

Estimation of general and specific combining abilities from a diallel cross of three inbred lines of *Fayoumi* chicks

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Summary

Three inbred lines of *Fayoumi* chicks were incrossed in diallel mating system to estimate general and specific combining ability. The inbreeding coefficients in three inbred lines were 25, 37.5 and 50 per cent.

L 25 showed the highest g.c.a. in fertility and body weight at 8 weeks of age. L 37.5 exhibited the best g.c.a. in viability, while L 50 gave the best g.c.a. in hatchability.

The inbreeding coefficient of sire had a highly significant effect on both fertility and hatchability while its effect on viability and body weight at 8 weeks of age was not significant.

L 25 × L 37.5 incrossbred chicks gave the best s.c.a. in viability and body weight, fertility and hatchability.

Introduction

The model of inbreeding and incrossing has been applied successfully in chicken production and has played a major role in many broiler and egg production investigation programs.

YAO (1961) using diallel crosses of inbred lines of chickens reported that line effect was highly significant for 10 — week body weight. COLE and HUTT (1962) found that hybrids resulted from crossing 2 strains of white *Leghorns* showed a high degree of heterosis in egg production, hatchability and body weight. EISEN *et al.* (1964) reported that cross effects were highly significant for 8 week body weight and adult mortality.

HAZEL and LAMOREUX (1947), and GOTO and NORDSKOG (1959), using *Leghorn* breed of Chicken suggested that nicking was not of major importance. HALE

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and CLAYTON (1965) found the same concept in *Leghorn* breed and crosses, showing that genetic interactions were unimportant. HILL and NORDSKOG (1958) stressed the importance of general combining ability over specific combining ability.

WEARDEN *et al.* (1964) in a full-diallel crossing experiment using 3 white *Leghorn* and 3 *Rhode Island Red* "closed flock" strains suggested that general combining ability was much more important than specific combining ability for five and ten-month body weights. Contrarily, specific combining ability was estimated to be of more importance for sexual maturity, hen day and hen-housed egg production to 260 and 470 days. HOWEVER ERASMUS *et al.* (1968), illustrated the importance of specific combining ability as compared with the general combining ability.

Material and methods

The main objective of the present study was to estimate general and specific combining ability (g.c.a. and s.c.a.) of *Fayoumi* chicks resulting from incrossing of three inbred lines.

Full —and half-sib matings were used through 4 years (i.e. 1971-1974) to get different inbreeding intensities. Inbreeding coefficients were 25, 37.5 and 50 per cent in three different inbred lines. All possible combinations along with the three inbred lines were represented using diallelic mating system. The traits studied were fertility, hatchability, viability and body weight. The birds used in this study are the same as described in the paper by SOLTAN *et al.* (in press).

General and specific combining ability were calculated as means (FALCONE, 1964, p. 284) and also tested by the analysis of variance (GALAL *et al.*, 1972). (*) Maternal influence for each inbred line was estimated as the average of differences between the reciprocal incrosses which include that inbred line. Heterosis percentages were also estimated as the deviation of the incross mean from the average of the two parental inbreds. All the percentages data were converted to angles with the arcsin transformation using tables given by SNEDECOR, 1959.

Results and discussion

Data presented in Table 1 show the average of general and specific combining ability on some traits of *Fayoumi* incrossbreds. It was noticed that L 25 showed the highest general combining ability in both fertility and body weight at 8 weeks of age, while it was moderate in hatchability and viability percentage at the same age. L 37.5 gave the highest general combining ability in viability, while L 50 showed the best general combining ability in hatchability. The interaction between sires and dams, present in all the traits except body weight (see table 2) could be due to nicking between the genes of the sires and dams. Incrossbred chicks produced from L 25 × L 37.5 mating showed the best effect on viability and body weight. These improvements in viability and body weight may be due

(*) General combining ability is defined as the average performance of a breed, strain or line in a cross combination, while specific combined ability (« nicking ») is defined as the deviation in performance of a cross from the expectation on the basis of the average performance of the parental breeds, strains or lines involved.

TABLE I

Average General and specific combining ability in some traits in 1975
Aptitude générale et spécifique à la combinaison pour certains caractères en 1975

Combining ability	Traits			
	Fertility ± S.E	Hatchability ± S.E	Viability at 8 weeks ± S.E	Body weight at 8 weeks ± S.E
G.C.A. for:				
L 25	77.4 ± 4.9	57.5 ± 3.2	64.7 ± 5.5	280.4 ± 31.5
L 37.5	72.7 ± 4.1	57.2 ± 2.9	67.7 ± 5.1	275.6 ± 33.2
L 50.0	73.8 ± 4.4	57.9 ± 3.6	63.5 ± 3.1	270.2 ± 31.0
S.C.A. for:				
25 and 37.5	+ 1.1 ± .9	- 0.5 ± .8	+ 2.7 ± .6	+ 7.8 ± 7.2
25 and 50	+ 2.9 ± .9	+ 0.5 ± .8	- 3.6 ± 1.1	- 0.2 ± 6.6
37.5 and 50	- 4.1 ± 1.1	- 0.05 ± .7	+ 0.9 ± 1.2	- 7.5 ± 7.1

G.C.A. = General combining ability.
 S.C.A. = Specific combining ability.

to better general combining ability in L 25 and L 37.5 and also to a favourable specific combining ability between them. However, this incrossbred was moderate in fertility.

Table 2 shows the effect of sire and dam on different traits. It was noticed that the coefficient of inbreeding of sire had highly significant effect on both fertility and hatchability, while its effect on viability and body weight at 8 weeks of age was not significant. It was also noticed that the dam's inbred effect was highly significant on hatchability, while non-significant for all the other traits.

Table 3 shows maternal influence of different inbred lines on traits studied. It was noticed that L 25 exhibited the best maternal ability in fertility, viability and body weight, while L 50 gave the highest maternal ability in hatchability. The same trend, except viability, was observed in g.c.a. (Table 1). Therefore, it seems reasonable to take both g.c.a. and maternal ability into consideration when evaluating an inbred line performance in incrosses.

Heterosis percentages for different incrosses are given in Table 4. It was observed that L 25 × L 50 incross gave the highest heterosis in fertility and hatchability, while L 25 × L 37.5 gave the best heterosis in viability and body weight. It was also clear that both s.c.a. and heterosis percentages gave almost the same trend and it is quite reasonable to consider any one of them in explaining differences among incrosses.

These results indicate the possibility of improving the native breed; *Fayoumi* chickens, by incrossing inbred lines and detecting the most favourable incross-breds which give the best combinability.

TABLE 2

Variance analysis of genetic factors for traits studied
Analyse de variance concernant des facteurs génétiques pour les caractères étudiés

Source of variation	d.f	Fertility	Hatchability	Viability at 8 weeks of age	Body weight at 8 weeks of age
Among sires (S)	2	1 647.8 (**)	477.1 (**)	419.9	245.7
Among Dams (D)	2	64.8	1 565.3 (**)	57.9	8.4
Interaction (S × D)	4	3 399.9 (**)	343.4 (**)	378.8 (*)	187.7
Residual		123.1	71.3	125.9	128.2
Degrees of freedom for residual		18	18	18	324

(*) Significant at 5 p. 100 level.

(**) Significant at 1 p. 100 level.

TABLE 3

Estimated maternal influence of different inbred lines on traits studied
Estimation de l'influence maternelle de différentes lignées consanguines sur les caractères étudiés

Inbred lines	Fertility	Hatchability	Viability at 8 weeks	Body weight at 8 weeks
L 25	17.5	10.5	15.1	10.2
L 37.5	— 1.6	— 23.0	— 15.3	— 16.9
L 50	— 15.9	12.5	0.2	6.7

TABLE 4

Heterosis percentage for different incrosses
Pourcentage d'hétérosis pour les différents croisements

Incrosses	Fertility	Hatchability	Viability at 8 weeks	Body weight at 8 weeks
L 25 × L 37.5	— 5.27	8.56	7.03	7.84
L 25 × L 50	3.61	27.0	— 12.13	— 2.29
L 37.5 × L 50	0.00	— 5.61	3.24	— 2.10

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Résumé

Estimation de l'aptitude générale et spécifique à la combinaison à partir d'un croisement diallèle de trois lignées consanguines de poulets Fayoumi

Trois lignées consanguines de *Fayoumi* ont été croisées dans un système diallèle pour estimer l'aptitude générale et spécifique à la combinaison. Les coefficients de consanguinité dans ces trois lignées étaient 25, 37,5 et 50 p. 100.

L 25 montrait la g.c.a. la plus élevée pour la fertilité et le poids corporel à 8 semaines d'âge, L 37,5 pour la viabilité et L 50 pour le taux d'éclosion.

Le coefficient de consanguinité du père avait un effet hautement significatif à la fois sur la fertilité et l'éclosion, alors que son effet sur la viabilité et le poids à 8 semaines d'âge n'était pas significatif.

Les poussins croisés L 25 × L 37,5 donnaient la meilleure S.C.A. pour la viabilité, le poids corporel, la fertilité et l'éclosion.

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