Egypt. J. Agric. Res., 80 (3), 2002.

A STUDY OF HETEROSIS IN SOME EGG PRODUCTION TRAITS IN NORFA LAYERS

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(Manuscript received 19 Novembre 2002)

Abstract

The main objective of the experiment was to study heterosis effect on some egg production traits in two lines of Norfa layers (i.e. heavy , HBW and light body weight , LBW) The results and conclusion can be summarized as follows :

1. The heterosis estimates were 5.2 and – 1.5 % for body weight at sexual maturity in HBW x LBW and LBW x HBW crosses, respectively, while, the corresponding estimates of body weight at maturity were 9.7 and 4.5 %, respectively. It was clear that, crossing between lines is considered an effective method to increase body weight in chickens.
2. Sexual maturity was 166.4 , 176.2 and 172.6 d. for heavy , light and control, respectively. It was noticed that, LBW x HBW cross had sexual maturity equal to 169.5 d., while, it was 173 and 172.6 d. in HBW x LBW and control, respectively. The heterosis effects were 1.0 and – 1.1 % for HBW x LBW and LBW x HBW crosses, respectively. It was clear that, both of selection and line crossing are useful tool to decrease age at sexual maturity.
3. At maturity, heterosis effects of egg weight as deviation from parental means were 5.8 and 1.7 % for HBW x LBW and LBW x HBW crosses, respectively.
4. Breast width is positively correlated with body weight. The results of breast width were promising, and selection for improving this trait or crossing among different strains were considered effective methods to increase it.
5. At 52-weeks of age, the means of egg number of pure groups were 117.4 , 109.9 and 105.6 eggs for heavy , light and control lines, while, HBW x LBW and LBW x HBW crosses were intermediate between the figures of the parents and control.

INTRODUCTION

Indigenous breeds of chickens have the advantages of good adaptation to local environment and natural genetic resistance to some serious diseases such as Marek. Moreover, a lot of people still prefer the taste and flavour of indigenous chicken meat and eggs. It was advisable to combine these advantages of indigenous chickens with the high performance of the exotic and commercial breeds. This was the main aim of the Norfa Project, which was initiated jointly between Agricultural University of Norway and Minufiya University in 1980 to develop Norfa breed.

A panel meeting was held on 1992 to find out a solution for the problem of poor fleshing of Norfa slim carcass after finishing its egg production (Abdou, 1992). One main recommendation of this panel meeting was to develop two lines of Norfa chickens by divergent selection (i.e. high and low body weight) and then, be crossed to get hybrid vigor. This method is considered a way to increase genetic variations, which seemed to be exhausted by the previous selection experiments. Abou El-Ghar (1994) selected two lines of Norfa layers and the results were promising.

The aim of the present experiment is to study the effect of divergent selection of body weight on some economic traits in Norfa layers. Breast width is also taken into consideration as recommended in the panel meeting.

MATERIALS AND METHODS

This study was carried out at the Poultry Farm of Faculty of Agriculture, Minufiya University, Shebin El-Kom, Egypt as a part of Norfa project experiments. The present experiment started in Season 1992/1993 with divergent selection to obtain two selected lines (i.e. LBW for light body weight and HBW for heavy body weight) plus a base population control.

The selection criterion of independent culling levels was approximately the general average of body weight minus or plus 1.0 – 1.5 standard deviation for light and heavy body weight lines, respectively.

The genetic gain $\Delta (R_{G1})$ from the generation 0 (G0) to generation 1 (G1) was estimated according to the equation given by Hill (1972) as follows :

$\Delta (R_{G1}) = (\bar{S}1 - \bar{C}1) - (\bar{S}0 - \bar{C}0)$

Where, $\bar{S}$, $\bar{C}$ are the means of selected lines and control, respectively.

In 1994, 2-way crosses were done between the two lines to produce the following :- HBW x LBW and LBW x HBW plus the two pure lines and the control derived from the base population.

MATING SYSTEM

All matings were done by artificial insemination twice a week in the two generations. Fresh semen from each male was collected in individual tube and an equal number of females (4) were inseminated. Artificial insemination was started a week before collecting the hatching eggs. Mating of relatives was avoided to restrict inbreeding effects. Random mating was applied in the control population.

In the second generation 2- way crosses (HBW x LBW) and (LBW x HBW) were obtained by crossing HBW and LBW lines plus two pure-lines (HBW and LBW) and a random bred control were kept. The number of parents and F1 crosses were given in Table 1.

FLOCK MANAGEMENT

A total of 7715 pedigreed hatching eggs was collected and was kept in an egg cooler room at 55ºF and 90 % humidity and were moved to hatching room one night before incubation in full automatic forced draft incubation machine.

A total of 6282 one-day chicks was individually wing-banded, vaccinated against Marek's disease and reared in a brooder with a central heating system till 8 weeks of age. Chicks were also vaccinated against New Castle and Gumboro diseases. The pullets were transferred to individual laying cages, while, cockerels were moved to individual cages in cock's house.

The feeding regime consisted of chick ration containing 22.17 % CP and 2928.1 ME/Kcal, while, the laying ration contained 16.2 % CP and 2757 ME/Kcal (Table 2).

A (step down-step up) lighting programme was applied for all chicks. In the first week, the photoperiod was 24 h / d., while, it was 19 h /d. in the second week. Later, photoperiod decreased about 20 minutes per week. At sexual maturity, the day length was increased to 16 h./d. continues light and 8 hours darkness. Light was increased by adding artificial light (incandescent).

STUDIED TRAITS

The studied traits were as follows :

1. Body weight, in grams at 4 , 8 , 12 , 16 , at sexual maturity (BW1) and at maturity (BW2 ; 40 weeks of age).
2. Age at first egg in days (d.).
3. Egg weight : (EW1) , average weight in grams of five eggs at sexual maturity and (EW2) , average weight in grams of five eggs at 40 weeks of age.
4. breast width (Br.W1) , breast width at sexual maturity.
   (Br.W2) , breast width at 40 weeks of age were measured by a caliper with a vernier scale to the nearest cm.
5. Egg number : (EN1) , number of eggs during the first ninety days after sexual maturity, (EN2) , number of eggs up to 42 weeks of age and (EN3) , number of eggs up to 52 weeks of age.

STATISTICAL ANALYSIS

Results were subjected to statistical analysis according to the method of analysis of variance (Snedecor and Cochran, 1968) using the following models :

Model 1 : $Y_{ij} = \mu + L_i + e_{ij}$

Model 2 : $Y_{ijk} = \mu + L_i + S_j + (L \times S)_{ij} + e_{ijk}$

Where : Y_{ij} and Y_{ijk} = Individual observation.

μ = General mean.

L_i = Line effect.

S_j = Sex effect.

$(L \times S)_{ij}$ = Interaction between lines and sex.

e_{ijk} = Error.

The differences among the means were tested by Duncan's New Multiple range test (Steel and Torrie, 1960).

The overall means of heterosis was determined according to equation given by Brody (1945) as follows :

$$\{(\overline{C} - \overline{P}) / \overline{P}\} \times 100$$

Where :

$\overline{C}$ = Mean cross.

$\overline{P}$ = Mean parents.

RESULTS AND DISCUSSION

1. BODY WEIGHT

Body weight of laying hens plays a significant role in consuming ration where, heavy body weight requires more feed for maintenance requirements. Therefore, light body weights of pullets is preferable. Keepers of laying pullets always expose them to a long light regime when they notice that the pullets reach suitable size for laying. Therefore, fast growing pullets having high growth rate through brooding and rearing periods are economically preferable.

Data in Table 3 indicate means of body weights at different ages for the lines studied. Body weight means of combined sexes at 4 weeks of age were 147.6 , 148.1 and 136.2 g for heavy , light and control groups with significant differences among them. At 8 weeks of age the cross HBW x LBW was the heaviest, and body weight means were 316.4 and 269.7 g for males and females, respectively. However, there were significant differences between lines ($P \leq 0.1$), as well as between sexes ($P \leq 0.1$). No significant interactions between sexes and lines all over the experiment were found. This may be due to males being always heavier than females, and the ranges between the two sexes in each age were nearly to some extent the same.

At 12 weeks of age the male means of the three lines were 522.8, 504.9 and 521.9 g for heavy, light and control, respectively, while, the means of females were 428.0 , 417.0 and 452.7 g, in the same order. The HBW x LBW cross had the heaviest weights (578.1 and 453.7 g for males and females, respectively). The heterosis effects or deviations of the line cross from their parental means are shown in Table 5, and it was 8.5 and 5.1 % for males and females of HBW x LBW cross at 8 weeks of age.

At 16 weeks of age, the same trend was observed and HBW x LBW cross was the heaviest (860.2 g for males), while, control was the heaviest (661.7 g for females) with heterosis equal to 11.2 and 10.6 % for HBW x LBW males and females, respectively. The effect of selection expressed as a deviation from control was – 15 and 84.2 g for heavy line males and females and – 93.0 and – 71.3 g in light line, respectively.

It was clear that, selection and line crossing is considered an effective method to increase body weight in chickens. Body weight at sexual maturity is an important trait which affects egg size due to the positive correlation between both these two traits. Abou El-Ghar (1994) found that the correlations between body and egg weights were positive at sexual maturity and maturity (i.e. 0.35 and 0.26 , respectively). On the other hand, light body weights of layers are preferable to decrease maintenance requirements and to save final cost where ration is the most expensive item in raising layers.

Table 4 indicates body weights of different lines at sexual maturity and maturity. It was clear that, light line had significantly less means at both ages than heavy and control lines, while, there was no significant difference between the last two lines as shown by Duncan's new multiple range test (Table 4).

Selection responses as deviations from control mean were 9.7 and – 79.3 g for heavy and light lines, respectively. These estimates of selection response at maturity (at 40-weeks of age) were 88.6 and – 167.1 g in the same order. It was clear that, selection for light body weight was more effective than the divergent selection. This may be due to the fact that, Norfa was originally developed from light breeds (Abdou, 1992).

Line crossing was proved to affect body weight. Table 4 shows that mean body weights of control , HBW x LBW , LBW x HBW crosses were 1101.3 , 1122.4 and 1050.4 g, respectively. The HBW x LBW cross had significantly heavier weight than its reciprocal cross, while, there was no significant difference between its mean and the control one as shown by Duncan's test (Table 4). However, there were no significant differences among the means of these lines at maturity. The means at maturity were 1342.9 , 1279.2 and 1263.1 g for HBW x LBW , LBW x HBW crosses and the control, respectively.

Heterosis effects of body weight of HBW x LBW and LBW x HBW are shown in Table 5. The heterosis estimates were 5.2 and – 1.5 % at sexual maturity. The corresponding estimates of body weights at maturity (at 40-weeks of age) were 9.7 and 4.5 %, respectively. These results indicate that both selection and line crossing are effective in improving body weights.

2. EGG PRODUCTION TRAITS

From complete individual records of egg laying hens, some egg production traits can be estimated such as age at first egg laid (sexual maturity), clutch size and number of eggs during different periods. Moreover, body and egg weights at different ages should be also listed in the records. The most economic important traits in egg production are egg number and size , sexual maturity , hatchability , mortality , feed consumption and egg quality and they play a significant role in determining the net final income of egg producers (Kolstad, 1979).

Data presented in Table 4 illustrate some egg production traits , body weight and egg weight of the different lines. Sexual maturity in days was 166.4 , 176.2 and 172.6 for heavy , light lines and control, respectively. It was found that, heavy line had significantly earlier sexual maturity than light line, while, the difference between it and the control was not significant. It was expected that, light line reached sexual maturity earlier than heavy line. This unexpected result may be due to sexual organs in heavy line reach specific weight, which were associated with growth rate. The growth included all the organs of the body especially, sexual organs that secreted sexual hormones which caused early sexual maturity.

Selection responses expressed as deviation from the control mean were 6.2 and – 3.6 d. for selected heavy and light body weight lines, respectively. Crossing between heavy and light lines caused some deviations from the control. It was clear that, LBW x HBW cross had sexual maturity equal to 169.5 d., while, it was 173.0 and 172.6 d. in HBW x LBW and control, respectively. The heterosis effects were 0.99 and – 1.05 % for HBW x LBW and LBW x HBW crosses, respectively. It was clear that, both of selection and line crossing are useful tool to decrease age at sexual maturity. However, this decrease should not be to the limit affecting body weight or egg size.

Moderate egg weights are preferable in egg layers. Kolstad (1979) stated that, a high valuable egg laying strain is very often characterized by early sexual maturity, high egg laying intensity, moderate egg weight and low body weight. Moreover, fertility, hatchability, feed utilization and disease resistance are all examples of characters of great importance in laying hens. Table 4 presents egg weights at both sexual maturity and maturity. Means of egg weight at sexual maturity were 35.5 , 35.8 and 36.2 g for heavy , light and control lines, respectively, with differences being insignificant among them. Selection response in early egg size (at sexual maturity) was not clear, while it was clear and negative at maturity. Selection response as a deviation from the control was – 1.6 and – 3.1 g at maturity for heavy and light lines, respectively. This was due to the fact that, selected two lines had more egg number than the control as will be mentioned later. The negative correlations between egg number and egg weight may be the cause of the negative response. Similar results were obtained by Abdou and Enab (1994) who reported that the genetic correlation between mature egg weight and egg number till 52-weeks of age was – 0.32.

Effect of line crossing on early egg size (at sexual maturity) was also not clear, and HBW x LBW and LBW x HBW crosses had egg weight averages equal to 36.9 and 36.0 g, respectively. At maturity heterosis effect as deviation from parental means was 5.8 and 1.7 % for HBW x LBW and LBW x HBW crosses, respectively (Table 5). This was mainly due to the positive correlations between body weight and egg size, where, both line crosses had heavier body weights at maturity than the control. Enab (1982) reported that the phenotypic correlations between body weight and egg weight at maturity were 0.61 and 0.51 in two selected lines of W. Leghorn (i.e. EN for high egg number and EW for high egg weight, respectively).

3. BREAST WIDTH

Breast width is positively correlated with body weight. It was found that, breast width ranged from 6.45 to 6.78 cm for all the lines at sexual maturity, while, this range at maturity was 6.78 to 7.46 cm. It was also noticed that heavier body weight of a certain line had the highest breast width. Breast width is a valuable measurement for good fleshing of breast meat. Abdou (1992) in panel meeting discussed the problem of poor fleshing of Norfa as a culling layer after finishing its first season of egg production. One recommendation of this panel meeting was to select for heavy body weight and breast width. This was one of the main objectives of the present study.

Selected heavy line showed the highest breast width, while, light strain had the least one comparing with the control line. Selection response for breast width as a deviation from the control mean was 0.17 and – 0.16 cm at sexual maturity for heavy and light lines, respectively. The selection response at maturity for heavy and light lines were 0.16 and – 0.37 cm. Stino *et al.* (1981) studied the wide breast of two selected lines of Fayoumi breed (i.e. G.G selected for high body weight and P.P selected for high egg number and their crossbreds G.P and P.G) and random bred (R.R). They found that, female breast width at 16 weeks of age was 26.8 , 25.7 , 26.4 , 27.1 and 26.0 millimeters, respectively.

Effect of line crossing on breast width was little and amounted to 1.3 and 0.5 as a heterosis effect at sexual maturity for HBW x LBW and LBW x HBW crosses, respectively, however, HBW x LBW cross showed a significant increase over the reciprocal at maturity. The results of breast width are promising and selection for improving this trait or crossing among different lines are considered effective methods to increase it. This may be valuable to keep the Norfa layer within light body weights comparing to the standard breeds with good breast fleshing.

4. EGG NUMBER

Data in Table 4 indicate means egg number at different ages for different lines. Egg number through the first ninety days after sexual maturity (EN1) was 55.9 , 52.1 and 48.2 eggs for heavy , light and control lines, respectively, while, it was 50.8 and 53.3 eggs for HBW x LBW and LBW x HBW crosses, respectively, with significant differences among them.

Selection responses as deviations from control mean were 7.7 and 3.9 eggs for heavy and light lines, respectively. It was clear that, selection is useful tool to increase egg number during the first ninety days after sexual maturity. The heterosis effects (Table 5) were - 5.9 and - 1.3 % for HBW x LBW and LBW x HBW crosses.

At 40-weeks of age (EN2), the means of pure line groups were 81.8 , 76.5 and 67.2 eggs in heavy , light and control, respectively, with highly significant differences among them. The deviations of egg number means at 40-weeks of age of selected pullets from their control were 14.3 and 9.3 eggs for heavy and light lines, respectively. Heterosis effects estimated as deviation of the cross from the mean of its parents are shown in Table 5. These estimates in egg number at 42-weeks of age were – 9.7 and – 4.9 % for HBW x LBW and LBW x HBW crosses, respectively.

At 52-weeks of age (EN3), the means of pure line groups were 117.4 , 109.6 and 105.6 eggs for heavy , light and control lines, while, HBW x LBW and LBW x HBW crosses were intermediate between the figures of the parents and control. However, all of the means of egg number at 52-weeks of age had no significant differences among them, this may be due to sample error.

Selection responses as deviation from the control mean were 11.8 and 4.3 eggs for heavy and light strains, respectively. Line crossing was proved to affect egg number till 52-weeks of age. Table 4 shows that, the means of control, HBW x LBW and LBW x HBW crosses were 105.6 , 112.3 and 106.3 eggs, respectively, with no significant differences among them by Duncan's test.

Heterosis effects of egg number at 52-weeks of age are shown in Table 5. The heterosis estimates were – 1.2 and – 6.5 % for HBW x LBW and LBW x HBW crosses, respectively. Abd-Alla, (1978) reported that, heterosis percentage for egg number during the first ninety days of crossbred chickens ranged from 38.1 to – 33.1 % while, it ranged from 13.9 to – 31.9 % for reciprocals.

Generally, the results of the present experiment cleared that, selection and line crossing are considered an effective method to improve some economic traits in Norfa chickens.

Table 1. Number of parents and F1 crosses used in this experiment.

Season	Heavy (HBW)			Light (LBW)			Control			HBW x LBW			LBW x HBW		
	sire	dam	progeny	sire	dam	progeny	sire	dam	progeny	sire	dam	progeny	sire	dam	progeny
1993	75	300	1725	75	300	1964	70	180	1561						
1994	17	50	156	17	50	173	34	100	335	17	50	242	17	50	126

Table 2. Compositions of rations used in the experiment.

Ingredients	Chick ration	Laying ration
Ground yellow corn	60	65
Wheat bran	0	13
Soybean meal	22	12
Corn gluten meal	8	0
Animal protein	7.5	6.5
Ground limestone	0	0.5
Bone meal	2	2
Oyster shell	0	0.5
Salt (sodium chloride)	0.5	0.5
Vitamine mixture*	+	+
Mineral mixture**	+	+
Total	100	100
Crude protein % (calculated)	22.17	16.2
M.E, (Kcal / Kg., calculated)	2928.1	2757

* Every Kg. Vit. Contains :
Nicotinic acid, 20g.; B2, 4.5g. ; B6, 3g. ; B12, 13m. And Choline coloride, 100mg.
Every Kg. Vit. AD3E contains :
20000000 I.U. Vit. A. ; 20000000 I.U. Vit. D3 and 400 I.U. Vit. E.
** Every 3Kg. Mineral mixture contains :
Copper, 3g. ; Iodine, 0.3g. ; Iron, 30g. ; Manganese, 40g. ; Zinc, 45g. ;
Selenium, 0.1g. And Calcium carbonate, 2881.6g.

Table 3. Means ($\bar{x}$) in grams and standard deviations (s.d) of body weight at different ages for different lines and control.

Age	Sex	Heavy (HBW)		Light (LBW)		Control		HBW x LBW		LBW x HBW	
		n	$\bar{X}$ ± s.d	n	$\bar{X}$ ± s.d	n	$\bar{X}$ ± s.d	n	$\bar{X}$ ± s.d	n	$\bar{X}$ ± s.d
4 WKS.	C	124	147.6 ± 30.8 a	144	148.1 ± 34.1 a	100	136.2 ± 26.9 b	186	144.3 ± 30.6 ab	104	148.9 ± 28.2 a
8 WKS.	M	35	293.6 ± 66.9 ab	48	289.4 ± 62.5 ab	40	278.6 ± 58.2 b	58	316.4 ± 61.4 a	39	292.7 ± 6.6 ab
	F	62	252.3 ± 45.6 a	63	260.7 ± 56.3 a	50	250.1 ± 56.4 a	76	269.7 ± 50.9 a	46	261.1 ± 53.8 a
12 WKS.	M	34	522.8 ± 109.1 b	50	504.9 ± 93.0 b	40	521.9 ± 79.7 b	58	578.1 ± 108.6 a	40	530.3 ± 120.1 b
	F	63	428.0 ± 115.5 a	64	417.0 ± 99.1 a	50	452.7 ± 112.7 a	82	453.7 ± 102.8 a	46	420.5 ± 98.0 a
16 WKS.	M	32	812.3 ± 193.6 ab	44	734.4 ± 144.3 b	40	827.3 ± 136.6 a	55	860.2 ± 161.5 a	38	806.5 ± 171.8 ab
	F	61	577.5 ± 147.5 a	64	590.4 ± 136.0 a	50	661.7 ± 136.4 a	77	645.7 ± 134.7 ab	41	602.8 ± 151.0 b

Means having different letters in the same row are significant at 5 % level (Duncan's test)

M = Males F = Females C = Combined

Table 4. Means ($\bar{x}$) in grams and standard deviations (s.d) of some traits of different lines and control.

Lines	Heavy (HBW)		Light (LBW)		Control		HBW x LBW		LBW x HBW	
Traits	n	$\bar{X}$ ± s.d	n	$\bar{X}$ ± s.d	n	$\bar{X}$ ± s.d	n	$\bar{X}$ ± s.d	n	$\bar{X}$ ± s.d
SM (d.)	41	166.4 ± 17.7 b	37	176.2 ± 22.5 a	111	172.6 ± 17.5 a	70	173.0 ± 17.7 a	37	169.5 ± 20.7 a
BW1 (g.)	41	1111.0 ± 206.9 ab	37	1022.0 ± 135.1 c	111	1101.3 ± 141.9 ab	70	1122.4 ± 142.3 a	37	1050.4 ± 141.2 bc
BW2 (g.)	29	1351.7 ± 240.8 a	31	1096.0 ± 160.7 b	90	1263.1 ± 193.6 a	55	1342.9 ± 202.0 a	30	1279.2 ± 171.3 a
EW1 (g.)	41	35.5 ± 4.7 a	37	35.8 ± 5.8 a	111	36.2 ± 4.5 a	70	36.9 ± 4.7 a	36	36 ± 5.5 a
EW2 (g.)	29	46.2 ± 3.5 bc	30	44.7 ± 4.1 c	90	47.8 ± 3.7 ab	55	48.1 ± 3.3 a	30	46.2 ± 3.7 bc
Br.W1 (cm.)	41	6.78 ± 0.5 a	37	6.45 ± 0.5 b	111	6.61 ± 0.5 ab	70	6.70 ± 0.4 a	37	6.65 ± 0.5 ab
Br.W2 (cm.)	29	7.31 ± 0.4 ab	31	6.78 ± 0.6 c	91	7.15 ± 0.5 b	55	7.46 ± 0.5 a	30	7.08 ± 0.5 b
EN1 (egg)	29	55.9 ± 10.2 a	31	52.1 ± 10.9 ab	93	48.2 ± 13.5 b	54	50.8 ± 11.7 ab	30	53.3 ± 13.7 ab
EN2 (egg)	29	81.8 ± 18.4 a	23	76.5 ± 18.3 ab	90	67.2 ± 18.3 b	49	71.5 ± 15.9 b	30	75.3 ± 18.8 ab
EN3 (egg)	11	117.4 ± 12.0 a	12	109.9 ± 11.5 a	63	105.6 ± 21.9 a	33	112.2 ± 17.1 a	8	106.3 ± 19.4 a

Means having different letters in the same row are significant at 5 % level (Duncan's test)

SM = Sexual maturity, d.

BW1 = Body weight at sexual maturity, g.

EW1 = Egg weight at sexual maturity, g.

Br.W1 = Breast width at sexual maturity, cm.

EN1 = Egg number at 90 days after sexual maturity.

EN3 = Egg number till 52-weeks of age.

BW2 = Body weight at maturity (40-weeks of age), g.

EW2 = Egg weight at maturity (40-weeks of age), g.

Br.W2 = Breast width at maturity (40-weeks of age), cm.

EN2 = Egg number at 42-weeks of age.

Table 5. Estimates of heterosis percentages of the studied traits.

Traits / Cross	body weight at different ages						
	4 WKS.	8 WKS.		12 WKS.		16 WKS.	
	Combined	Male	Female	Male	Female	Male	Female
HBW x LBW	-2.4	8.5	5.1	13	7.4	11	11
LBW x HBW	0.8	0.4	1.8	3.2	-0.5	4.3	3.2

continued Table 5.

Traits / Cross	SM	BW1	BW2	EW1	EW2	Br.W1	Br.W2	EN1	EN2	EN3
HBW x LBW	0.99	5.2	9.7	3.7	5.8	1.3	5.9	-5.9	-9.7	-1.2
LBW x HBW	-1.05	-1.5	4.5	1	1.7	0.5	0.5	-1.3	-4.9	-6.5

SM = Sexual maturity, d.

BW1 = Body weight at sexual maturity, g.

EW1 = Egg weight at sexual maturity, g.

Br.W1 = Breast width at sexual maturity, cm.

EN1 = Egg number at 90 days after sexual maturity.

EN3 = Egg number till 52-weeks of age.

BW2 = Body weight at maturity (40-weeks of age), g.

EW2 = Egg weight at maturity (40-weeks of age), g.

Br.W2 = Breast width at maturity (40-weeks of age), cm.

EN2 = Egg number at 42-weeks of age.

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دراسة قوة الخليط في بعض صفات إنتاج البيض في دجاج النورفا

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١ *معهد بحوث الإنتاج الحيواني ، مركز البحوث الزراعية، وزارة الزراعة، الدقى، جيزة، مصر*
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أجريت هذه التجربة لمدة جيلين بمزرعة الدواجن بكلية الزراعة جامعة المنوفية – قسم إنتاج الدواجن مشروع النورفا. وكان الهدف من التجربة دراسة قوة الخليط على بعض صفات إنتاج البيض في دجاج النورفا.

الصفات المدروسة هي :

١- وزن الجسم عند ٤ ، ٨ ، ١٢ ، ١٦ أسبوع من العمر وعند النضج الجنسي والنضج التام.
٢- عمر النضج الجنسي .
٣- عرض الصدر عند النضج الجنسي والنضج التام .
٤- عدد البيض ووزنه عند ٩٠ يوم بعد النضج الجنسي وعند ٤٢ ، ٥٢ أسبوع من العمر .

تم عرض ومناقشة النتائج ويمكن تلخيصها في الآتي :

١- أظهرت النتائج أن وزن الجسم في دجاج النورفا يتراوح بين ١٠١٣ : ١٤٦٠ جرام وكان الفارق الانتخابي ٢٠٣ ، ٧٧ جرام للسلالة الثقيلة والخفيفة على التوالي وكان للانتخاب وقوة الهجين تاثير على زيادة وزن الجسم.
٢- أثّر الانتخاب لوزن الجسم الثقيل تأثيراً طفيفاً في النضج الجنسي والمتوسطات كانت ١٦٦,٤، ١٧٦,٢، ١٧٢,٦ يوما للثقيل والخفيف والكنترول في الجيل الأول وكان لقوة الخليط تاثير غير واضح على وزن البيض المبكر عند النضج الجنسي وكان متوسط الخلطات الثقيل × الخفيف والخفيف × الثقيل ٣٦,٩، ٣٦جرام عند النضج الجنسي وكانت قوة الخليط ٨,٥، ١,٧ ٪ جرام على التوالي.
٣- يوجد ارتباط موجب بين عرض الصدر ووزن الجسم وأن زيادة وزن الجسم تؤدي إلى زيادة عرض الصدر وكان للانتخاب وقوة الهجين تأثير على عرض الصدر وكانت النتائج مشجعة وتدل على أنه يمكن زيادتها عن طريق الخلط والانتخاب.
٤- كان معدل وضع البيض عمر ٥٢ أسبوعا لجيل الأساس ٦٢,٥، ٥٨,١، ٥٩,٧ للسلالة الثقيلة والخفيفة والمقارن بينما كانت هذه المعدلات في الجيل الأول ٥٩,٤، ٥٨,٥، ٥٥,٢ ٪ على التوالي.

٥- كانت لقوة الهجين تأثير سالب على عدد البيض حتى ٥٢ أسبوعا من العمر وكانت تقديرات قوة الهجين - ١،٢، - ٦،٥ ٪ للخلطات الخفيف × الثقيل والثقيل × الخفيف على التوالي.

٦- يوجد ارتباط موجب بين وزن البيض ووزن الجسم الثقيل والانتخاب لوزن الجسم الثقيل أدى إلى زيادة وزن البيض كصفة مرتبطة.

٧- تبين نتائج التجربة أن الانتخاب وكذلك الخلط بين السلالات يعتبران وسيلتان فعالتان لزيادة وزن الجسم وعرض الصدر وبعض الصفات المرتبطة بهما.