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SUMMARY AND CONCLUSION

COMBINING ABILITY AND GENETIC GAIN OF SOME ECONOMIC TRAITS IN NORFA CHICKENS.

The present experiment has been carried out at the Poultry Farm of the Faculty of Agriculture, Minufiya University , Shebin El-kom , Egypt as a part of Norwegian – Egyptian Project “ NORFA” for improving hens. The experiment started in 1997 / 1998. Four lines of “ NORFA” chicken were developed. A total of 60 males and 180 females were used to produce each line cross and line group. A full 4 x 4 diallel cross was used , which resulted in four pure – line , six cross line and six reciprocal cross line progenies. In 2001 / 2002, a total of 17 cocks and 50 hens were selected from each of LEN , LEW parental lines and control of Norfa chickens. The results can be summarized as follows :

I- reproductive fitness traits :-

1. Fertility percentages for parental lines ranged from 86.8 in the parental line L BW to 91.4 in the parental line L EN. However the crosses LBW x LEN and LBW x LEW showed the highest fertility percentages among all crosses 93.0 and 92.1, respectively. The mean of hatchability was 72.4 % for L BW, while the cross LBW x LEN gave a mean equal to 79.9 %. However, hatchability percentages for L SM , L EN and L EW parental lines were 63.9 , 68.5 and 79.9, respectively, while, it ranged from 60.9 to 67.9 % in the crosses.
2. The estimates of general combining ability (GCA) effects for fertility showed that 2 parental lines L EW and L SM showed negative GCA values were – 0.31 and – 0.35, respectively. While, the two parental lines L EN and L BW had positive GCA values 0.46 and 0.20, respectively.

3. For hatchability the parental line L BW showed significant GCA value (1.96), while the other parental lines L SM , L EN and L EW gave insignificant GCA values (- 2.50 , 0.65 and – 0.10, respectively).
4. Regarding specific combining ability (SCA) effects on fertility, the cross LEN x LBW showed significant SCA value (2.26). Insignificant negative SCA values were detected in two crosses (- 1.10 in the cross LEN x LEW and - 2.01 in the cross LSM x LEN). On the contrary, the remaining crosses showed positive insignificant SCA values. Specific combining ability (SCA) effects on hatchability showed that the highest significant positive SCA value (3.41) was given by the cross LEN x LBW. Insignificant SCA values were observed in the remaining crosses ranging from - 1.62 to 0.92.
5. Data obtained on reciprocal effects (r) on fertility showed that the desirable significant (r) value 2.0 was obtained from the cross LEW x LBW. Hatchability percentages showed desirable positive significant (r) values (3.1 and 3.8) in the crosses LEW x LEN and LEW x LBW, respectively.
6. It was noticed that the variance due to SCA (4.97) was higher than the variance due to GCA (- 0.91). The low estimates of σ_g^2 / σ_s^2 ratio (- 0.18) and heritability estimate (0.17) indicated that non-additive gene effects played the main role in the inheritance of fertility. For hatchability results showed that the additive component of genetic variance σ_A^2 was higher than the non-additive genetic variance σ_s^2 (5.71 vs. 1.21). The ratio between the mean squares of GCA / SCA was 2.35 and heritability estimate was 0.41. Such results point out the importance of additive gene effects in controlling hatchability.
7. It was noticed that the realized genetic gains in fertility ranged from - 0.20 % in the parental line L BW to 4.4 % in the parental line L EN. These values equal to - 0.01 and 0.33 as an expected genetic gains.

8. The absolute genetic gains for hatchability ranged from 4.8 % (0.9 in standard unit) in the parental line L SM to 13.30 % in the parental line L BW (2.4 in standard units). The expected genetic gains were 0.38 and 1.0 in the same order.
9. Positive values of heterosis ranging from 0.1 % in the cross LEW x LBW to 4.9 % in the cross LBW x LEW were obtained for fertility. Therefore, it could be concluded that dominance toward the highest parent was found. While for hatchability most of six F1 crosses had positive heterosis values ranging from 1.7 % in the cross LSM x LEW to 9.6 % in the cross LBW x LEW. Therefore, it could be concluded that dominance toward the highest parent was found. Most of F1 reciprocal crosses had negative heterosis values ranging from - 7.6 to - 1.4 % for the crosses LBW x LSM and LEW x LSM, respectively. This means that dominance effects tends to the lowest hatchability parent.

II – Body weight at different ages :-

1. Results showed that the L BW parental line had the highest body weights at hatch , 4 , 8 , 12 and 16 weeks of age (i.e. 34.2 , 225.5 , 536.3 , 1049.3 and 1561 g., respectively). Most of crosses had lower body weights at hatch than of their parental lines except the cross LEW x LSM (29.6 g.) which was higher than parental lines. At 8 weeks of age, body weights of the crosses LEN x LSM , LBW x LSM , LBW x LEN , LBW x LEW and LEW x LEN were 528 , 539 , 578.3 , 597.7 and 549 g., respectively.
2. The crosses LEN x LSM , LBW x LSM , LBW x LEN , LBW x LEW and LEW x LEN were the heaviest body weights at 12 weeks of age (i.e. 902.6 , 981.3 , 1093 , 1131.7 and 964 g., respectively). Also these crosses were the heaviest body weight weights at 16 weeks of age (i.e. 1127.7 , 1312.7 , 1520 , 1634.7 and 1266 g., respectively).

3. Results revealed that L BW parental line had the best estimates of GCA at all ages studied (i.e. 1.64 , 13.8 , 9.77 , 66.6 and 148.0 at hatch , 4 , 8 , 12 and 16 weeks of age). While the parental line L SM had the lowest GCA values at all ages. These findings suggested that the parental line L BW had higher additive genetic effects on body weights.
4. The effects of SCA on body weights were found to be significant at all ages in the crosses LSM x LEN and LBW x LEW except at 4 weeks of age. On the other hand, the lowest insignificant SCA values at all ages were reflected by the crosses LSM x LBW , LSM x LEW , LEN x LBW and LEN x LEW.
5. Reciprocal effects were found to have significant effects on body weights at all ages studied except at 4 weeks of age in the cross LEW x LBW (i.e. 1.4 , 69.7 , 124.15 and 163.7 at 1-day old , 8 , 12 and 16 weeks of age, respectively). While insignificant effects were found in the other reciprocal crosses .
6. The additive genetic variances (σ^2_A) for body weight were 1.66 , 100.48 , 595.19 , 8188.45 and 31800.59 for body weights at hatch , 4 , 8 , 12 and 16 weeks of age, respectively. While non-additive genetic variance (σ^2_s) were 1.65 , 208.18 , 655.3 , 1484.73 and 3878.7 at the same ages, respectively.
7. The estimates GCA / SCA mean squares ratio were 0.50 , 0.24 , 0.45 , 2.75 and 4.09 for body weights at hatch , 4 , 8 , 12 and 16 weeks of age, respectively. Heritability estimates were 0.31 , 0.28 , 0.13 , 0.42 and 0.66 for the same ages. These estimates showed an increase of additive genetic variance (σ^2_A) as the age advanced.
8. It was clear that L BW parental line had the highest realized genetic gains at all ages studied (i.e. 5.6 , 49.5 , 93.3 , 229.7 and 362.4 g. at hatch , 4 , 8 , 12 and 16 weeks of age, respectively).

9. Body weight at hatch showed heterotic effects ranged from - 13.1 to 5.5 %. At 4 weeks of age, heterosis percentages for body weights ranged from - 18.0 to 7.7 %. While, heterosis percentages for body weight at 8 weeks of age ranged from - 23.7 to 13.4 %. Heterosis percentages at 12 weeks of age ranged from - 21.5 to 13.1 %. At 16 weeks of age the average degrees of heterosis (ADH %) of body weights ranged from - 20.1 to 15.5 %.

III – Egg production traits :-

1. Sexual maturity means were 148 , 155 , 159 and 163 d. for L SM , L EN , L BW and L EW parental lines, respectively. The desirable significant sexual maturity means (157 , 159 and 161 d.) were obtained by the crosses LEN x LSM , LSM x LEN and LSM x LEW, respectively. With significant differences among different genetic groups.
2. Means of body weight at sexual maturity were 1178 , 1262 , 1459 and 1276 g. for L SM , L EN , L BW and L EW parental lines, respectively. The means of F1 crosses ranged from 986 g. in the cross LEN x LSM to 1183 g. in the cross LEW x LBW. There were highly significant differences among these means.
3. The means of weights of the first five egg laid after sexual maturity were 35 , 37 , 38 and 44 g. for L SM , L EN , L BW and L EW parental lines, respectively. While the highest means of egg weight at sexual maturity (42 and 40 g.) were given by the two crosses LBW x LEW and LEW x LBW, respectively.

4. Egg number during the first ninety d. after sexual maturity in the pure parental lines were 48 , 56 , 48 and 51 egg for L SM , L EN , L BW and L EW parental lines, respectively. The cross L SM x L EN had the highest significant mean (52 egg), with significant differences among genetic groups.
5. The means of body weight at maturity in the parental lines were 1204 , 1235 , 1549 and 1205 g. for L SM , L EN , L BW and L EW, respectively. The best F1 combinations were LBW x LEW , LEW x LBW and LEN x LEW they had the highest means of body weight at maturity (i.e. 1318 , 1292 and 1223 g., respectively). On the other hand, the lowest mean of body weight at maturity (1109 g.) was reflected by the cross LEN x LSM.
6. The means of egg weight at maturity were 51.2 , 49.4 , 51.2 and 53.2 g. for L SM , L EN , L BW and L EW parental lines, respectively. While, these means ranged from 44.3 to 51.2 g. in the crosses. There were highly significant differences among the means of parental lines and crosses.
7. Means of egg number laid till 52 weeks of age were 111 , 123 , 102 and 105 egg for L SM , L EN , L BW and L EW parental lines, respectively. These means in the crosses ranged from 91 to 108 egg with significant differences among these means .
8. The results showed that GCA effects ranged from – 4.31 to 3.81 for age at sexual maturity. Figures for body weight at sexual maturity ranged from – 51.5 to 63.37. GCA effects for egg weight at sexual maturity ranged from – 1.93 to 3.06. The effects of GCA on egg number in the first 90 d. after sexual maturity ranged from – 1.18 to 1.93. These estimates ranged from – 46 to 82.87 for body weight at maturity. While the estimated GCA effects ranged from – 1.0 to 1.75 for egg weight at maturity and from – 4.31 to 3.93 for egg number till 52 weeks of age.

9. Regarding specific combining ability (SCA) effects, results revealed that SCA effects ranged from -0.93 to 7.43 for sexual maturity and from -102.62 to -33.12 for body weight at sexual maturity. The estimated SCA effects ranged from -1.18 to 0.56 for egg weight at sexual maturity and from -3.81 to 1.06 for egg number during the first 90 d. after sexual maturity. SCA effects on body weight at maturity ranged from -101.87 to 11.5 . While, SCA effects ranged from -1.62 to 0.25 for egg weight at maturity and from -8.31 to 2.06 for egg number till 52 weeks of age.
10. The results showed that reciprocal effects (r) ranged from -3.5 to 8.5 for sexual maturity and from -11.5 to 29 for body weight at sexual maturity. Figures for egg weight at sexual maturity ranged from -0.5 to 1.0 and from 0.5 to 1.5 for egg number during the first 90 d. after sexual maturity. Reciprocal effects ranged from -32.5 to 46 for body weight at maturity and from -1 to 1.0 for egg weight at maturity. The estimates of reciprocal effects ranged from -2.5 to 2.0 for egg number till 52 weeks of age.
11. The variance components of general combining ability, specific combining ability, reciprocal effects and sampling errors for age at sexual maturity were 2.33 , 30.39 , 3.04 and 31.91 , respectively. These estimates were -376.54 , 16010.59 , -25.43 and 418.46 for body weight at sexual maturity. The estimates of σ^2_g , σ^2_s , σ^2_r and σ^2_e were 4.65 , 1.69 , 0.1 and 1.05 for egg weight at sexual maturity, respectively. Figures for egg number during the first 90 d. after sexual maturity were 0.26 , 5.93 , -0.69 and 3.73 in the same order. The genetic variance components for body weight at maturity were 1879.95 , 7569.397 , 238.93 and 930.04 for σ^2_g , σ^2_s , σ^2_r and σ^2_e , respectively. These estimates were 0.83 , 3.33 , 0.14 and 1.2 for egg weight at maturity. While, for egg number till 52 weeks of age figures were 0.44 , 48.35 , -11.97 and 29.12 in the same trend.

12. It could be noticed that non-additive gene effects were found to be more important than additive gene effects in the most traits studied. On the contrary of egg weight at sexual maturity which mainly affected by additive gene effects.
13. The performance of parental lines relative to their control showed decreased age at sexual maturity by - 26.0 , - 19.0 , - 15.0 and - 11.0 d. for parental lines L SM , L EN , L BW and L EW, respectively. These absolute genetic gains in standard units were - 1.5 , - 1.1 , - 0.9 and - 0.7 in the same trend. Actual genetic gains ranged from 86.0 to 367.0 g. for body weight at sexual maturity and from - 2.0 to 7.0 g. for egg weight at sexual maturity. For egg number in the first 90 d. after sexual maturity the absolute genetic gains ranged from 3.0 to 11.0 egg (0.32 to 1.16 in standard units). It was clear that L BW had the highest absolute and standard unit of genetic gains (403.0 g. and 1.95, respectively) for body weight at maturity. For egg weight at maturity, absolute genetic gains ranged from 2.0 to 6.0 g., those equals 0.44 to 1.31 in standard unit, respectively. The genetic gains in actual number ranged from 14.0 to 35.0 egg for egg number till 52 weeks of age.
14. Positive heterosis values ranging from 1.9 to 16.6 % were found for age at sexual maturity. On the contrary, negative heterosis values ranging from - 23.1 to - 12.4 % were found in body weight at sexual maturity. It was noticed that egg weight at sexual maturity showed negative heterotic effects ranged from - 11.1 to - 4.0 %. Also most of F1 crosses had negative heterosis values ranging from - 15.9 to - 3.0 % for egg number at the first 90 d. after sexual maturity.
15. It was also noticed that the negative heterosis values were obtained in all F1 hybrids except LEN x LEW which gave positive heterosis value 0.25 % for body weight at maturity. While, egg weight at maturity showed heterotic effect in all F1 crosses ranging from - 12.0 to 1.9 %. Unlike, All

means of F1 crosses were less than mid-parent in egg number till 52 weeks of age. Therefore, negative heterosis values ranging from - 19.1 to - 4.3 % were obtained in these crosses.

16. From the previous results the parental lines L EN and L EW proved to exploit both additive and non additive variations and could be used to produce crosses superior for egg number and egg weight .