR and FB crosses, respectively. The reciprocal crosses had lower means of 137.5 ± 2.9, and 139.9 ± 4.2 eggs for RF and BF, respectively. Similarly, when the Leghorn was the sire, we observe that the LF cross laid 143.3 ± 3.2 eggs, which was more than the reciprocal (FL) that laid 127.0 ± 2.9 eggs only.

These results did not agree with those of Mostafa (1958). He reported in the Fayoumi crosses that reciprocal combinations laid about the same number of eggs. In general, even the standard-bred crosses follow the statement, that whenever the

TABLE 2.—Results of the Analysis of Variance of the First Year Egg Number.

Source of Variations	D.F.	Mean Square
Total	488	—
Between populations	11	10871.4**
Between seasons	1	72796.4**
Populations X seasons	11	1339.3
Within populations	465	1402.6

**Significant at 0.01 level.

sire was from a higher laying breed than the dam, the crossbred pullets laid more eggs than the reciprocal cross. This may be interpreted as the effect of sex-linkage. Such linkage was also suggested by Niesel (1948), and King and Bruckner (1952) who stated that sex-linked genes are involved in the inheritance of egg number.

Fayoumi crosses averaged 17.2 eggs more than did the Fayoumi itself, and this difference was highly significant (Table 3). Similarly, the standard-bred crosses exceeded the standard purebreds with 24.7 eggs more, which proved to be a highly significant difference. Generally, it is evident that the crossbred pullets laid more eggs than the parental purebreds, as the Fayoumi crosses and standard bred crosses averaged 140.6 ± 1.8, and 138.9 ± 2.0 eggs respectively, versus 114.2 ± 2.5 eggs for the three standard purebreds and 123.4 ± 2.8 eggs for the Fayoumi. This agrees with the results reported on Fayoumi crosses by Nordskog and Phillips (1960) as well as those who worked in crossbreeding trials (see Hutt, 1949; Jull, 1952). Comparing the Fayoumi crosses with the standard bred crosses, the former laid more eggs but the difference was insignificant.

Heterosis in the F_1's was estimated in the present study by calculating the difference between the average of the two parental purebreds and that of the two reciprocal crosses. This difference was expressed in per cent of the parental mean. The results of these calculations are shown in Table 4, from which it is evident that there is a heterotic effect secured by crossing, especially when the Fayoumi was crossed with the standard breeds. Heterosis was low when Fayoumi and Leghorns were crossed (1.92%). But when Fayoumi was crossed with Rhode Island Red or Barred Rocks, higher heterosis resulted than from the crossbreeding between the standard breeds.

The fact that crosses between Fayoumi and Leghorns showed lower heterosis than any other group may be an indication that the difference between the strains used of these two breeds is not great, as they are both light breeds. The gap between the strains used from the Fayoumi and the two heavy breeds Rhode Island Red and Barred Rocks was apparently great enough to induce such large heterosis (Table 4). The same effect was suggested by Hutt (1949) in

TABLE 4.—Percentages of Heterosis in the First Year Egg Number.

Populations	Difference observed $\bar{X}F_1-\bar{X}P_1$	Heterosis $\frac{\bar{X}F_1-\bar{X}P_1}{\bar{X}P_1}$
FL and LF	+ 2.55	1.92%
FR and RF	+27.85	23.66%
FB and BF	+52.55	51.04%
LR and RL	+24.30	19.15%
LB and BL	+22.15	19.75%
RB and BR	+40.55	41.70%

TABLE 3.—Least significant differences in total first year egg Number.

Populations	No.	L. S. D. at .05 level	L. S. D. at .01 level	Difference observed
Fay. and Standard purebreds	141	13.4	—	9.2
Fay. and its crosses	277	11.4	15.1	17.2**
Standard purebreds and their crosses	286	11.0	14.5	24.7**
Fay. crosses and standard bred crosses	422	8.6	—	1.7
Fall and spring	563	7.2	9.5	28.3**

**Significant at 0.01 level.

comparison between breed and strain crosses.

The difference between the purebred Fayoumi and its two reciprocal crosses was estimated in per cent of the Fayoumi mean. For this percentage the term "improvement over Fayoumi" is used hereafter. Table 5 summarizes the improvement percentages in the first year egg record.

TABLE 5.—Percentages of improvement in the First Year Record of the Crosses over that of the Purebred Fayoumi.

Populations	Difference observed $\bar{X}F_1 - \bar{X}$ Fay.	Improvement over Fayoumi $\frac{\bar{X}F_1 - \bar{X} \text{ Fay.}}{\bar{X} \text{ Fay.}}$
FL and LF	+ 11.75	9.52%
FR and RF	+ 22.15	17.95%
FB and BF	+ 32.10	26.00%

The crosses between Fayoumi and Barred Rocks attained the highest improvement (26.0%) followed by the crosses between Fayoumi and Rhode Island Red (17.95%), the lowest improvement was secured in the case of crosses between Fayoumi and Leghorns (9.52%). This also indicates to some extent that the lines used from these breeds differ in the relationship to each other. This was in agreement with Maw (1941) who observed that the improvement over the parental lines tended to vary according to the degree of relationship between the parents.

It should be made clear that the data obtained in the present study reflect the performance and genetic potential of the strains used. Therefore, any conclusions concerning which breeds might be most successfully crossed or percentage of heterosis and improvement apply only to the specific sample of the breeds crossed in this experiment which may or may not be typical of the breeds involved as a whole.

In Table 1, the data was classified according to seasons as well as to populations, since the populations were hatched both in the fall and the spring. It has been tested statistically with two different methods, the analysis of variance according to the "F test" (Table 2) as well as the least significant difference method (Table 3). Both tests gave the same results. The pullets which were hatched in the fall averaged 28.3 eggs more than did the spring hatches as their means were 144.1 ± 1.1 eggs and 115.8 ± 1.8 eggs, respectively (Table 1). This difference was highly significant (Tables 2, 3).

Various strains of the standard breeds have been repeatedly introduced in the past four decades by Egyptian breeders and breeding stations. Since their introduction, it has been noticed that the local customer prefers the taste of indigenous breed eggs and meat over that of the standard breeds. By comparison with the standard breeds, Fayoumi chickens are generally smaller in size, lay their first egg earlier, and as a consequence lay smaller eggs than that of Leghorns or the heavy breeds (Abdel-Gawad, 1955, 1961; Mostafa, 1958; Nordskog and Phillips, 1960). Both eggs and meat of the Fayoumi are characteristically stronger in flavor than the standard breeds. The relatively small Fayoumi eggs contain bright golden yolk that is usually darker in pigmentation than that of the standard breeds. Furthermore, the meat of the indigenous Fayoumi chickens is darker in color and firmer in texture and is somewhat similar in taste to wild (game) fowls. The darkness of its meat color may be correlated with higher melanin content since its shanks are characterized with dark melanin color that extends sometimes to the meat in the lower portions of the thighs.

In a pioneering experiment (El-Ibiary, 1961), a taste panel compris-

ing a group of Americans and Egyptians sampled eggs and meat of both Fayoumi and the standard breeds after being prepared in the same way. Invariably, the Americans preferred the taste of eggs and meat of the standard breeds while the Egyptians preferred that of the Fayoumi. Even-though the experiment lacked adequate controls and the data was quite limited, the visual trend was strongly indicative of definite taste differences. Therefore, more experimental data on this line should be obtained before a final conclusion is made.

The problem then is not a quantitative increase in the number of eggs or meat produced, but the taste may become a crucial factor in accepting the quality of the product. Apparently the local poultry breeders have been consciously or unconsciously selecting for certain taste in their products over the years. If this is the case, it is probably safe to assume that the local consumer became adapted to a particular taste in these products. Unfortunately, most breeding experiments concentrate primarily on the quantitative increase and do not take into account the taste of the product.

In the present study, it has been noticed that under the same conditions, the Fayoumi crosses were not only better adapted to the local disease, feeding, and management conditions than the standard breeds, but their eggs and meat were accepted as equal to that of the Fayoumi in taste.

Summary and Conclusion

In a breeding program intended to increase egg production of the Egyptian Fayoumi chickens, Fayoumi, White Leghorn, Rhode Island Red and Barred Plymouth Rock breeds were crossed in all possible combinations and compared with the pure-breds. In the first year egg record, the Fayoumi crosses were slightly but insignificantly higher than the standard bred crosses. They were also higher than that of the Fayoumi alone and the standard breeds as a group. The difference in both cases was highly significant. Among all twelve cross combinations, the cross between Fayoumi sires and Barred Plymouth Rock dams proved the best. Within the standard bred crosses, the cross between the White Leghorn and the Rhode Island Red was the highest. Data from these twelve crosses indicate that whenever the sire was from a higher laying breed than the dam, the resulting cross-bred pullets laid more eggs than the reciprocal cross. Such a difference may be attributed to certain sex-linked genes that are involved in the inheritance of egg number. Spring hatched pullets were inferior to fall hatched ones and the difference in all cases was highly significant. Fa-youmi crosses seemed better adapted to local conditions than the standard breeds or their crosses. The local consumer seems to prefer the taste of eggs and meat of Fayoumi and its crosses to that of the standard breeds and their crosses.

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Literature Cited

Abdel-Gawad, E. M. 1955. Effect of crossing Fayoumi fowls with light Sussex and Rhode Island Red. M.S. thesis, Univ. of Cairo, Cairo, Egypt.

———. 1961. Genetic and phenotypic parameters in the Fayoumi breed

and their relation to its improvement through breeding. Ph.D. thesis, Univ. of Alexandria, Alexandria, Egypt.

ASSEM, M. A. 1951. A study of first year egg production of Egyptian fowl. M.S. thesis, Univ. of Cairo, Cairo, Egypt.

EL-IBIARY, H. M. 1961. Personal Communication.

HUTT, F. B. 1949. *Genetics of the fowl.* McGraw-Hill Book Co., Inc., New York.

JULL, M. A. 1952. *Poultry breeding.* John Wiley and Sons, Inc., New York.

KING, S. C. and J. H. BRUCKNER. 1952. A comparative analysis of purebreds and crossbred poultry. Poult. Sci., 31:1030-1036.

MAW, A. J. G. 1941. Crosses between inbred lines of the domestic fowl. Poult. Sci., 20:465.

MOSTAFA, A. B. 1958. Some economical characteristics in different breeds and crosses of fowl. M.S. thesis, University of Cairo, Cairo, Egypt.

NIESEL, M. F. 1948. Investigations on the sex-linked inheritance of laying capacity of domestic fowl. Anim. Breed. Abst., 16: Abst. No. 697.

NORDSKOG, A. W., and R. E. PHILLIPS. 1960. Five reciprocal crosses involving Leghorn, heavy breeds and Fayoumi. Poult. Sci., 39:257-263.

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