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EFFECT OF CROSSING BETWEEN THE LOCAL BLACK BALADI (BRONZE) AND WHITE NICHOLAS TURKEYS ON PRODUCTIVE AND REPRODUCTIVE TRAITS
2-EFFECT OF REPEATED BACKCROSSING FOR TWO GENERATIONS ON GROWTH TRAITS

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ABSTRACT

A backcrossing experiment was carried out between two strains of turkey, Black Baladi (BB) and commercial White Nicholas (WW) as well as their reciprocal crosses in Maryant experimental station at El-Amria region, desert research center, ministry of agriculture, through three successive years. Results were as follows:

White Nicholas birds were significantly the heaviest at the first generation compared to birds of both BB and the reciprocals crosses at either the second or the third generation, repeated crossing with WW as a sire improved body weight of progeny (3/4 w x 1/4 B and 7/B w x 1/8 B) at all ages studied to be the best averages. Males of the same genotypes had the best weights compared to males or females of the other genotypes in all ages studied. Same trend was found concerning body weight gain, where WW birds had the best weight gains in most ages studied in the 1st generation, while those of (3/4 W x 1/4 B) in the 2nd generation and (7/8 W x 1/ 8 B) in the 3rd generation had the highust averages compared to the other genotypes.

The BB birds grew faster than those of pure WW and the reciprocals birds in the growth period studied in the 1st and 2nd generations while at the 3rd one, both the pure BB and WW birds had the same and the highest growth rate compared to birds of the other genotypes. In contrary at the rearing period (12-20 weeks of age), BB birds had the lowest growth rate compared to the other genotypes. Males surpassed females in growth rate at 4-12, 12-20 and 4-20 weeks of age.

Birds of pure BB had significantly the best growth efficiency (GE) through growth period in the three generations except at 4-8 wks of age in the 3rd one, where both WW and (7/8 B x 1/8W) cross were the best in this trait. Concerning the rearing period, the superiority varied thought the three generations. In general, the pure BB had the best averages in the whole period studied. Also, male's surpassed females in these traits (4.2 vs. 3.9%) (4.3 vs. 3.8%) and (4.9 vs. 4.6%) in the 1st, 2nd, 3rd generation respectively.

As for (½ B x ½ W) and (½ W x ½ B) crosses, heterosis, the average degree of heterosis (ADOH%) and potency ratio indicated that there was no dominance was found towards the high parent but partial dominance and complete dominance were found tends to the low parent (B x B) except for male of (½ W x ½ B) cross at 4 week of age which had positive values. The (3/4 W x 1/4 B) backcross had superior heterotic effect than the (3/4 B x 1/4 W) backcross for body weight at 8 week of age while the (3/4 B x 1/4 W) backcross had higher heterosis percentage than the (3/4 W x 1/4 B) backcross for body weight at 4 week of age. The (3/4 W x 1/4 B) backcross had higher potency ratio values than the (3/4 B x 1/4 W) backcross at all ages studied. Potency ratio values for (3/4 W x 1/4 B) backcross for body weight indicated that there was over dominance towards the high parent for body weights at 4, 8, 20 week of age and complete dominance towards the high parent (W x W) for body weight at 12 and 16 week of age. The ADOH % decreased in the third generation than in the second one at all ages studied except for 8 week.

In general, the second generation had better values of H1 % and H2%, ADOH % and P1 and P2 compared to those of the 1st and the 3rd generations concerning the whole period (4-20 wk of age) for body weight gain.

Concerning growth efficiency percentage, results indicated that over dominance effects were towards the high parent in the first generation, furthermore, complete dominance towards the low parent in the 2nd and the 3rd generations depending on the values of potency ratio P1 and P2 were found.

It could be concluded that the backcrosses for one generation between local Black Baladi and White Nicholas strains of turkey as a sire parent with 1/2B x 1/2W and 1/2W x 1/2B crosses as a dam parent, respectively, enhanced growth traits (body weight, body weight gain, growth rate). Moreover, backcrosses produced progenies have a black feather which has more acceptability by consumers in Egypt.

INTRODUCTION

Early research has indicated that non additive genetic variation is not a major contribution to total genetic variation for growth trails (McCartney and Chamberlin, 1961; Nestor, 1971 and 1985; Amin, 1999, 2007 and 2008). Emmerson *et al.* (1991) reciprocally, crossed two sire lines of similar body weight but differing greatly in body conformation, heterosis for body weight was present in the F_1 and F_2 crosses but the level and sign of the heterosis were not consistent at different ages. Moreover, in crosses of two commercial sire lines and an experimental line selected for increased 16 wk body weight, heterosis was observed for BW (Nestor *et al.*, 2001 and 2005).

Nestor *et al.* (1997) repeatedly backcrossed the line selected for egg number to the line selected for increased BW at 16 wk of age, and even though the results of the two backcrosses were slightly different. Nestor *et al.* (2005) reported that heterosis was important source of variation in BW for males from both cresses which used. Nestor *et al.* (2006) reported that for maximum gains per generation, backcrossing probably should be used for maximum of two or three generations.

The present study was initiated to evaluate the response of crossbreeding program throughout three generations between the local black Baladi and White Nicholas turkey on growth traits (body weight, body weight gain, and growth rate and growth efficiency percentage at different ages. Heterotic, maternal additive, direct additive effects, potency ratio and Strait-bred differences of growth traits also were studied.

MATERIALS AND METHODS

The present study was carried out at the Maryout Experimental Station at El-Amria region, Desert Research Center, Ministry of Agriculture, through three successive years from 2005 to 2007. The turkeys stock consisted of two strains , the local Black Baladi (BB) which was introduced to the station from El-Minea Government in 1997 (Amin , 1999) and a commercial White Nicholas (WW).

In the first generation, reciprocal were practiced between the (B x B) and (W x W) to get the F1 (1/2W x 1/2B and1/2 B x1/2 W), at the second generation, pullets of the F1 (1/2W x 1/2B) were backcrossed with toms of (W x W) and pullets of (1/2 B x1/2 W) were backcrossed with toms of(B x B) to get progeny (¾W×¼B) and (¾B×¼W), respectively. In the third generation, pullets of the two genotypes which produced from the second generation were backcrossed again with toms from both the pure lines to get (7/8W x 1/8 B) and (7/8B x 1/8 W), respectively.

Hens were artificially inseminated twice during the week the first egg was laid and weekly there after volume of semen inseminated per hen varied but was almost greater then minimum amount generally recommended (0.025 ml) for maximum fertility , at hatching, birds were pedigreed , wing banded and birds were reared on litter floor pens until 24 weeks of age. Poults were fed a starter ration contained 28% crude protein and 2860 Kcal ME/kg ration until 8 weeks of age , after that they received a growing ration contained 22% crude protein and 2950 Kcal ME/ kg ration. At 20 weeks of age, a laying ration contained 15.5% crude protein and 2920 Kcal ME/kg ration was given. Conventional husbandry practices were followed. Feed and water supplied *ad libitum*. Poults were housed in floor brooders and vaccinated according to vaccination program recommended birds at the Meryout Experimental station. All birds were sexed by the external characteristics. Individual body weights were recorded in gram at 4, 8, 12, 16 and 20 weeks of age. Body weight gain, g/day , growth rate and growth efficiency were calculated for each bird during 4-8, 8-12, 12-16 and 16-20 weeks of age. Body weight gains, growth rate and growth efficiency were calculated as follows

Body weight gain :-

$$WG = \frac{LW_{ti} - LW_{to}}{ti - t_0}$$

Where,

WG is weight gain per time period, LW_{ti} live weight at particular week: ti , LW_{to} is live weight for the precious period = t_0

Growth rate:-

Growth rate (%) = (W2 – W1) × 100/0.5 × (W2 + W1)

Where,

W1 and W2 are body weights at the early and late ages studied.

Growth efficiency:-

$$GE = \frac{WG_{ti}}{LW_{to}}$$

Where,

GE is growth efficiency per time period= t_i WG_{ti} is weight gain at time = t_i ; t_i LW_{t0} is live weight at time = t_0

The strait line difference, maternal additive and direct additive effect were calculated according to Dickerson (1992). Average degree of hetesosis (ADH %) and potency ratio (PR) were calculated according to Sinha and Khanna (1975) as follow:

$$ADOH\% = \frac{F_1 - MP}{MP} \times 100$$

$$PR = \frac{F_1 - MP}{\frac{1}{2}(P_H - P_L)}$$

Where

F_1 = mean of crosses,

MP = mid – parent,

P_H = mean of the high parent,

P_L= mean of the low parent.

1-Straits – line difference:-

$(G^i_W + G^m_W) - (G^i_B + G^m_B) = (W\times W) - (B\times B)$

2-Maternal additive effect (i.e. reciprocal crosses differences) :-

a- In the first generation $F_1 = G^m_W - G^m_B = [(\frac{1}{2}W\times\frac{1}{2}B) - (\frac{1}{2}B\times\frac{1}{2}W)]$

b-In the second generation $F_2 = G^m_W - G^m_B = [(\frac{3}{4}W\times\frac{1}{4}B) - (\frac{3}{4}B\times\frac{1}{4}W)]$

c-In the third generation$F_3 = G^m_W - G^m_B = [(7/8W\times1/8\,B) - (7/8B\times1/8W)]$

3-Direct additive effect (i.e line group of sire differences) :-

a- In the first generation$F_1 = G^m_W - G^m_B$

$= [(W\times W) + (\frac{1}{2}W\times\frac{1}{2}B)] - [(B\times B) + (\frac{1}{2}B\times\frac{1}{2}W)]$

b-In the second generation $F_2 = G^m_W - G^m_B$

$= [(W\times W) + (\frac{3}{4}W\times\frac{1}{4}B)] - [(B\times B) + (\frac{3}{4}B\times\frac{1}{4}W)]$

c-In the third generation$F_3 = G^m_W - G^m_B$

$= [(W\times W) + (7/8W\times1/8B)] - [(B\times B) + (7/8B\times1/8W)]$

4-Heterosis percentage for crosses and backcrosses:-

a- In the first generation F_1

heterosis percentage for (½ B x ½ W) crosses(H 1%)

$$= \frac{(\frac{1}{2}W\times\frac{1}{2}B) - \frac{1}{2}[(B\times B) + (W\times W)]}{\frac{1}{2}[(B\times B) + (W\times W)]} \times 100$$

heterosis percentage for (½ B x ½W) crosses(H 2 %)

$$= \frac{(\frac{1}{2}B\times\frac{1}{2}W) - \frac{1}{2}[(B\times B) + (W\times W)]}{\frac{1}{2}[(B\times B) + (W\times W)]} \times 100$$

Average degree of heterosis (A.D.O.H %)

$= \underline{\frac{1}{2}[(B\times W) + (W\times B)] - \frac{1}{2}[(B\times B) + (W\times W)]} \times 100$

$\frac{1}{2}$ [(B x B) + (W x W)]

b-In the second generation F_2

Heterosis percentage for backcross (¾W×¼B)

$$= \frac{(\frac{3}{4}W\times\frac{1}{4}B) - \frac{1}{2}[(W\times W) + (\frac{1}{2}W \times \frac{1}{2}B)]}{\frac{1}{2}[(W\times W) + (\frac{1}{2}W\times\frac{1}{2}B)]} \times 100$$

Heterosis percentage for backcross (¾B×¼W)

$$= \frac{(\frac{3}{4}B\times\frac{1}{4}W) - \frac{1}{2}[(B\times B) + (\frac{1}{2}B \times \frac{1}{2}W)]}{\frac{1}{2}[(B\times B) + (\frac{1}{2}B\times\frac{1}{2}W)]} \times 100$$

Average degree of heterosis (A.D.O.H%)

$$= \frac{\frac{1}{2}[(\frac{3}{4}B\times\frac{1}{4}W)+(\frac{3}{4}W\times\frac{1}{4}B)] - \frac{1}{4}[(B\times B)+(W\times W)+(\frac{1}{2}W\times\frac{1}{2}B)+(\frac{1}{2}B\times\frac{1}{2}W)]}{\frac{1}{4}[(B \times B) + (W \times W) + (\frac{1}{2} W \times \frac{1}{2} B) + (\frac{1}{2} B \times \frac{1}{2} W)]} X100$$

c-In the third generation F_3

Heterosis percentage for backcross (7/8W×¼ B)

$$= \frac{(7/8W\times\frac{1}{4}B) - \frac{1}{2}[(W\times W) + (\frac{3}{4}W \times \frac{1}{4} B)]}{\frac{1}{2}[(W\times W) (\frac{3}{4}W \times \frac{1}{4} B)]} \times 100$$

Heterosis in percentage for backcross (7/8B×¼ W)

$$= \frac{(7/8\ B \times\frac{1}{4}W) - \frac{1}{2}[(B\times B) + (\frac{3}{4}B \times\frac{1}{4}W)]}{\frac{1}{2}[(B\times B) + (\frac{3}{4}B \times\frac{1}{4}W)]} \times 100$$

Average degree of heterosis (A.D.O.H %)

$$= \frac{\frac{1}{2}[(7/8B\times1/8W)+(7/8W\times1/8\ B)] - \frac{1}{2}[(B\times B)+(W\times W)+(\frac{3}{4}W\times\frac{1}{4}B)+(\frac{3}{4}B\times\frac{1}{4}W)]}{1/4\ [(B \times B) + (W \times W) + (\frac{3}{4} W \times \frac{1}{4}B) + (\frac{3}{4} B \times \frac{1}{4} W)]} \times100$$

5- potency ratio values for crosses and backcrosses :-

a- In the first generationF_1

Potency ratio for (½W x ½B) crosses (P1)

$$= \frac{(\frac{1}{2} W \times \frac{1}{2} B) - \frac{1}{2}[(B \times B) + (W \times W)]}{\frac{1}{2}[(W \times W) - (B \times B)]}$$

Potency ratio for (½B B x ½W N) crosses (P 2)

$$= \frac{(\frac{1}{2}B \times \frac{1}{2}W) - \frac{1}{2}[(B \times B) + (W \times W)]}{\frac{1}{2}[(W \times W) - (B \times B)]}$$

b-In the second generation F_2

Potency ratio for backcross (¾W×¼B)

$$= \frac{(\frac{3}{4}W\times\frac{1}{4}B) - \frac{1}{2}[(W\times W) + (\frac{1}{2}W\ x\frac{1}{2}B)]}{\frac{1}{2}[(W\times W) - (\frac{1}{2}W\ x\frac{1}{2}B)]}$$

Potency ratio for backcross (¾B×¼W)

$$= \frac{(\frac{3}{4}B\times\frac{1}{4}W) - \frac{1}{2}[(B\times B) + (\frac{1}{2}B\ x\frac{1}{2}W)]}{\frac{1}{2}[(\frac{1}{2}Bx\frac{1}{2}W) - (B\times B)]}$$

c-In the third generation F_3

Potency ratio for backcross (7/8W ×1/8 BB)

$$= \frac{(7/8W\ \times1/8\ B) - \frac{1}{2}[(W\times W) + (\frac{3}{4}W\ x\frac{1}{4}B)]}{\frac{1}{2}[(\ (\frac{3}{4}W\ x\frac{1}{4}B) - (W\times W)]}$$

potency ratio for backcross (7/8BB×1/8 WN)

$$= \frac{(7/8B\times1/8\ W) - \frac{1}{2}[(B\times B) + (\frac{3}{4}B\ x\frac{1}{4}W)]}{\frac{1}{2}[(\frac{3}{4}B\ x\frac{1}{4}W) - (B\times B)]}$$

Statistical analysis:

Data of all traits studied were analyzed using the following linear model (SAS) Institute, (1992)

$$Y_{ijkl} = \mu + Gn_i + Gt_j + S_k + GnGt_{ij} + Gn\ S_{ik} + GtS_{jk} + GnGtS_{ijk} + e_{ijkl}$$

Where:

Y_{ijkl} = the observation of the ijkl pullet,
μ = the overall mean,
Gn_i = fixed effect of $_i^{th}$ generation,
Gt_j = fixed effect of $_j^{th}$ genotype,
S_k = fixed effect of $_k^{th}$ sex effect
$GnGt_{ij}$, GnS_{ik}, GtS_{jk}, $GnGtS_{ijk}$ = the interaction between the main factors effect,
e_{ijkl} = the remainder error.

Significant differences among means were tested by Duncan Test (1955).

RESULTS AND DISCUSSION

1 -Body weight(BW):

Table (1) showed that White Nicholas (WW) strain had about %1.50 fold larger than black Baladi (BB) one at all ages studied, it had significantly the highest BW while the BB strain had the lowest weights at all ages except that at 12 weeks of age where both the reciprocal crosses had the lowest BW (but not significantly) compared to the other genotypes. Males of WW strain were heavier than females in all ages. In the first backcross (generation 2), the birds of 3/4 W x 1/4 B genotype had significantly the highest weights at 4, 8 and 20 week of age, while at 12 and 16 week of age, birds of 3/4 W x 1/4 B cross and the pure WW were significantly the heaviest compared to the other two genotypes. The reciprocal crosses improved BW of BB strain for all ages

Table (1): Mean± standard errors for body weight, g, Strait-bred differences, heterosis percentages, and average degree of heterosis, potency ratio, maternal additive and direct additive effects, at the different ages studied for the two parental strains and their crossbred for both males and females in the first generation

Age wk	Sex	Genotypes					Straight bred difference	Reciprocal effect	Heterosis percentage			Potency ratio		Direct Additive effect
		Parental strains		Reciprocal crosses		Overall mean								
		B x B	W x W	½ B x ½ W	½ W x ½ B				H 1%	H 2%	A.D.O.H %	P 1	P 2	
	M	434.0±12.9^{e}	780.25±17.62^{a}	600.76±22.24^{c}	717.28±20.58^{b}	645.53±11.80^{X}	346.3	116.5	18.1	-1.0	8.5	0.64	-0.04	462.8
	F	380.٥±10.2^{f}	740.88±21.83^{ab}	553.63±17.69^{cd}	541.00±15.33^{d}	531.23±10.84^{Y}5	360.4	-12.6·	-3.5	-1.3	-2.4	-0.11	-0.04	347.8
4	AV	406.٧+8.30^{D}	765.85+13.77^{A}	**578.84+14.61^{C}**	**628.70+14.23^{B}**	**92.34+8.36**	359.7	·49.9	7.3	-1.2	3.0	0.24	-0.04	409.5
	M	1348.٨±30.9^{d}	2133.69±50.69^{a}	1638.91±67.02^{c}	1831.06±51.24^{c}	1773.38±29.52^{X}	784.9	192.2	5.2·	-5.9	-0.4	0.23	-0.26	977.0
	F	1101.١±23.٦^{e}	1977.50±54.32^{b}	1305.25±20.02^{d}	1344.05±33.99^{d}	1393.63±25.57^{Y}	876.4	38.8·	-12.7	-15.2	-13.9	-0.45	-0.53	915.2
8	AV	1220.٧+21.٠^{D}	2076.59+38.11^{A}	1483.72+41.03^{C}	1586.33+35.16^{B}	1596.69+21.05	855.9	102.6	-3.8·	-10.0	-6.9	-0.15	-0.39	958.5
	M	2817.٠±51.2^{c}	3744.36±76.10^{a}	2757.83±61.61^{c}	2767.27±64.55^{c}	3098.19±41.67^{X}	927.4	9.4·	-15.6	-15.9	-15.8	-1.11	-1.13	936.8
	F	2196.٤±36.٤^{d}	3308.97±87.24^{b}	2022.88±23.62^{d}	2152.25±49.58^{d}	2400.52±38.59^{Y}	1112.6	129.4	-21.8	-26.5	-24.2	-1.08	-1.31	1241.9
12	AV	2494.٧+37.٨^{B}	3585.19+59.74^{A}	2415.99+52.68^{B}	2458.22+46.06^{B}	2773.57+31.57	1090.5	42.2·	-19.1	-20.5	-19.8	-1.07	-1.14	1132.7
16	M	4042.٣±68.٥^{d}	5605.34±86.69^{a}	4330.65±105.56^{c}	4951.92±79.65^{b}	4837.19±53.87^{X}	1563.0	621.3	2.7·	-10.2	-3.8	0.16	-0.63	2184.3
	F	2947.٧±34.٩^{f}	4820.66±129.29^{b}	3504.00±43.37^{e}	3676.21±39.51^{e}	3653.91±50.80^{Y}	1873.0	172.2	-5.4·	-9.8	-7.6	-0.22	-0.41	2045.2
	AV	3473.٧+53.٥^{D}	5318.47+77.46^{A}	3946.16+74.54^{C}	4310.86+63.32^{B}	4286.62+43.61	1844.8	364.7	-1.9·	-10.2	-6.1	-0.09	-0.49	2209.5
	M	5118.٢±80.٢^{d}	7010.25+89.53^{a}	5336.20±94.45^{d}	6303.43±84.44^{b}	6086.78±60.91^{X}	1892.1	967.2	3.9·	-12.0	-4.0	0.25	-0.77	2859.3
20	F	3633.٥±57.٥^{g}	5850.51±148.64^{c}	4309.38±61.41^{f}	4658.90±47.49^{e}	4523.43±61.54^{Y}	2217.0	349.5	-1.8·	-9.1	-5.4	-0.07	-0.39	2566.5
	AV	4346.١+71.٠^{D}	6586.26+88.٥^{A}	4858.60+80.10^{C}	5477.04+75.74^{B}	5359.37+52.70	2240.2	618.4	0.2·	-11.1	-5.5	0.01	-0.54	2858.6

Cont.Table (1): The second generation

Age (wk)	Sex	Genotypes				Overall mean	Straight bred difference	Reciprocal effect	Heterosis percentage			Potency ratio		Direct Additive effect
		Parental strains		Reciprocal crosses										
		B x B	W x W	3/4 B x 1/4 W	3/4 W x 1/4 B				H 1%	H 2%	A.D.O.H %	P 1	P 2	
4	M	455.90+004.4^{f}	747.40+10.0^{e}	695.30+022.2^{b}	762.50+008.4^{a}	664.00+08.9^{X}	291.5	67.2	4.1	31.6	15.6	2.00	231	358.7
	F	379.90+004.2^{g}	570.80+04.7^{d}	496.80+008.8^{e}	620.10+005.0^{c}	527.70+05.4^{Y}	190.9	123.3	11.5	6.4	9.20	4.31	0.35	314.2
	AV	418.10+004.2^{D}	654.30+07.4^{B}	587.80+016.2^{C}	681.80+007.4^{A}	591.08+05.7	236.2	94.0	6.3	17.9	11.4	3.15	1.11	330.2
8	M	1370.8+028.0^{d}	2000.0+31.8^{b}	1366.7+052.0^{d}	2156.6+038.7^{a}	1792.1+25.9^{X}	629.2	789.9	12.6	-9.2	3.00	2.85	-1.03	1419.1
	F	1145.7+027.9^{e}	1440.2+15.2^{cd}	1491.2+033.1^{c}	1486.9+025.3^{c}	1384.4+13.6^{Y}	294.5	-4.3	6.8	21.7	13.8	1.97	3.33	290.2
	AV	1258.9+021.4^{D}	1704.8+23.6^{B}	1434.1+030.5^{C}	1777.1+035.0^{A}	1576.2+16.1	445.9	343.0	8.0	4.6	6.40	2.22	0.56	788.9
12	M	2791.8+059.7^{b}	3778.3+35.7^{a}	2746.8+102.8^{bc}	3932.7+069.3^{a}	3430.4+39.9^{X}	986.5	1185.9	20.2	-1.0	10.4	1.31	1.65-	2172.4
	F	2171.2+040.6^{e}	2613.6+32.9^{cd}	2528.6+088.1^{d}	2553.7+062.0^{d}	2482.6+25.7^{Y}	442.4	25.1	7.2	20.6	13.4	0.74	5.82	467.5
	AV	2483.2+042.9^{B}	3164.1+41.8^{A}	2628.6+067.8^{B}	3151.2+072.5^{A}	2928.5+29.3	680.9	522.6	12.1	7.3	9.90	0.96	5.33	1203.5
16	M	4067.9+087.7^{d}	5498.6+49.4^{b}	4387.0+105.1^{c}	5892.3+067.1^{a}	5066.5+54.4^{X}	1430.7	1505.3	12.8	4.5	9.10	2.44	1.43	2936.0
	F	3005.7+045.1^{f}	4017.8+54.6^{d}	3672.1+129.6^{e}	3848.1+056.2^{de}	3694.4+38.0^{Y}	1012.1	176.0	0.0	12.8	5.90	0.01	1.67	1188.1
	AV	3539.7+063.3^{C}	4717.6+57.0^{A}	3999.7+094.6^{B}	4733.9+093.5^{A}	4340.0+41.6	1177.9	734.2	4.9	6.9	5.80	1.08	1.26	1912.1
20	M	5123.1+102.6^{d}	6707.9+63.3^{b}	5402.6+107.0^{c}	7149.6+078.9^{a}	6223.0+62.8^{X}	1584.8	1747.0	9.9	3.3	7.0	3.18	1.62	3331.8
	F	3709.9+069.8^{f}	4914.6+63.7^{d}	4602.7+124.3^{e}	4878.6+081.6^{d}	4578.6+47.0^{Y}	1204.7	275.9	1.9	14.8	7.8	0.72	1.98	1480.6
	AV	4420.4+081.4^{D}	5762.1+69.1^{B}	4969.3+095.3^{C}	5862.7+108.6^{A}	5352.3+49.6	1341.7	893.4	4.3	7.1	5.6	1.71	1.51	2235.1

Cont.Table (1): The third generation

Age (week)	Sex	Genotypes: Parental strains: B x B	W x W	Reciprocal crosses: 7/8 B x 1/8W	7/8 W x 1/8 B	Overall mean	Straight bred difference	Reciprocal effect	Heterosis percentage%: H 1%	H 2%	A.D.O.H	Potency ratio: P 1	P 2	Direct Additive effect
4	M	473.9±12.1^{c}	595.9±10.7^{b}	576.5±14.6^{bc}	771.7±11.3^{a}	604.7±08.5^{X}	122	195	13.6	-1.4	6.7	1.11	-0.07	317
	F	371.2±06.1^{e}	469.6±09.0^{d}	442.9±11.2^{d}	543.7±10.8^{c}	450.0±05.7^{Y}	098	100	-0.2	2.1	0.8	-0.02	0.14	199
	AV	**418.0±07.5^{C}**	**523.3±07.8^{B}**	**505.6±11.7^{B}**	680.9±12.7^{A}	**523.0±05.8**	**105**	**175**	**13.0**	0.5	7.3	0.99	0.03	**280**
8	M	1284.1±29.2^{e}	1886.8±33.3^{b}	1836.3±53.5^{b}	2137.5±55.1^{a}	1786.4±27.2^{X}	602	301	5.7	38.5	18.7	0.86	12.37	903
	F	1102.0±23.1^{f}	1351.1±14.7^{d}	1164.3±20.4^{e}	1656.2±36.4^{c}	1303.8±14.5^{Y}	249	491	16.7	-10.2	3.9	3.49	-0.68	741
	AV	**1184.9±19.5^{D}**	**1578.8±22.7^{B}**	**1479.6±46.3^{C}**	**1945.7±41.7^{A}**	**1531.5±17.6**	**393**	**466**	**16.0**	13.0	**14.7**	2.70	1.37	**860**
12	M	2867.7±62.1^{c}	3607.3±34.5^{b}	3069±102.4^{c}	3826.6±45.7^{a}	3406.1±33.9^{X}	0739	756	1.5	9.3	4.9	0.35	4.34	1496
	F	2239.3±47.0^{f}	2532.3±36.2^{e}	2431.9±61.5^{e}	2486.4±35.9^{e}	2433.2±23.8^{Y}	0293	54	-2.2	2.0	-0.2	-5.29	0.33	0347
	AV	2525.6±44.6^{D}	2989.3±40.4^{B}	2731.1±67.8^{C}	3292.6±65.9^{A}	2892.3±27.6	0463	561	7.2	6.0	6.7	2.75	2.99	1025
16	M	4013.5±73.7^{d}	5152.5±45.4^{b}	4390±104.7^{c}	5369.7±47.7^{a}	4821.3±43.6^{X}	1139	979	-2.8	4.5	0.4	-0.41	1.02	2118
	F	3027.9±56.0^{h}	3594.2±30.7^{f}	3402.3±42.4^{g}	3815.9±45.6^{e}	3447.3±26.9^{Y}	566.3	413	2.5	1.6	2.1	0.75	0.16	979
	AV	3476.9±58.2^{D}	4256.6±52.5^{B}	3865.7±76.9^{C}	4750.6±75.5^{A}	4095.7±36.3	779.7	884	5.7	3.4	4.6	1.07	0.49	1664
20	M	5152.7±92.2^{c}	6449.0±57.5^{b}	5452.2±114^{c}	6677.1±57.1^{a}	6052.1±51.8^{X}	1296	1224	-1.8	3.3	0.4	-0.35	1.40	2521
	F	3655.3±70.4^{g}	4549.0±37.0^{e}	4109.2±65.2^{f}	4511.5±80.9^{e}	4245.3±35.7^{Y}	893	402	-4.3	-0.5	-2.5	-1.23	-0.04	1296
	AV	4337.5±79.5^{D}	5356.7±64.3^{B}	4739.3±98.3^{C}	5814.2±105^{A}	5097.9±46.5	1019	1074	3.6	1.8	2.8	0.81	0.27	2094

M, F and AV. = Male, Female and Average , H 1% and H 2 % = heterosis for (7/8 W x 1/8 B) and (7/8 B x 1/8W backcrosses
A.D.O.H%, P1 and P 2 = average degree of heterosis and potency ratio for (7/8 W x 1/8 B) and (7/8 B x 1/8W) backcrosses
-The first parent of each cross was the sire.
- Means in columns (X – Y) or rows (A- D) each trait having the same superscripts are non significant at $p \leq 0.05$
- Means of the interactions of genotypes x sex in each trait having the same small superscripts are non significant at $p \leq 0.05$.

Cont.Table (1): Mean± standard errors for body weight, g at the different ages studied for the three generations

Traits	Body weight, g (week): 4	8	12	16	20
Generations:					
Gn1	592.34±8.36^{x}	1596.69±21.05^{x}	2773.57±31.57^{y}	4286.62±43.61^{x}	5359.37±52.70^{x}
Gn2	591.81±5.69^{x}	1576.21±16.09^{x}	2928.52±29.34^{x}	4340.01±41.64^{x}	5352.27±49.60^{x}
Gn3	522.98±5.83^{y}	1531.52±17.58^{y}	2892.31±27.63^{x}	4095.68±36.33^{y}	5097.94±46.45^{y}

- Means in each column having the same superscripts are non significant at $p \leq 0.05$.

studied. Males of 3/4 W x 1/4 B cross were the heaviest at 4 and 12 weeks of age. While males of the same cross and those of pure WW strain were significantly the heaviest compared to all males and females in the same age.

Concerning the second backcross (the 3rd generation), weights of birds for the four genotypes had the same trend which found in generation two where birds of 7/8 w x 1/8 B cross were the heaviest while those of pure BB had lowest averages compared to the other genotypes. Also, males of 7/8 W x 1/8 B had significantly the highest weights at the different ages. Females which realized the highest weights were for 7/8W x 1/8 B cross at 4,8 and 16 weeks of age , for the pure WW and both the reciprocal crosses at 12 weeks and for both pure WW and 7/8 W x 1/8 W cross compared to the other females. Statistical analysis revealed significant strain by sex interaction for body weight at all ages in the three generations.

In general, males had significantly higher weights than females in all of ages studies. Highly significant differences in BW were found among generations in most of the traits studied (Table 1) where BW of birds at the 1st and the 2nd generations surpassed those of the 1st one in all ages except at 16 wk where birds of the 1st generation were the lightest.

These results are in agreement with those reported by El-Naggar *et al.* (1992); Mostafa (1997); Amin (1999 and 2008) and Mostafa and Nofal (2000) who found significant difference between the two sex in body weight. Nestor et al. (2006) using backcrossing of an egg line with a commercial line found that males in the F1 generation did not differ from expected for body weight at any age but the females of that cross had higher body weight than expected at 16 and 20 weeks of age .

The first generation had the highest values of Strait-bred differences flowed by the second generation while the third generation had the lowest values (105, 393, 463, 779.7 and 1019 g, respectively). The values of maternal additive effect showed that offspring of the (1/2 W ×1/2 B) mating had better performance than those of the (1/2 B × 1/2 W) mating for body weights at all ages studied in the first generation. Using (1/2 W x 1/2 B) and (3/4 W x 1/4 B) poults as a dam with White Nicholas toms as a sire – breed gave an advantage for body weights at all ages studied. These results lead to affirm that dams of these genotypes are better concerning their mothering ability. The values of direct additive effect indicating that using White Nicholas (W x W) toms is better than Black Baladi toms for body weights at all ages studied but the direct additive effect decreased from one generation to another due to the decrease of weights of the (W x W) toms from one generation to another.

The results of Table (1) showed heterosis for (½ B x ½ W) and (½ W x ½ B) crosses, the average degree of heterosis and Potency ratio indicated that no dominance was found toward the high parent but partial dominance and complete dominance were found tends to the low parent (B x B) except for male of (½ W x ½ B) cross at 4 week of age which had positive values (18.1% , 0.6% and 8.5 %) for heterosis (H1), potency ratio cross (p1) and average degree of heterosis (ADOH%), respectively.

The estimates of heterosis percentages in the second generation indicated that the (3/4 W x 1/4 B) backcross had superior heterotic effect than the (3/4 B x 1/4 W) backcross for body weight at 8 week of age (8 % vs. 4.6 %), at 12 week of age (12.1 % vs. 7.3 %) While the (3/4 B x 1/4 W) backcross had higher heterosis percentage than the (3/4 W x 1/4 B) backcross for body weights at 4 week of age (17.9 % vs. 6.3 %), at 16 week of age (6.9 % vs. 1.9%) and at 20 week of age (7.1% vs. 4.3%) as shown in Table (1).

As for ADOH % and potency ratio, the results showed that the ADOH % were 11.4 %, 6 .4%, 9.9%, 5.8 % and 5.6 %, respectively, for body weight at 4, 8, 12, 16 and 20 week of age respectively, The (3/4 W x 1/4 B) backcross had higher potency ratio values than the (3/4 B x 1/4 W) backcross at all ages studied. The estimates for (3/4 W x 1/4 B) backcross were 3.1, 2.2, 0.96, 1.01 and 1.7 for BW at 4, 8, 12, 16 and 20 week of age, respectively, which indicated that there was over dominance towards the high parent (W x W) for BW at 4, 8, 20 week of age and complete dominance towards the high parent at 12 and 16 weeks of age.

Considering the third generation, the (7/8 W x 1/8 B) backcross had superior heterotic effect and potency ratio than the (7/8 B x 1/8 W) backcross for BW at all ages studied but decreased the degree of dominance towards the high parent at 4 and 20 week of age. Overall mean of ADOH % was decreased in the third generation than in the second one at all ages studied except for 8 week.

It could be concluded that the backcrosses between local Black Baladi and White Nicholas strains of turkey as a sire parent with (1/2 B x1/2 W) and (1/2 W x 1/2 B) crosses as a dam parent, respectively, improved body weight of progeny of F2 .These results are in agreement with those reported by Kondre and Shoffner (1955), Clark (1961), McCartney and Chamberlin (1961) and Nestor (1971) who reported that non additive genetic variation of body weight of turkeys is not an important source of variation, while several authors as (Asmundson, 1942; El-Naggar *et al.,* 1990; Emmerson *et al.,* 1991; Ye *et al.,* 1997 and Mostafa and Nofal, 2000) found that non additive genetic variation has been observed in some crosses. The positive effect of crossing agrees with the findings of Mohamed (2003), Aly *et al.* (2005) and Amin (2007) in chicken.

Commercial turkeys are usually produced by mating a sire line (or sire-line cross) selected for growth traits with a cross of two dam lines in which selection emphasis is balanced between growth and reproduction (Nestor *et al.* 1997 and Emmerison *et al*, 1991) reciprocally crossed two sire lines of similar body weight but differing greatly in body composition. Heterosis for body weight was present in the F1 and F2 crosses but the level and sign of the heterosis were not consistent at different ages. Repeated back crossing of a dam line to a sire line is one method of rapidly increasing of a dam line to a sire line is one method of rapidly increasing body weight in a dam line and would be economic importance, such as body conformation and reproduction, are not seriously compromised and non additive genetic variation is not an important source of variation (Nestor *et al.*, 2006).

2 -Body weight gain (BWG):

The analysis of BWG shows significant effects due to crossing and sex (Table 2). Pure WW birds had significantly the highest weight gain through the growth period while WW and 1/2 W x 1/2 B birds had significantly the largest average of BWG through the rearing period. However, the pure WW surpassed all genotypes in BWG through the whole period studied (4-20 weeks) of age. Males grew significantly faster than females in all periods studied. The interaction between genotype and sex were significant in most periods studied where males and female of pure WW had the highest BWG while males of (1/2 W x 1/2 B) and females of the pure WW had the highest averages of BWG through the rearing period, however, pure males and females of WW surpassed all the two sexes in the other genotypes in the whole periods studied. With respect to the second generation, progeny produced from pure WW and those from backcrossing between (1/2 W x 1/2 B) pullets with toms of pure WW birds of (3/4 W x 1/4 B) had the highest BWG compared to the other two genotypes in all periods studied except that of 16-20 period where (3/4 W x 1/4 B) progeny had the highest BWG compared to the other three genotypes. Males had higher BWG than females in all periods studied. The interaction between genotype and sex where highly significant at all periods studied except those of 12-20 and 16-20 weeks of age.

Table (2): Significance of the main factors and the different interactions between them for body weight at different ages studied

S.O.V.	d. f.	Body weight, g (week)				
		Growth period			Rearing period	
		4 wk	8 wk	12 wk	16 wk	20 wk
G n	2	**	**	**	**	**
G t	3	**	**	**	**	**
S	1	**	**	**	**	**
G n x G t	6	**	**	**	**	**
G n x S	2	**	**	**	**	**
G t x S	3	**	**	**	**	**
G n x G t x S	6	**	**	**	**	*

- Generation: Gn , Genotype: Gt , and Sex: S ,
* Genotype 1: White Nicholas (WW), and Gt. 4: Black Baladi (BB), at the 1st generation: Gt. 2: (½ WW x ½ BB) and Gt3: (½ BB x ½ WW), at the 2nd generation, Gt. 2: (3/4 WW x 1/4 BB), Gt. 3:(3/4BBx 1/4 WW), and at the 3rd generation,(7/8 WW x 1/8 BB) Gt. 3: (7/8BBx 1/8 WW)
*The first parent of each backcross denote to the sire parent,
- All main factors had Significant ($p \leq 0.01$),
- Interaction between all factors for all traits was significant at ($p \leq 0.01$),
* Significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, NS: non significant.

Males of both pure WW and (3/4 W x 1/4 B) cross and females of the two genotypes and those of (3/4 B x 1/4 W) cross had significantly the highest averages of BWG compared to both sexes in the other genotypes. However, males of the backcrosses (3/4 W x 1/4 B) had the highest BWG compared to males of the other genotypes while females of pure BB had the lowest BWG compared to the others through the whole period studied (4-20 weeks) of age.

As for the 3rd generation, results of Table 3 appears that progeny produced from backcrossing of (3/4 W x 1/4 B) and (7/8 W x 1/8 B) with toms of pure WW had the highest BWG in the periods 4-8 and 12-16 weeks of age while the same genotypes and those of pure WW surpassed significantly the other two genotype concerning BWG at 4-12 and 16-20 weeks of age. Amin (1999) reported that WW could be used as a sire line to improve body weight and body weight gain. These results are in agreement with those of El-Naggar *et al.* (1992); Mostafa (1997); Amin (1999) and Mostafa and Nofal (2000) who found significant difference due to sex in body weight gain.

Results of Table (3) showed that the first generation had the highest values of Strait-bred differences flowed by the 2nd generations but the third generation had the lowest values (13.1, 7.9, 6.4 g, respectively), at 4-12 week of age, (20.5 , 11.5 ,9.9 g at 12-20 week of age, respectively), and (16.8, 9.9, 8.2 g at 4-20 week of age, respectively).

Considering the maternal additive effects, it could be seen that using 1/2 W x 1/2 B and 3/4 W x 1/4 B poults as a dam with toms of White Nicholas gives an advantage for body weights gain at all periods studied. The third generation had the highest values of the maternal additive effects flowed by the second generation (except period 4-12 wk of age) while the first generation had the lowest values. On the contrary, direct additive effects in the first generation had the highest values flowed by the second one but the third one had the lowest value. It could be concluded that using White Nicholas toms for one backcross with 1/2 W x 1/2 B pullets improved BWG at all period studied. The H1 %and H2%, ADOH %, and (P1 and P2) had negative values (-25.4%, -25.2%, -25.3%, -1.7 and -1.7) at 4-12 week of age, respectively), in the first generation, and positive values in the second one, (13.8%, 2.4%, 9.4%, 0.9 and 1.5 at 4-12 wk of age, respectively) and for the third generation (5.8%, 7.3%, 6.5%, 5.1, 1.5 and 0.2 at 4-12 week of age, respectively). These results indicated that over dominance effects were towards low parent in the first generation, furthermore, complete dominance and over dominance towards the high parent (W x W) in the 2st and the 3nd generations depending on the values of potency ratio in each generation.

On the other hand, positive values (24.3%, 0.6%, 12.5%, 1.02 and 0.24 at 12-20 week of age, respectively) were found in the first generation. These values were decreased in both the 2st and the 3nd generations. Those results indicated that complete dominance and partial dominance effects were found for 1/2 W x 1/2 B and 1/2 B x 1/2 W, respectively, towards the high parent.

In general, the 2nd generations had better values compared to those of the first and the third generations concerning the whole period (4-20 week of age) for BWG for H1 %and H2%, ADOH % and P1 and P2 had positive values (2.2 %, 5.8%, 4.9%, 1.6 and 1.8, respectively). This results indicated that over dominance toward the high parent for body weight gain in the backcrosses (3/4 B x 1/4 W and 3/4 W x 1/4 B). Nestor *et al.* (2006) found that after 3 generations of backcrossing, the backcrosses exhibited a gain in 20-wk body weight for males (12.5 kg) and females (8.8 kg).

Table (3): Mean± standard errors for body weight gain, (g/day), Strait-bred differences, heterosis percentages, average degree of heterosis, potency ratio, maternal additive and direct additive effects at the different ages studied for the two parental strains and their crossbred for both males and females in the first generation

periods (Wk)	sex	Genotypes				Overall mean	Straight bred difference	Reciprocal effect	Heterosis percentage			Potency ratio		Direct Additive effect
		Parental strains		Reciprocal crosses										
		B x B	W x W	1/2Bx 1/2W	1/2 W x 1/2 B				H 1%	H 2%	A.D.O.H%	P 1	P 2	
Growth period 4-8	M	32.7 ± 0.9^{e}	48.3 ± 1.3^{a}	37.1 ± 2.0^{d}	39.8 ± 1.4^{c}	0.3 ± 0.7^{X}	15.6	2.7	-1.7	-8.4	-5.1	-0.09	-0.44	18.3
	F	25.8 ± 0.7^{e}	44.2 ± 1.5^{b}	26.8 ± 0.9^{e}	28.7 ± 1.0^{e}	0.8 ± 0.7^{Y}	18.4	1.9	-18.0	-23.4	-20.7	-0.68	-0.89	20.3
	AV	29.1 ± 0.6^{C}	46.8 ± 1.0^{A}	32.3 ± 1.2^{B}	34.2 ± 0.9^{B}	35.9 ± 0.5	17.7	1.9	-9.9	-14.9	-12.4	-0.42	-0.64	19.6
8-12	M	52.4 ± 1.6^{b}	57.5 ± 1.4^{a}	40.0 ± 1.8^{d}	33.4 ± 1.4^{d}	47.3 ± 0.9^{X}	5.1	-6.6	-39.2	-27.2	-33.2	-8.45	-5.86	-1.5
	F	39.1 ± 1.1^{d}	47.6 ± 2.2^{c}	25.6 ± 0.9^{e}	28.9 ± 1.3^{e}	36.0 ± 0.9^{Y}	8.5	3.3	-33.3	-40.9	-37.1	-3.40	-4.18	11.8
	AV	45.5 ± 1.1^{B}	53.9 ± 1.3^{A}	33.3 ± 1.3^{C}	31.1 ± 0.9^{C}	42.0 ± 0.7	8.4	-2.2	-37.4	-33.0	-35.2	-4.43	-3.90	6.2
4-12	M	42.6 ± 0.9^{c}	52.9 ± 1.2^{a}	38.5 ± 0.9^{d}	36.6 ± 1.0^{d}	43.8 ± 0.6^{X}	10.3	-1.9	-23.4	-19.4	-21.4	-2.17	-1.80	8.4
	F	32.4 ± 0.7^{e}	45.9 ± 1.4^{b}	26.2 ± 0.6^{f}	28.8 ± 0.8^{f}	33.4 ± 0.6^{Y}	13.5	2.6	-26.4	-33.1	-29.8	-1.53	-1.92	16.1
	AV	37.3 ± 0.7^{B}	50.4 ± 0.9^{A}	32.8 ± 0.9^{C}	32.7 ± 0.7^{C}	39.0 ± 0.5	13.1	-0.1	-25.4	-25.2	-25.3	-1.70	-1.69	13.0
Rearing period 12-16	M	43.8 ± 1.7^{d}	66.5 ± 2.5^{b}	56.2 ± 3.1^{c}	78.0 ± 2.1^{a}	62.1 ± 1.4^{X}	22.7	21.8	41.4	1.9	21.7	2.01	0.09	44.5
	F	26.8 ± 1.0^{e}	54.0 ± 3.1^{c}	52.9 ± 1.8^{c}	54.4 ± 1.4^{c}	44.8 ± 1.2^{Y}	27.2	1.5	34.7	30.9	32.8	1.03	0.92	28.7
	AV	35.0 ± 1.1^{C}	61.9 ± 2.0^{A}	54.7 ± 1.9^{B}	66.2 ± 1.5^{A}	54.0 ± 1.0	26.9	11.5	36.6	12.9	24.8	1.32	0.46	38.4
16-20	M	38.4 ± 1.5^{b}	50.2 ± 2.3^{a}	35.9 ± 2.3^{b}	48.3 ± 2.0^{a}	44.6 ± 1.1^{X}	11.8	12.4	9.0	-19.0	-5.0	0.68	-1.42	24.2
	F	24.5 ± 1.3^{c}	36.8 ± 2.2^{b}	28.8 ± 1.7^{c}	35.1 ± 1.5^{b}	31.1 ± 0.9^{Y}	12.3	6.3	14.5	-6.0	4.2	0.72	-0.30	18.6
	AV	31.2 ± 1.1^{B}	45.3 ± 1.7^{A}	32.6 ± 1.5^{B}	41.7 ± 1.3^{A}	38.3 ± 0.8	14.1	9.1	9.0	-14.8	-2.9	0.49	-0.80	23.2
12-20	M	41.1 ± 1.1^{d}	58.3 ± 1.5^{b}	46.0 ± 1.6^{c}	63.2 ± 1.3^{a}	53.4 ± 0.9^{X}	17.2	17.2	27.2	-7.4	9.9	1.57	-0.43	34.4
	F	25.7 ± 0.9^{e}	45.4 ± 1.9^{c}	40.8 ± 1.1^{d}	44.8 ± 1.0^{cd}	37.9 ± 0.8^{Y}	19.7	4.0	26.0	14.8	20.4	0.94	0.53	23.7
	AV	33.1 ± 0.9^{C}	53.6 ± 1.3^{A}	43.6 ± 1.0^{B}	53.9 ± 1.0^{A}	46.2 ± 0.7	20.5	10.3	24.3	0.6	12.5	1.03	0.02	30.8
whole period 4-20	M	41.8 ± 0.7^{d}	55.6 ± 0.8^{a}	42.3 ± 0.81^{d}	49.9 ± 0.7^{b}	48.6 ± 0.5^{X}	13.8	7.6	2.5	-13.1	-5.3	0.17	-0.93	21.4
	F	29.0 ± 0.5^{g}	45.6 ± 1.3^{c}	33.5 ± 0.6^{f}	36.8 ± 0.4^{e}	35.6 ± 0.5^{Y}	16.6	3.3	-1.3	-10.2	-5.8	-0.06	-0.46	19.9
	AV.	35.2 ± 0.6^{D}	52.0 ± 0.8^{A}	38.2 ± 0.7^{C}	43.3 ± 0.6^{B}	42.6 ± 0.4	16.8	5.1	-0.7	-12.4	-6.5	-0.04	-0.64	21.9

Cont. Table (3): The second generation

periods (Wk)	Sex	Genotypes				Overall mean	Straight bred difference	Reciprocal effect	Heterosis percentage			Potency ratio		Direct Additive effect
		Parental strains		Reciprocal crosses										
		B x B	W x W	3/4 B x 1/4W	3/4 W x 1/4 B				%H 1	%H 2	%A.D.O.H	P 1	P 2	
Growth period 4-8	M	32.7 ± 1.0^{c}	44.7 ± 1.2^{b}	24.0 ± 1.7^{e}	49.8 ± 1.4^{a}	40.3 ± 0.8^{X}	12.0	25.8	17.9	-31.2	-4.3	3.08	-4.95	37.8
	F	27.4 ± 0.9^{e}	31.1 ± 0.6^{d}	35.5 ± 1.2^{c}	31.0 ± 0.8^{d}	30.6 ± 0.4^{Y}	3.7	-4.5	3.7	31.0	16.7	0.92	8.2	-0.8
	AV.	30.0 ± 0.7^{B}	37.5 ± 0.8^{A}	30.2 ± 1.2^{B}	39.1 ± 1.1^{A}	35.2 ± 0.5	7.5	8.9	9.1	-3.0	3.4	1.97	0.8	16.4
8-12	M	50.8 ± 1.5^{b}	63.5 ± 1.4^{a}	49.3 ± 2.0^{b}	63.4 ± 2.8^{a}	58.5 ± 1.0^{X}	12.7	14.1	30.9	8.6	20.1	0.99	0.72	26.8
	F	36.6 ± 1.1^{c}	41.9 ± 1.1^{c}	37.1 ± 2.8^{c}	38.1 ± 1.9^{c}	39.2 ± 0.7^{Y}	5.3	1.0	7.6	19.3	13.1	0.42	1.09	6.3
	AV.	43.7 ± 1.1^{B}	52.1 ± 1.1^{A}	42.7 ± 1.9^{B}	49.1 ± 1.9^{A}	48.3 ± 0.7	8.4	6.4	18.0	10.9	14.6	0.71	0.81	14.8
4-12	M	41.7 ± 1.1^{b}	54.1 ± 0.7^{a}	36.6 ± 1.7^{c}	56.6 ± 1.3^{a}	49.4 ± 0.7^{X}	12.4	20.0	24.8	-8.7	9.1	1.29	-2.19	32.4
	F	32.0 ± 0.7^{d}	36.5 ± 0.6^{c}	$36.3\pm.5^{c}$	34.5 ± 1.1^{cd}	34.9 ± 0.4^{Y}	4.5	-1.8	5.7	24.7	14.7	0.48	2.48	2.7
	AV.	36.9 ± 0.7^{B}	44.8 ± 0.7^{A}	36.4 ± 1.1^{B}	44.1 ± 1.2^{A}	41.7 ± 0.5	7.9	7.7	13.8	4.4	9.4	0.88	0.76	15.6
Rearing period 12-16	M	45.6 ± 1.9^{cd}	61.4 ± 1.8^{b}	58.6 ± 2.1^{b}	70.0 ± 2.4^{a}	58.4 ± 1.2^{X}	15.8	11.4	0.4	15.1	6.6	-0.04	1.45	27.2
	F	29.8 ± 1.1^{f}	50.2 ± 1.9^{c}	40.8 ± 2.3^{e}	46.2 ± 1.5^{cd}	43.3 ± 1.0^{Y}	20.4	5.4	-11.7	-1.3	-7.1	-2.90	-0.05	25.8
	AV.	37.7 ± 1.2^{C}	55.5 ± 1.3^{A}	49.0 ± 1.9^{B}	56.5 ± 1.7^{A}	50.4 ± 0.8	17.8	7.5	-7.1	6.1	-1.4	-0.81	0.33	25.3
16-20	M	37.7 ± 1.2^{b}	43.2 ± 1.6^{a}	36.3 ± 1.6^{b}	44.9 ± 1.6^{a}	41.3 ± 0.9^{X}	5.5	8.6	-1.9	-1.4	-1.6	-0.33	-0.56	14.1
	F	25.1 ± 1.6^{c}	32.0 ± 1.1^{b}	33.2 ± 3.0^{b}	36.8 ± 2.1^{b}	31.6 ± 0.9^{Y}	6.9	3.6	9.7	23.2	15.7	2.10	3.38	10.5
	AV.	31.5 ± 1.1^{C}	37.3 ± 1.0^{B}	34.6 ± 1.8^{B}	40.3 ± 1.4^{A}	36.2 ± 0.6	5.8	5.7	2.0	8.0	4.7	0.36	4.64	11.5
12-20	M	41.6 ± 1.2^{d}	52.3 ± 1.1^{b}	47.4 ± 1.4^{c}	57.5 ± 1.6^{a}	49.9 ± 0.7^{X}	10.7	10.1	-0.4	8.2	3.3	-0.05	1.64	20.8
	F	27.5 ± 1.0^{f}	41.1 ± 1.0^{d}	37.0 ± 1.7^{e}	41.5 ± 1.5^{d}	37.4 ± 0.7^{Y}	13.6	4.5	-3.4	8.3	1.8	-0.78	0.43	18.1
	Bold	34.6 ± 0.9^{C}	46.4 ± 0.8^{A}	41.8 ± 1.3^{B}	48.4 ± 1.3^{A}	43.3 ± 0.6	11.8	6.6	-3.5	6.9	1.1	-0.47	0.60	18.4
whole period 4-20	M	41.7 ± 0.9^{c}	53.2 ± 0.6^{b}	42.0 ± 0.9^{c}	57.0 ± 0.7^{a}	49.6 ± 0.5^{X}	11.5	15.0	10.6	0.0	5.8	3.30	0.00	26.5
	F	29.7 ± 0.60^{e}	38.8 ± 0.6^{d}	36.7 ± 1.1^{d}	38.0 ± 0.7^{d}	36.2 ± 0.4^{Y}	9.1	1.3	0.5	16.1	7.6	0.20	2.68	10.4
	AV.	35.7 ± 0.7^{C}	45.6 ± 0.6^{A}	39.1 ± 0.8^{B}	46.3 ± 0.9^{A}	42.5 ± 0.4	9.9	7.2	4.2	5.8	4.9	1.61	1.72	17.1

Cont.Table (3): The third generation

periods (Wk)	Sex	Genotypes				Overall mean	Straight bred difference	Reciprocal effect	Heterosis percentage			Potency ratio		Direct Additive effect
		Parental strains		Reciprocal crosses										
		B x B	W x W	7/8 B x 1/8W	7/8 Wx1/8 B				H 1%	H 2%	A.D.O.H%	P 1	P 2	
Growth period 4-8	M	$28.9\pm.1^{cd}$	46.1 ± 1.2^{a}	45.0 ± 2.1^{a}	48.8 ± 2.1^{a}	42.2 ± 0.9^{X}	17.2	3.8	1.8	70.1	26.1	0.46	7.57	21.0
	F	26.1 ± 0.8^{d}	31.5 ± 0.6^{c}	25.8 ± 0.8^{d}	39.7 ± 1.4^{b}	30.5 ± 0.5^{Y}	5.4	13.9	27.0	-16.2	5.6	03.3	-1.06	19.3
	AV.	27.4 ± 0.7^{D}	37.7 ± 0.7^{B}	34.8 ± 1.5^{C}	45.2 ± 1.4^{A}	36.0 ± 0.5	10.3	10.4	17.7	20.8	19.0	9.71	4.29	20.7
8-12	M	56.6 ± 1.9^{a}	61.4 ± 1.4^{a}	44.1 ± 3.2^{b}	60.3 ± 1.9^{a}	57.9 ± 1.0^{X}	4.8	16.2	-3.4	-16.7	-9.5	0-2.1	-2.42	21.0
	F	40.6 ± 1.4^{b}	42.2 ± 1.3^{b}	45.3 ± 2.1^{b}	29.7 ± 1.8^{c}	40.3 ± 0.8^{Y}	1.6	-15.6	-26.0	16.6	-5.1	-5.10	3.69	-14.0
	AV.	47.9 ± 1.3^{AB}	50.4 ± 1.1^{A}	44.7 ± 1.9^{C}	48.1 ± 1.9^{AB}	48.6 ± 0.7	2.5	3.4	-3.3	-1.3	-2.4	-2.54	0.23	5.9
4-12	M	42.8 ± 1.1^{b}	53.8 ± 0.6^{a}	44.5 ± 1.9^{b}	54.6 ± 0.9^{a}	50.0 ± 0.6^{X}	11.0	10.1	-1.1	12.1	4.4	-0.43	1.55	21.1
	F	33.4 ± 0.8^{d}	36.8 ± 0.6^{c}	35.5 ± 1.0^{cd}	34.7 ± 0.7^{cd}	35.4 ± 0.4^{Y}	3.4	-0.8	-2.7	1.9	-0.4	-0.83	0.45	2.6
	AV.	37.6 ± 0.8^{B}	44.0 ± 0.7^{A}	39.7 ± 1.1^{B}	46.6 ± 1.0^{A}	42.3 ± 0.4	6.4	6.9	5.8	7.3	6.5	51.0	-4.50	13.3
Rearing period 12-16	M	40.9 ± 2.1^{c}	55.2 ± 1.8^{a}	47.2 ± 1.9^{b}	55.1 ± 2.3^{a}	50.5 ± 1.1^{X}	14.3	7.9	-12.0	-5.1	-8.9	-1.01	-0.29	22.2
	F	28.2 ± 1.4^{d}	37.9 ± 1.1^{c}	34.7 ± 1.8^{c}	47.5 ± 1.7^{b}	36.2 ± 0.8^{Y}	9.7	12.8	13.0	0.6	7.4	1.31	0.03	22.5
	AV.	34.0 ± 1.3^{D}	45.3 ± 1.1^{B}	40.5 ± 1.5^{C}	52.1 ± 1.5^{A}	43.0 ± 0.7	11.3	11.6	2.4	-2.4	0.2	0.21	-0.13	22.9
16-20	M	40.7 ± 1.7^{b}	46.3 ± 1.6^{a}	37.9 ± 1.1^{bc}	46.7 ± 1.5^{a}	44.0 ± 0.9^{X}	5.6	8.8	2.4	-1.6	0.6	1.57	0.27	14.4
	F	22.4 ± 1.2^{d}	34.1 ± 0.8^{c}	25.2 ± 1.7^{d}	24.8 ± 2.0^{d}	28.5 ± 0.7^{Y}	11.7	-0.4	-30.0	-9.4	-20.9	-7.89	-0.48	11.3
	AV.	30.7 ± 1.2^{B}	39.3 ± 0.9^{A}	31.2 ± 1.2^{B}	38.0 ± 1.5^{A}	35.8 ± 0.6	8.6	6.8	-4.5	-4.4	-4.5	-3.60	-0.74	15.4
.12-20	M	40.80 ± 1.22^{b}	50.7 ± 1.0^{a}	50.9 ± 1.3^{a}	42.5 ± 1.0^{b}	47.3 ± 0.6^{X}	9.9	-8.4	-21.4	15.4	-4.9	-3.41	2.06	1.5
	F	25.30 ± 1.0^{e}	36.0 ± 0.7^{c}	36.2 ± 1.5^{c}	30.0 ± 1.3^{d}	32.4 ± 0.6^{Y}	10.7	-6.2	-22.6	16.2	-5.3	-3.18	0.86	4.5
	A	32.4 ± 1.0^{D}	42.3 ± 0.7^{B}	45.0 ± 1.0^{A}	35.9 ± 1.1^{C}	39.4 ± 0.5	9.9	-9.1	-20.8	21.3	-1.9	-3.10	1.68	0.8
whole period 4-20	M	41.8 ± 0.8^{b}	52.3 ± 0.5^{a}	52.7 ± 0.5^{a}	43.5 ± 1.0^{b}	48.6 ± 0.4^{X}	10.5	-9.2	-20.4	25.8	-0.4	-4.74	108	1.3
	F	29.3 ± 0.6^{e}	36.4 ± 0.3^{c}	35.4 ± 0.7^{c}	32.7 ± 0.6^{d}	33.9 ± 0.3^{Y}	7.1	-2.7	-12.1	7.3	-3.0	-5.62	0.65	4.4
	AV.	35.0 ± 0.7^{D}	43.2 ± 0.5^{B}	45.8 ± 0.9^{A}	37.8 ± 0.8^{C}	40.9 ± 0.4	8.2	-8.0	-15.5	23.6	2.2	-4.48	4.27	0.2

M, F and AV. **= Male, Female and Average, H 1% and H 2 % = heterosis for (7/8 W x 1/8 B) and (7/8 B x 1/8W backcrosses,**
A.D.O.H%, P1 and P 2 = average degree of heterosis and potency ratio for (7/8 W x 1/8 B) and (7/8 B x 1/8W) backcrosses,
-The first parent of each cross was the sire.
- Means in columns (X – Y) or rows (A- D) each trait having the same superscripts are non significant at $p \leq 0.05$
- Means of the interactions of genotypes x sex in each trait having the same small superscripts are non significant at $p \leq 0.05$.

Cont.Table (3): Mean± standard errors for body weight gain, g/period at the different periods studied for the three generations

Traits	Body weight gain, g/period						
	Growth period, wk			Rearing period, wk			whole period, wk
Generations	4-8	8-12	4-12	12-16	16-20	12-20	4-20
Gn1	1004.35 ± 14.95	1176.88 ± 18.89^{y}	2181.23 ± 27.22^{y}	1513.05 ± 26.74^{x}	1072.75 ± 21.14^{x}	2585.80 ± 36.60^{x}	4767.03 ± 48.43^{x}
Gn2	984.40 ± 13.35	1352.31 ± 19.83^{x}	2336.71 ± 26.23^{x}	1411.49 ± 22.91^{y}	1012.26 ± 17.70^{y}	2423.75 ± 31.42^{y}	4760.46 ± 46.16^{x}
Gn3	1008.54 ± 15.01	1360.78 ± 20.00^{x}	2369.33 ± 24.66^{x}	1203.37 ± 20.09^{z}	1002.26 ± 17.18^{y}	2205.63 ± 28.41^{z}	4574.96 ± 43.00^{y}

- Means in each column having the same superscripts are non significant at $p \leq 0.05$.

Table (4): Significance of the main factors and the different interactions between them for body weight gain at different periods studied

S.O.V	d. f	Body weight gain, g/period						
		Growth period			Rearing period			whole period
		4-8 wk	8-12 wk	4-12 wk	12- 16 wk	16 - 20 wk	12 -20 wk	4-20 wk
G n	2	NS	**	**	**	**	**	**
G t	3	**	**	**	**	**	**	**
S	1	**	**	**	**	**	**	**
G n x G t	6	**	**	**	**	**	**	**
G n x S	2	**	**	**	NS	**	NS	**
G t x S	3	**	**	**	NS	NS	NS	**
G n x G t x S	6	**	**	**	**	*	**	**

- Generation: Gn , Genotype: Gt , and Sex: S ,
* Genotype 1: White Nicholas (WW), and Gt. 4: Black Baladi (BB), at the 1st generation: Gt. 2: (½ WW x ½ BB) and Gt3: (½ BB x ½ WW), at the 2nd generation, Gt. 2: (3/4 WW x 1/4 BB), Gt. 3:(3/4BBx 1/4 WW), and at the 3rd generation,(7/8 WW x 1/8 BB) Gt. 3: (7/8BBx 1/8 WW)
˙The first parent of each backcross denote to the sire parent,
- All main factors had Significant ($p \leq 0.01$) effects on the different traits except that of body weight gain at 4-8 wks of age which was not affected significantly by generation,
* Significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, NS: non significant.

3-Growth rate (G R) :

Results in Table (5) showed that birds of the pure BB grew through the growth period (4-8, 8-12, 4-12 and at 4-20 wks of age) significantly faster compared to the other three genotypes, while GR cf those produced from mating toms of WW with pure BB pullets (1/2W x 1/2 B) was significantly the highest at the rearing period (12 -16 and 16-20 weeks of age). However, birds of BB strain had the highest average of GR compared to the other genotypes where they were approximately equal. In the first backcross (generation 2), same trend was found as in the 1st generation, where BB birds grew faster either through the growth or the whole periods compared to the pure WW birds and the reciprocal crosses. Males surpassed females in GR in all periods studied. There were significant interaction between genotype and sex where males of pure BB realized the highest GR in the whole period studied thought generations one and two, while both pure birds WW and BB had the highest GR at the same period.

With respect to the 3rd generation, the pure WW birds had the highest GR average in the early period of growth (4-8weeks) compared to the other three genotypes where they were approximately equal. No significant differences between GR of birds of either pure BB or WW strains were found at 4-12, 16-20 and 4-20 wks of age they surpassed both the backcrosses (7/8 W x 1/8 B and 7/8 B x 1/8 W) in growth rate through 12-16 and 12-20 weeks of age. Males grew approximately as females during the early periods of growth (4-8 , 8-17and 12-16) weeks of age and thus they surpassed females throughout the later periods of age (16-20)wks .Males were significantly faster in growth than females at the whole period studied (4-20 weeks). There were significant interactions between genotype and sex in all periods of age which studied although no significant affect was found at the whole period (4-20 weeks of age). These results are in agreement with those reported by Mostafa and Nofal (2000) who found that White Holland poults had higher growth rate than Broad Breast Bronze at 16-20, 20-24 and 16-24 weeks of age. The overall means of growth rate for males were significantly higher than those for females at 4-8, 16-20 and 20-24 weeks of age. These results are in agreement with those reported by Amin. (1999), Emmersen *et al.* (1991 and 2002), Nestor *et al.*, (2004) and Amin. (2008).

Results of Table 5 showed that Strait-bred differences, maternal additive effect, heterosis H1% and H2%, ADOH %, P1 and P2 and direct additive effect at the different periods studies had other trend compared to body weight and body weight gain. In the first generation wide variation of values and direction were found concerning heterosis of growth rate throughout the different ages studied and estimates of direct additive were negative at all ages except at 12-16 wks of age. Negative values were found for all traits studied through the growth periods except the reciprocal effect on females which had positive values -14.1, -3.9, –13.1 %, -10.3 %, -11.7 %, -2.5, - 1.9, -1.7 and -1.8 at 4-12 week of age, respectively). On the other hand, positive values (5.6, 9.2, 36.2%, 19.9%, 28.0 % ,7.2, 4.0 and 14.8 were found for the aforementioned traits, respectively, at 12-20 week of age). These results indicated that over dominance effects were towards the high parent. However, these values was decreased in the second and third generations which indicate that there were partial dominance and over dominance effects towards the low (B B) depending on the value of Potency ratio (P1 =-0.7 and P1=1.8) in the sound and third generations, respectively. Aly *et al.* (2005) reported that different Egyptian strains of chicken can used as a good combiner for growth breeding. Nestor *et al.* (2001) found that percentage of heterosis at the variance ages which they studied ranged from 2.6 to 4.9 %.

Table (5): Mean± standard errors for growth rate percentage, Strait-bred differences, heterosis percentages, average degree of heterosis, potency ratio, maternal additive and direct additive effects at the different ages studied for the two parental strains and their crossbred for both males and females in the first generation

periods (wk)	Sex	Genotypes				Overall mean	Straight bred difference	Reciprocal effect	Heterosis percentage			Potency ratio		Direct Additive effect
		Parental strains		Reciprocal crosses										
		B x B	W x W	1/2 B x 1/2W	1/2 W x 1/2 B				H 1%	H 2%	A.D.O.H%	P 1	P 2	
Growth period 4-8	M	102.7±1.6^{a}	92.4±1.2^{bc}	91.7±2.5^{d}	86.8±1.7^{de}	93.6±0.9^{x}	-10.3	-4.9	-11.0	-6.0	-8.5	-2.09	-1.14	-15.2
	F	97.2±1.5^{b}	90.9±1.7^{d}	81.3±2.5^{g}	84.8±1.8^{ef}	89.9±1.0^{y}	-6.3	3.5	-9.8	-13.6	-11.7	-2.94	-4.05	-2.8
	AV.	99.9±1.1^{A}	91.8±1.0^{B}	86.90±1.8^{C}	85.8±1.2^{C}	91.9±0.7	-8.1	-1.1	-10.5	-9.3	-9.9	-2.48	-2.21	-9.2
8-12	M	70.5±1.7^{a}	55.4±1.1^{b}	52.7±2.6^{b}	41.6±1.6^{d}	55.4±1.0^{x}	-15.1	-11.1	-33.9	-16.3	-25.1	-2.83	-1.36	-26.2
	F	66.6±1.7^{a}	50.1±1.8^{bc}	43.2±1.5^{d}	46.1±1.7^{cd}	53.6±1.1^{x}	-16.5	2.9	-21.0	-26.0	-23.5	-1.48	-1.84	-13.6
	AV.	68.5±1.2^{A}	53.5±1.0^{B}	48.3±1.6^{C}	43.8±1.2^{D}	54.6±0.7	-15.0	-4.5	-28.2	-20.8	-24.5	-2.29	-1.69	-19.5
4-12	M	146.1±1.4^{a}	130.7±1.2^{c}	128.9±1.7^{c}	117.6±1.5^{d}	131.1±0.9^{x}	-15.4	-11.3	-15.0	-6.9	-10.9	-2.70	-1.23	-26.7
	F	140.4±1.5^{b}	126.1±1.8^{c}	114.3±2.2^{d}	118.8±1.8^{d}	127.1±1.1^{y}	-14.3	4.5	-10.8	-14.2	-12.5	-2.02	-2.65	-9.8
	AV.	143.1±1.1^{A}	129.0±1.0^{B}	122.1±1.6^{C}	118.2±1.2^{D}	129.2±0.7	-14.1	-3.9	-13.1	-10.3	-11.7	-2.53	-1.98	-18.0
Rearing period 12-16	M	35.8±1.3^{c}	40.4±1.5^{bc}	44.0±2.1^{b}	57.4±1.7^{a}	44.3±0.9^{x}	4.6	13.4	50.7	15.5	33.1	8.39	2.57	18.0
	F	29.9±1.2^{d}	37.0±1.9^{c}	53.4±1.6^{a}	53.9±1.8^{a}	42.0±1.0^{x}	7.1	0.5	61.1	59.6	60.4	5.76	5.62	7.6
	AV.	32.7±0.9^{D}	39.2±1.2^{C}	48.4±1.4^{B}	55.6±1.2^{A}	43.2±0.7	6.5	7.2	54.7	34.6	44.6	6.05	3.83	13.7
16-20	M	23.6±0.9^{ab}	22.6±1.1^{abc}	21.4±1.5^{abc}	24.4±1.1^{a}	23.2±0.6^{x}	-1.0	3.0	5.6	-7.4	-0.9	2.60	3.40-	2.0
	F	20.3±0.9^{bc}	19.5±1.1^{c}	20.5±1.1^{bc}	23.6±1.0^{ab}	21.2±0.5^{x}	-0.8	3.1	18.6	3.0	10.8	9.25	1.50	2.3
	AV.	21.9±0.6^{B}	21.5±0.8^{AB}	21.0±1.0^{B}	24.0±0.7^{A}	22.3±0.4	-0.4	3.0	10.6	-3.2	3.7	11.50	3.50-	2.6
12-20	M	58.1±1.3^{de}	61.4±1.7^{cd}	63.8±2.1^{c}	78.9±1.7^{a}	65.6±0.9^{x}	3.3	15.1	32.1	6.8	19.4	11.61	2.45	18.4
	F	49.3±1.4^{f}	55.4±2.0^{e}	71.9±1.4^{b}	74.8±1.9^{ab}	61.6±1.1^{y}	6.1	2.9	42.9	37.3	40.1	7.36	6.41	9.0
	AV.	53.6±1.0^{D}	59.2±1.3^{C}	67.6±1.4^{B}	76.8±1.3^{A}	63.7±0.7	5.6	9.2	36.2	19.9	28.0	7.29	4.00	14.8
whole period 4-20	M	168.4±0.9^{a}	159.5±1.0^{b}	159.5±1.4^{b}	159.4±1.0^{b}	161.9±0.6^{x}	-8.9	-0.1	-2.8	-2.7	-2.7	1.02-	1.00--	-9.0
	F	161.6±0.0^{b}	154.0±1.6^{c}	154.4±1.4^{c}	158.5±1.0^{b}	158.1±0.6^{y}	-7.6	4.1	0.4	-2.2	-0.9	-0.18	0.89-	-3.5
	AV.	164.9±0.7^{A}	157.5±0.9^{B}	157.1±1.0^{B}	158.9±0.7^{B}	160.1±0.4	-7.4	1.8	-1.4	-2.5	-2.0	0.62-	1.11-	-5.6

Cont. Table (5): the second generation

periods (wk)	Sex	Genotypes				Overall mean	Straight bred difference	Reciprocal effect	Heterosis percentage			Potency ratio		Direct Additive effect
		Parental strains		Reciprocal crosses										
		B x B	W x W	3/4 B x 1/4W	3/4 W x 1/4 B				H1 %	H 2%	A.D.O.H%	P 1	P 2	
Growth period 4-8	M	98.4 ± 1.6^{a}	90.0 ± 1.6^{bc}	63.7 ± 3.2^{f}	94.6 ± 1.6^{ab}	85.7 ± 1.1	-8.4	30.9	7.0	-33.0	-13.7	3.87	9.36-	22.5
	F	98.2 ± 1.6^{a}	85.7 ± 1.1^{cd}	99.4 ± 1.8^{a}	81.3 ± 1.1^{e}	87.7 ± 1.0	-12.5	-18.1	-4.6	10.8	3.3	-8.78	1.14	-30.6
	AV.	90.0 ± 1.6^{A}	87.7 ± 1.0^{B}	83.0 ± 2.8^{C}	87.1 ± 1.1^{B}	89.8 ± 0.6	-2.3	4.1	0.4	-6.2	-2.9	0.37	-3.52	1.8
8-12	M	67.7 ± 1.3^{a}	62.0 ± 1.3^{ab}	67.1 ± 1.0^{a}	57.8 ± 2.3^{b}	57.2 ± 1.1	-5.7	-9.3	11.6	11.5	11.5	0.59	0.92	-15.0
	F	62.4 ± 1.7^{ab}	57.2 ± 1.1^{b}	49.9 ± 3.0^{c}	51.2 ± 1.8^{c}	59.5 ± 0.9	-5.2	1.3	-0.9	-5.5	-3.2	-0.08	-0.30	-3.9
	AV.	62.0 ± 1.3^{A}	59.5 ± 0.9^{B}	57.8 ± 2.0^{B}	54.0 ± 1.4^{C}	59.6 ± 0.6	-2.5	-3.8	4.5	4.8	4.7	0.30	-0.39	-6.3
4-12	M	142.1 ± 1.3^{a}	133.5 ± 1.0^{b}	117.9 ± 2.1^{d}	134.1 ± 1.3^{b}	$127.3\pm0.9x$	-8.6	16.2	6.8	-13.0	-3.5	1.08	-2.67	7.6
	F	139.5 ± 0.9^{a}	127.3 ± 0.9^{c}	132.7 ± 1.7^{b}	119.7 ± 1.4^{d}	130.3 ± 0.7^{y}	-12.2	-13.0	-2.7	4.6	1.0	-0.79	0.46	-25.2
	AV.	133.5 ± 1.0^{A}	130.3 ± 0.7^{A}	125.9 ± 1.6^{B}	125.9 ± 1.1^{B}	131.6 ± 0.5	-3.2	0.0	1.3	-1.5	-0.1	0.27	-0.33	-3.2
Rearing period 12-16	M	37.1 ± 1.4^{bc}	37.0 ± 1.1^{bc}	47.1 ± 2.2^{a}	40.3 ± 1.5^{bc}	41.8 ± 1.4^{x}	-0.1	-6.8	-14.6	16.2	-0.4	-0.68	1.90	-6.9
	F	32.6 ± 1.2^{c}	41.8 ± 1.4^{b}	36.8 ± 1.4^{bc}	41.7 ± 1.6^{bc}	39.5 ± 0.9^{y}	9.2	4.9	-12.9	-14.4	-13.6	1.02	-0.60	14.1
	AV.	37.0 ± 1.1^{B}	39.5 ± 0.9^{A}	41.5 ± 1.4^{A}	41.1 ± 1.1^{A}	38.8 ± 0.5	2.5	-0.4	-13.6	-2.8	-8.5	-0.80	-0.21	2.1
16-20	M	23.2 ± 0.7^{ab}	19.8 ± 0.7^{b}	21.0 ± 0.9^{ab}	19.3 ± 0.7^{c}	20.2 ± 0.7	-3.4	-1.7	-12.7	-5.8	-9.2	-1.22	1.44	-5.1
	F	20.5 ± 1.0^{a}	20.2 ± 0.7^{ab}	23.3 ± 2.5^{a}	23.2 ± 1.2^{ab}	20.0 ± 0.5	-0.3	-0.1	5.9	13.7	9.7	-0.76	+++	-0.4
	AV.	19.8 ± 0.7	20.0 ± 0.5	22.2 ± 1.4	21.5 ± 0.8	21.0 ± 0.3	0.2	-0.7	-2.3	8.8	3.1	-0.25	3.00	-0.5
12-20	M	58.9 ± 1.4^{bc}	55.7 ± 1.0^{cd}	66.2 ± 2.4^{a}	$58.4\pm.6$	60.6 ± 1.2	-3.2	-7.8	-13.2	7.9	-3.1	-0.77	1.98	-11.0
	F	52.1 ± 1.5^{d}	60.6 ± 1.2^{bc}	58.6 ± 2.6^{bc}	62.8 ± 2.2^{ab}	58.3 ± 0.8	8.5	4.2	-7.2	-5.5	-6.4	-0.69	-0.34	12.7
	AV.	55.7 ± 1.0^{C}	58.3 ± 0.8^{B}	62.1 ± 1.8^{A}	60.9 ± 1.4^{AB}	58.5 ± 0.8	2.6	-1.2	-9.8	0.7	-4.8	-0.72	0.08	1.4
whole period 4-20	M	166.3 ± 0.7^{a}	159.5 ± 0.6^{cd}	154.3 ± 1.2^{c}	161.2 ± 0.6^{bc}	157.6 ± 0.6	-6.8	6.9	1.1	-5.3	-2.1	35.00	-2.53	0.1
	F	162.3 ± 0.5^{b}	157.6 ± 0.6^{d}	160.2 ± 1.1^{bc}	154.0 ± 0.8^{e}	158.5 ± 0.4	-4.7	-6.2	-2.6	1.2	-0.7	-9.00	-0.47	-10.9
	AV.	159.5 ± 0.6^{A}	158.5 ± 0.4^{B}	157.5 ± 0.9^{B}	157.1 ± 0.6^{B}	159.6 ± 0.3	-1.0	-0.4	-1.0	-0.5	-0.8	-8.00	-0.67	-1.4

Cont. Table (5): The third generation

period (wk)	Sex	Genotypes: Parental strains: B x B	W x W	Reciprocal crosses: 7/8 Bx1/8W	7/8Wx1/8 B	Overall mean	Straight bred difference	Reciprocal Effect	Heterosis percentage: H 1%	H 2%	A.D.O.H%	Potency ratio: P 1	P 2	Direct Additive effect
Growth period 4-8	M	91.0±2.5^{abc}	102.8±1.7^{a}	102.8±3.2^{a}	91.2±2.5^{b}	97.0±1.1	11.8	-11.6	-7.6	32.9	10.2	-1.83	1.9	0.2
	F	97.9±1.5^{ab}	97.1±1.4^{abc}	89.6±2.3^{c}	100.1±2.2^{a}	96.8±0.9	-0.8	10.5	12.2	-9.2	1.0	1.38	-1.2	9.7
	AV.	94.8±1.4^{B}	99.5±1.1^{A}	95.8±2.1^{B}	94.8±1.8^{B}	96.9±0.7	4.7	-1.0	1.6	7.8	4.6	0.24	1.2	3.7
8-12	M	75.9±1.8^{a}	63.3±1.6^{cd}	49.4±3.0^{e}	57.9±2.1^{d}	63.5±1.1	-12.6	8.5	-4.4	-30.9	-18.7	-0.96	-5.0	-4.1
	F	67.4±1.7^{bc}	59.6±1.3^{d}	69.5±2.3^{b}	40.4±2.5^{f}	60.2±1.0	-7.8	-29.1	-27.1	18.5	-3.6	-3.57	1.2	-36.9
	AV.	71.3±1.3^{A}	61.2±1.0^{B}	60.1±2.2^{B}	50.9±1.8^{C}	61.8±0.7	-10.1	-9.2	-11.6	-6.9	-9.1	-1.86	-0.7	-19.3
4-12	M	142.2±1.6^{a}	143.2±0.9^{a}	135.2±2.1^{bc}	132.5±1.1^{c}	139.4±0.7^{X}	1.0	-2.7	-4.4	4.0	-0.4	-1.35	0.42	-1.7
	F	141.8±1.2^{a}	136.7±1.0^{b}	137.7±1.6^{b}	127.9±1.4^{d}	137.0±0.6^{Y}	-5.1	-9.8	-0.2	0.3	0.1	-0.04	0.10	-14.9
	Bold	142.0±1.0^{A}	139.5±0.7^{A}	136.5±1.3^{B}	130.7±0.7^{C}	138.1±0.5	-2.5	-5.8	-1.5	1.9	0.2	-0.29	0.32	-8.3
Rearing period 12-16	M	33.6±1.7^{bc}	35.20±1.1^{bc}	36.2±1.5^{bc}	33.7±1.4^{bc}	34.5±0.7	1.6	-2.5	-10.7	-10.3	-10.5	-1.59	-0.61	-0.9
	F	30.4±1.4^{c}	35.5±1.2^{bc}	34.1±2.1^{bc}	42.30±1.5^{a}	34.9±0.8	5.1	8.2	9.6	1.5	5.8	1.19	-0.16	13.3
	AV.	31.8±1.1^{B}	35.4±0.8^{A}	35.1±1.3^{A}	37.1±1.1^{A}	34.7±0.5	3.6	2.0	-3.0	-4.2	-3.6	-0.40	-0.32	5.6
16-20	M	24.90±1.04^{a}	22.3±0.7^{ab}	21.8±0.7^{b}	21.7±0.7^{b}	22.8±0.4^{X}	-2.6	-0.1	4.3	-5.0	-0.6	0.60	0.59	-2.7
	F	18.68±0.84^{S}	23.5±0.5^{ab}	18.6±1.1^{c}	16.3±1.1^{c}	20.5±0.4^{Y}	4.8	-2.3	-30.2	-11.4	-21.3	-47.0	-1.03	2.5
	AV.	21.5±0.7^{A}	23.0±0.4^{A}	20.1±0.7^{B}	19.5±0.7^{B}	21.6±0.3	1.5	-0.6	-12.4	-8.0	-10.2	-3.67	-5.00	0.9
12-20	M	57.21±1.6^{a}	56.39±1.0^{a}	56.9±1.5^{ab}	54.3±1.3^{ab}	56.2±0.7^{X}	-0.8	-2.6	-5.4	-7.8	-6.6	-3.08	-1.07	-3.4
	F	48.2±.5^{c}	57.6±1.2^{a}	51.7±2.3^{bc}	57.4±2.0^{a}	54.3±0.8^{Y}	9.4	5.7	-4.7	-3.2	-4.0	-1.08	-0.33	15.1
	AV.	52.3±1.1B	57.1±0.8^{A}	54.1±1.5^{AB}	55.6±1.1^{AB}	53.6±0.5	4.8	1.5	-5.8	-5.4	-5.6	-1.79	-0.63	6.3
whole period 4-20	M	165.8±0.9^{a}	166.1±0.5^{a}	161.3±1.2^{b}	158.4±0.6^{c}	163.6±0.4^{X}	0.3	-2.9	-3.2	0.8	-1.2	-2.14	0.22	-2.6
	F	162.5±0.6^{b}	162.8±0.6^{b}	160.9±0.9^{b}	156.6±1.0^{c}	161.5±0.4^{Y}	0.3	-4.3	-1.1	-0.3	-0.7	-0.41	-0.39	-4.0
	AV.	164.0±0.6^{A}	164.1±0.43^{A}	161.1±0.7^{B}	157.7±0.6^{C}	162.5±0.3	0.1	-3.4	-1.8	0.2	-0.8	-0.83	0.11	-3.3

M, F and AV. = Male, Female and Average, H 1% and H 2 % = heterosis for (7/8 W x 1/8 B) and (7/8 B x 1/8W backcrosses,
A.D.O.H%, P1 and P 2 = average degree of heterosis and potency ratio for (7/8 W x 1/8 B) and (7/8 B x 1/8W) backcrosses,
-The first parent of each cross was the sire.
- Means in columns (X – Y) or rows (A- D) each trait having the same superscripts are non significant at $p \leq 0.05$.
- Means of the interactions of genotypes x sex in each trait having the same small superscripts are non significant at $p \leq 0.05$.

Cont. Table (5): Mean± standard errors for growth rate percentage at the different periods studied for the three generations

Traits / Generations:	Growth rate percentage: Growth period, wk: 4-8	8-12	4-12	Rearing period, wk: 12-16	16-20	12-20	whole period: 4-20
Gn1	91.87±0.65^{y}	54.55±0.72^{z}	129.24±0.69^{z}	43.22±0.69^{x}	22.29±0.38^{x}	63.73±0.72^{x}	160.11±0.42^{y}
Gn2	89.84±0.65^{z}	59.57±0.60^{y}	131.62±0.50^{y}	38.84±0.53^{y}	21.01±0.34^{y}	58.52±0.57^{y}	159.61±0.29^{y}
Gn3	96.90±0.73^{x}	61.77±0.74^{x}	138.13±0.48^{x}	34.72±0.52^{z}	21.59±0.31^{xy}	55.18±0.53^{z}	162.49±0.29^{x}

- Means in each column having the same superscripts are non significant at $p \leq 0.05$.

Table (6): Significance of the main factors and the different interactions between them for growth rate percentage at different periods studied

S.O.V	d. f	Growth rate percentage						
		Growth period			Rearing period			whale period
		4-8 wk	8-12 wk	4-12 wk	12-16 wk	16 - 20 wk	12 -20 wk	4-20 wk
G n	2	**	**	**	**	*	**	**
G t	3	**	**	**	**	NS	**	**
S	1	*	**	**	NS	**	**	**
G n x G t	6	**	**	**		**	**	**
G n x S	2	**	**	**	NS	**	**	NS
G t x S	3	**	**	**	**	**	**	**
G n x G t x S	6	**	**	**	**	**	**	**

- Generation: Gn , Genotype: Gt , and Sex: S ,

*Genotype 1: White Nicholas (WW), and Gt. 4: Black Baladi (BB), at the 1st generation: Gt. 2: (½ WW x ½ BB) and Gt3: (½ BB x ½ WW), at the 2nd generation, Gt. 2: (3/4 WW x 1/4 BB), Gt. 3:(3/4BBx 1/4 WW), and at the 3rd generation,(7/8 WW x 1/8 BB) Gt. 3: (7/8BBx 1/8 WW)

'The first parent of each backcross denote to the sire parent,

- All the interactions between factors had Significant ($p \leq 0.01$) effects on the different traits except that of growth rate percentage growth traits, 12-16 wk and 4-20 wk of age which was not affected significantly by Gn x S interaction,

* Significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, NS: non significant.

4- Growth efficiency percentage (GEP) :

Table (7) shows that 1/2 W x 1/2 B cross had the highest (P<0.01) means (3.2 %) of GEP at 4-12 weeks of age compared to the other three genotypes. On the opposite, these three genotypes had the highest (P<0.01) means (0.8%, 0.8 % and 0.8 %), respectively, at 12-20 weeks of age compared to 1/2 W x 1/2 B cross. The difference between overall means of GEP for both sexes was significant at all periods studied except for 12-16 and 12-20 weeks of age.

As for the second generation, no significant differences between the pure strains and backcrosses at 4-12 and 12-20 weeks of age but the pure strain BB had the highest significant means (2.0%, 1.0 % and 2.5 %) of GEP at growth periods (4-8, 4-12 and 4-12 weeks of age, respectively), while backcross (3/4 w x 1/4 B) had the highest significant means (0.5 %, 0.3 and 0.8%) in the rearing periods (12-16, 12-12 and 12-20 weeks of age, respectively), and no significant difference between the two backcrosses was found in the same period.

In general the pure strain BB had the highest significant means (5.5 %, 5 % and 5.2 %) of GEP at whole period (4-20 wks of age) in the 1st, 2nd, 3rd generations, respectively, followed by pure strain W W (3.8% , 3.9 and 4.9 %, respectively) while all crosses and backcrosses had significantly the lowest means of GEP in the three generations.

The difference between overall means of GEP for both sexes was significant at all periods studied except for 12-16 and 12-20 weeks of age in the three generation.

Table (7): Mean± standard errors for growth efficiency percentage, Strait-bred differences, heterosis percentages, average degree of heterosis, potency ratio, maternal additive and direct additive effects, at the different ages studied for the two parental strains and their crossbred for both males and females in the first generation

period (wk)	Sex	Genotypes				Overall mean	Straight bred difference	Reciprocal effect	Heterosis percentage			Potency ratio		Direct Additive effect
		Parental strains		Reciprocal crosses										
		B x B	W x W	1/2 B x 1/2W	1/2 W x 1/2 B				H 1%	H 2%	A.D.O.H%	P 1	P 2	
Growth	M	2.2±0.1^{a}	1.8±0.04^{bc}	1.8±0.1^{b}	1.6±0.1^{d}	1.9±0.03^{X}	-0.4	-0.2	-20.0	-10.0	-15.0	-2.00	-1.00	-0.6
period	F	2.0±0.1^{a}	1.7±0.1^{cd}	1.4±0.1^{e}	1.6±0.1^{d}	1.7±0.03^{Y}	-0.3	0.2	-13.5	-24.3	-18.9	-1.67	-3.00	-0.1
4-8	AV.	2.1±0.1^{A}	1.8±0.03^{B}	1.6±0.1^{B}	1.6±0.04^{B}	1.8±0.02	-0.3	0.0	-17.9	-17.9	-17.9	-2.33	-2.33	-0.3
8-12	M	1.2±0.1^{a}	0.8±0.02^{b}	0.8±0.1^{b}	0.6±0.03^{c}	0.8±0.02^{X}	-0.4	-0.2	-40.0	-20.0	-30.0	-2.00	-1.00	-0.6
	F	1.1±0.0^{a}	0.7±0.03^{bc}	0.6±0.02^{c}	0.6±0.03^{c}	0.8±0.02^{Y}	-0.4	0.0	-33.3	-33.3	-33.3	-1.50	-1.50	-0.4
	AV.	1.1±0.0^{A}	0.8±0.02^{B}	0.7±0.03^{C}	0.6±0.02^{C}	0.8±0.02	-0.3	-0.1	-36.8	-26.3	-31.6	-2.33	-1.67	-0.4
4-12	M	3.0±0.1^{ab}	2.7±0.1^{b}	2.8±0.2^{b}	3.3±0.1^{a}	3.0±0.1^{X}	-0.3	0.5	15.8	-1.8	7.0	3.00	-0.33	0.2
	F	2.1±0.1^{c}	2.2±0.2^{c}	2.7±0.1^{b}	3.1±0.1^{ab}	2.5±0.1^{Y}	0.1	0.4	44.2	25.6	34.9	19.00	11.00	0.5
	AV.	2.6±0.1^{B}	2.5±0.1^{B}	2.8±0.1^{B}	3.2±0.1^{A}	2.8±0.1	-0.1	0.4	25.5	9.8	17.6	13.0	5.00	0.3
Rearing	M	0.5±0.02^{d}	0.5±0.03^{d}	0.6±0.04^{c}	0.9±0.04^{a}	0.6±0.02^{X}	0.0	0.3	80.0	20.0	50.0	+++	+++	0.3
period	F	0.4±0.02^{e}	0.5±0.03^{d}	0.7±0.03^{bc}	0.8±0.04^{ab}	0.6±0.02^{X}	0.1	0.1	77.8	55.6	66.7	7.00	5.00	0.2
12-16	AV.	0.4±0.01^{D}	0.5±0.0[illegible]	0.7±0.03^{B}	0.8±0.03^{A}	0.6±0.01	0.1	0.1	77.8	55.6	66.7	7.00	5.00	0.2
16-20	M	0.3±0.01^{a}	0.3±0.01	0.3±0.02^{a}	0.3±0.02^{a}	0.3±0.01^{X}	0.0	0.0	0.0	0.0	0.0	+++	+++	0.0
	F	0.2±0.01^{b}	0.2±0.01^{b}	0.2±0.01^{b}	0.3±0.01^{a}	0.2±0.01^{Y}	0.0	0.1	50.0	0.0	25.0	+++	+++	0.1
	AV.	0.3±0.01^{A}	0.3±0.01^{A}	0.2±0.01^{B}	0.3±0.01^{A}	0.3±0.01	0.0	0.1	0.0	-33.3	-16.7	+++	+++	0.1
12-20	M	0.8±0.01^{a}	0.8±0.00^{a}	0.8±0.01^{a}	0.74±0.01^{b}	0.79±0.00^{X}	0.0	-0.1	-7.5	0.0	-3.8	+++	+++	-0.1
	F	0.8±0.01^{a}	0.8±0.01^{a}	0.7±0.01^{b}	0.74±0.01^{b}	0.77±0.00^{X}	0.0	0.0	-7.5	-12.5	-10.0	+++	+++	0.0
	AV.	0.8±0.00	0.8±0.00	0.8±0.01	0.7±0.0	0.8±0.0	0.0	-0.1	-12.5	0.0	-6.3	+++	+++	-0.1
whole	M	5.9±0.2^{a}	4.0±0.1^{c}	3.8±0.2^{c}	3.0±0.1^{d}	4.2±0.1^{X}	-1.9	-0.8	-39.4	-23.2	-31.3	-2.05	-1.21	-2.7
period	F	5.1±0.2^{b}	3.6±0.14^{c}	2.8±0.1^{c}	3.2±0.1^{d}	3.9±0.1^{Y}	-1.5	0.4	-26.4	-35.6	-31.0	-1.53	-2.07	-1.1
4-20	AV.	5.5±0.1^{A}	3.8±0.1^{B}	3.3±0.1^{C}	3.1±0.1^{C}	4.1±0.1	-1.7	-0.2	-33.3	-29.0	-31.2	-1.82	-1.59	-1.9

Cont. Table (7): The second generation

periods (wk)	Sex	Genotypes: Parental strains B x B	Genotypes: Parental strains W x W	Genotypes: Reciprocal crosses 3/4 B x 1/4W	Genotypes: Reciprocal crosses 3/4 W x 1/4 B	Overall mean	Straight bred difference	Reciprocal effect	Heterosis percentage H 1%	Heterosis percentage H 2%	Heterosis percentage A.D.O.H%	Potency ratio P 1	Potency ratio P 2	Direct Additive effect
Growth	M	2.0 ± 0.1^{a}	1.8 ± 0.1^{b}	1.0 ± 0.1^{c}	1.9 ± 0.1^{ab}	1.8 ± 0.0^{X}	-0.2	0.9	11.8	-47.4	-19.4	2.0	-9.0	0.7
period	F	2.0 ± 0.1^{a}	1.6 ± 0.0^{b}	2.0 ± 0.1^{a}	1.4 ± 0.0^{c}	1.7 ± 0.0^{X}	-0.4	-0.6	-12.5	17.6	3.0	++	1.0	-1.0
4-8	AV.	2.0 ± 0.0^{A}	1.7 ± 0.0^{B}	1.6 ± 0.1^{B}	1.6 ± 0.0^{B}	1.7 ± 0.0	-0.3	0.0	-3.0	-11.1	-7.2	-1.0	-1.0	-0.3
8-12	M	1.1 ± 0.0^{a}	0.9 ± 0.0^{b}	1.0 ± 0.0^{a}	0.9 ± 0.0^{ab}	1.0 ± 0.0^{X}	-0.2	-0.1	20.0	5.3	11.8	1.0	0.4	-0.3
	F	0.9 ± 0.0^{b}	0.8 ± 0.0^{c}	0.7 ± 0.1^{d}	0.7 ± 0.0^{d}	0.8 ± 0.0^{Y}	-0.1	0.0	0.0	-6.7	-3.4	0.0	-0.4	-0.1
	AV.	1.0 ± 0.0^{A}	0.9 ± 0.0^{B}	0.9 ± 0.0^{B}	0.8 ± 0.0^{C}	0.9 ± 0.0	-0.1	-0.1	6.7	5.9	6.3	0.4	0.4	-0.2
4-12	M	2.8 ± 0.1^{a}	2.4 ± 0.1^{bcd}	2.4 ± 0.1^{bcd}	2.6 ± 0.1^{ab}	2.5 ± 0.1^{X}	-0.4	0.2	-8.8	-14.3	-11.5	-0.7	++	-0.2
	F	2.2 ± 0.1^{bcd}	2.5 ± 0.1^{bc}	2.3 ± 0.1^{bcd}	2.1 ± 0.1^{d}	2.3 ± 0.1^{Y}	0.3	-0.2	-25.0	-6.1	-16.2	-2.4	-0.6	0.1
	AV.	2.5 ± 0.1	2.4 ± 0.1	2.4 ± 0.1	2.3 ± 0.1	2.4 ± 0.0	-0.1	-0.1	-17.9	-9.4	-13.8	-1.3	-1.7	-0.2
Rearing	M	0.5 ± 0.0^{b}	0.5 ± 0.0^{b}	0.6 ± 0.0^{a}	0.5 ± 0.0^{b}	0.5 ± 0.0^{X}	0.0	-0.1	-28.6	9.1	-12.0	-1.0	1.07	-0.1
period	F	0.4 ± 0.0^{c}	0.6 ± 0.0^{a}	0.5 ± 0.0^{b}	0.6 ± 0.0^{a}	0.5 ± 0.0^{X}	0.2	0.1	-14.3	-9.1	-12.0	-1.0	-0.4	0.3
12-16	AV.	0.4 ± 0.0^{B}	0.5 ± 0.0^{A}	0.5 ± 0.0^{A}	$0.5\pm u.0^{A}$	0.5 ± 0.0	0.1	0.0	-23.1	-9.1	-16.7	-1.0	-0.4	0.1
16-20	M	0.3 ± 0.0^{a}	0.2 ± 0.0^{b}	0.2 ± 0.0^{b}	0.2 ± 0.0^{b}	0.2 ± 0.0^{X}	-0.1	0.0	-20.0	-33.3	-27.3	1.0		-0.1
	F	0.2 ± 0.0^{b}	0.2 ± 0.0^{b}	0.3 ± 0.0^{a}	0.3 ± 0.0^{a}	0.3 ± 0.0^{Y}	0.0	0.0	20.0	50.0	33.3	-1.0	++	0.0
	AV.	0.3 ± 0.0^{A}	0.2 ± 0.0^{B}	0.3 ± 0.0^{A}	0.3 ± 0.0^{A}	0.2 ± 0.0	-0.1	0.0	20.0	20.0	20.0	-1.0	1.0	-0.1
12-20	M	0.8 ± 0.0^{a}	0.8 ± 0.0^{a}	0.7 ± 0.0^{b}	0.8 ± 0.0^{a}	0.8 ± 0.0^{X}	0.0	0.1	3.9	-12.5	-4.5	1.0	++	0.1
	F	0.8 ± 0.0^{a}	0.8 ± 0.0^{a}	0.8 ± 0.0^{a}	0.8 ± 0.0^{a}	0.8 ± 0.0^{X}	0:0	0.0	3.9	6.7	5.3	1.0	1.0	0.0
	AV.	0.8 ± 0.0	0.8 ± 0.0	0.8 ± 0.0	0.8 ± 0.0	0.8 ± 0.0	0.0	0.0	6.7	0.0	3.2	1.0	!++	0.0
whale	M	5.2 ± 0.1^{a}	4.2 ± 0.1^{b}	3.0 ± 0.2^{d}	4.2 ± 0.1^{b}	4.3 ± 0.1^{X}	-1.0	1.2	16.7	-33.3	-11.1	1.00	-2.2	0.2
period	F	4.7 ± 0.1^{a}	3.6 ± 0.1^{c}	4.1 ± 0.2^{b}	3.1 ± 0.1^{d}	3.8 ± 0.1^{Y}	-1.1	-1.0	-8.8	9.3	0.7	-1.50	0.4	-2.1
4-20	AV.	5.0 ± 0.1^{A}	3.9 ± 0.1^{B}	3.6 ± 0.1^{C}	3.6 ± 0.1^{C}	4.1 ± 0.0	-1.1	0.0	2.9	-13.3	-5.9	0.25	0.6	-1.1

Cont. Table (7): The third generation

period (wk)	Sex	Genotypes				Overall mean	Straight bred difference	Reciprocal effect	Heterosis percentage			Potency ratio		Direct Additive effect
		B x B	W x W	7/8 B x 1/8W	7/8 W x 1/8 B				H 1%	H 2%	A.D.O.H%	P 1	P 2	
Growth period 4-8	M	1.8±0.1^{c}	2.3±0.1^{a}	2.3±0.1^{a}	1.8±0.1^{c}	2.1±0.1^{X}	0.5	-0.5	-14.3	64.3	17.1	-1.5	2.2	0.0
	F	2.0±0.1^{b}	2.0±0.1^{b}	1.7±0.1^{c}	2.1±0.1^{ab}	2.0±0.0^{X}	0.0	0.4	23.5	-15.0	2.7	1.3	00	0.4
	AV.	1.9±0.1^{B}	2.1±0.0^{A}	2.0±0.1^{A}	1.9±0.1^{B}	2.0±0.0	0.2	-0.1	2.7	14.3	8.3	0.2	1.7	0.1
8-12	M	1.3±0.1^{a}	1.0±0.0^{c}	0.7±0.1^{d}	0.9±0.1^{c}	1.0±0.0^{X}	-0.3	0.2	-5.3	-39.1	-23.8	-1.0	-3.0	-0.1
	F	1.1±0.0^{b}	0.9±0.0^{c}	1.1±0.1^{b}	0.5±0.0^{e}	0.9±0.0^{Y}	-0.2	-0.6	-37.5	22.2	-5.9	-3.0	1.0	-0.8
	AV.	1.2±0.0^{A}	0.9±0.0^{B}	0.9±0.1^{B}	0.7±0.0^{C}	1.0±0.0	-0.3	-0.2	-17.6	-14.3	-15.8	-3.0	-1.0	-0.5
4-12	M	2.5±0.2^{abc}	2.7±0.1^{a}	2.4±0.1^{abc}	2.0±0.1^{e}	2.5±0.1^{X}	0.2	-0.4	-24.5	-2.0	-13.7	-13.	1.0	-0.2
	F	2.1±0.1^{e}	2.4±0.1^{abc}	2.2±0.1^{bce}	2.5±0.1^{abc}	2.3±0.1^{Y}	0.3	0.3	11.1	0.0	5.6	1.7	0.0	0.6
	AV.	2.3±0.1^{AB}	2.5±0.1^{A}	2.3±0.1^{AB}	2.2±0.1^{B}	2.4±0.0	0.2	-0.1	-8.3	-2.1	-5.3	-2.0	-1.0	0.1
Rearing period 12-16	M	0.4±0.0^{c}	0.4±0.0^{c}	0.5±0.0^{b}	0.4±0.0^{c}	0.4±0.0^{X}	0.0	-0.1	-11.1	0.0	-5.3	-1.0	0.0	-0.1
	F	0.4±0.0^{c}	0.5±0.0^{b}	0.4±0.0^{c}	0.6±0.0^{a}	0.4±0.0^{X}	0.1	0.2	9.1	-11.1	0.0	1.0	-1.0	0.3
	AV.	0.4±0.0^{B}	0.5±0.0^{A}	0.4±0.0^{B}	0.5±0.0^{A}	0.4±0.0	0.1	0.1	0.0	-11.1	-5.3	.0.0	-1.0	0.2
16-20	M	0.3±0.0^{a}	0.3±0.0^{a}	0.3±0.0^{a}	0.3±0.0^{a}	0.3±0.0^{X}	0.0	0.0	20.0	20.0	20.0	-1.0	1.0	0.0
	F	0.2±0.0^{b}	0.3±0.0^{a}	0.2±0.0^{b}	0.2±0.0^{b}	0.2±0.0^{Y}	0.1	0.0	-33.3	-20.0	-27.3	.00	-1.0	0.1
	AV.	0.3±0.0^{A}	0.3±0.0^{A}	0.2±0.0^{B}	0.2±0.0^{B}	0.3±0.0	0.0	0.0	-33.3	-33.3	-33.3	.00	00	0.0
12-20	M	0.8±0.0^{a}	0.8±0.0^{a}	0.8±0.0^{a}	0.8±0.0^{a}	0.8±0.0^{X}	0.0	0.0	0.0	6.7	3.2	00	1.0	0.0
	F	0.8±0.0^{a}	0.8±0.0^{a}	0.8±0.0^{a}	0.8±0.0^{a}	0.8±0.0^{X}	0.0	0.0	0.0	0.0	0.0	00	00	0.0
	AV.	0.8±0.0	0.8±0.0	0.8±0.0	0.8±0.0	0.8±0.0	0.0	0.0	0.0	0.0	0.0	00	00	0.0
whole period 4-20	M	5.3±0.2^{a}	5.2±0.1^{a}	4.5±0.2^{bc}	4.0±0.1^{cd}	4.9±0.1^{X}	-0.1	-0.5	-14.9	8.4	-4.0	-1.4	0.3	-0.6
	F	5.1±0.1^{a}	4.6±0.1^{b}	4.6±0.2^{b}	3.6±0.1^{d}	4.6±0.1^{Y}	-0.5	-1.0	-6.5	0.0	-3.0	-0.3	0.0	-1.5
	AV.	5.2±0.1^{A}	4.9±0.1^{B}	4.5±0.1^{C}	3.9±0.1^{D}	4.7±0.1	-0.3	-0.6	-8.2	2.3	-2.9	-0.5	0.1	-0.9

M, F and AV. = Male, Female and Average, H 1% and H 2 % = heterosis for (7/8 W x 1/8 B) and (7/8 B x 1/8W backcrosses,
A.D.O.H%, P1 and P 2 = average degree of heterosis and potency ratio for (7/8 W x 1/8 B) and (7/8 B x 1/8W) backcrosses,
-The first parent of each cross was the sire.
- Means in columns (X – Y) or rows (A- D) each trait having the same superscripts are non significant at ≤ 0.05 .
- Means of the interactions of genotypes x sex in each trait having the same small superscripts are non significant at p ≤ 0.05.

Cont. Table (7): Mean± standard errors for growth efficiency percentage at the different periods studied for the three Generations

Traits	Growth efficiency percentage						
	Growth period			Rearing period			whole period
Generations:	4-8 wk	8-12 wk	4-12 wk	12-16 wk	16-20 wk	12-20	4-20
Gn1	1.79±0.02^{y}	0.80±0.02^{z}	2.75±0.05^{x}	0.59±0.01^{x}	0.26±0.01^{x}	0.78±0.00^{z}	4.05±0.06^{y}
Gn2	1.72±0.02^{z}	0.88±0.01^{y}	2.42±0.04^{y}	0.50±0.01^{y}	0.24±0.00^{xy}	0.79±0.00^{y}	4.07±0.04^{y}
Gn3	2.01±0.03^{x}	0.95±0.02^{x}	2.37±0.04^{y}	0.44±0.01^{z}	0.25±0.00^{y}	0.82±0.00^{x}	4.73±0.05^{x}

- Means in each column having the same superscripts are non significant at p ≤ 0.05.

As for GEP of Strait-bred differences, heterosis percentages, ADOH %, potency ratio, and maternal additive and direct additive effects, at the different ages studied in the three generations were varied in decreasing in values from one generation to another and the best result was found in the first generation at the age of 12 - 16 week. No changes in the values of Strait-bred through the three generations was found, however maternal additive and direct additive effects in the first generation and the third generation at the same ages. The H1% and H2%, ADOH% and P1 and P2 had positive values (77.8 %, 55.6 %, 66.7 % 7.00 and 5.00) at 12-16 week of age, respectively), in the first generation, negative values in the second one (-23.1%, -9.1%, -16.7 %, -1.0 and -0.4, respectively, and at the third generation (0.0%, -11.1%, -5.3 %, 0.0 and -1.0 at 12-16 week of age, respectively. These results indicated that over dominance effects were towards high parent in the first generation, furthermore, complete dominance towards the low parent in the second and third generations depending on the values of (P1 and P2) in each generation.

Table (8): Significance of the main factors and the different interactions between them for growth efficiency percentage at different periods studied

S.O.V	d. f	Growth efficiency percentage						
		Growth period			Rearing period			whole period
		4-8 wk	8-12 wk	4-12 wk	12- 16 wk	16 - 20 wk	12 -20 wk	4-20 wk
Gn	2	**	**	**	*	**	**	**
Gt	3	**	**	**	*	**	**	**
S	1	**	**	**	NS	**	**	**
Gn x Gt	6	**	**	**	**	**	**	**
Gn x S	2	NS	*	NS	*	NS	**	NS
Gt x S	3	**	**	**	**	**	**	**
Gn x Gt x S	6	**	**	**	**	**	**	**

- Generation: Gn , Genotype: Gt , and Sex: S ,

*Genotype 1: White Nicholas (WW), and Gt. 4: Black Baladi (BB), at the 1st generation: Gt. 2: (½ WW x ½ BB) and Gt3: (½ BB x ½ WW), at the 2nd generation, Gt. 2: (3/4 WW x 1/4 BB), Gt. 3:(3/4BBx 1/4 WW), and at the 3rd generation,(7/8 WW x 1/8 BB) Gt. 3: (7/8BBx 1/8 WW)

˙The first parent of each backcross denote to the sire parent,

* Significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, NS: non significant.

It could be concluded that the backcrosses for one generation between local Black Baladi and White Nicholas strains of turkey as a sire parent with (1/2B x 1/2W) and (1/2W x 1/2B) crosses as a dam parent, improved body weight, body weight gain, growth rate Moreover, backcrosses produced progenies have a black feather which has more acceptability by consumers in Egypt.

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تأثير خلط الرومي المحلى الأسود (البرونزي) مع النيـوكلس الأبـيض علـى النمـو والصفات التناسلية.
٢- تأثير الخلط الرجعى لمدة جيلين على صفات النمو

عماد محمد أمين
محطة بحوث مريوط - مركز بحوث الصحراء- وزارة الزراعة

أجريت هذة الدراسة في محطة بحوث مريوط بمنطقة العامرية - التابعة لمركز بحوث الصحراء- وزارة الزراعة لمدة ثلاث سنوات بهدف دراسة نتائج الخلط الرجعى لذكور كل من الرومي النيوكلس الأبيض WW والرومي المحلى الأسود BB مع إناث كل من خليط (ذكور نيوكلس x إناث البلدي الأسود) وخليط (ذكور البلدي الأسود x إناث النيوكلس) على الترتيب لمدة جيلين من الخلط الرجعى وأوضحت النتائج الاتى:-

أن الرومي النيوكلس الأبيض كان الأثقل وزنا معنويا عند مختلف الأعمار التي درست في الجيل الأول مقارنة بالرومى المحلى الأسود والخليط والخليط العكسى بينما وجد أن عند أستخدام ذكور النيوكلس الأبيض فى خلط رجعى لمدة جيلين مع الإناث الخليطة لنفس الأب أدى ذلك إلى تحسين متوسط وزن جسم للأبناء الناتجة فى الجيل الثانى والثالث (3/4 W x 1/4 B) و(7/8 W x 1/8 B) عند كل الأعمارالتى تم دراستها، كما حققت الذكور الناتجة أعلى متوسط وزن جسم مقارنة بالتراكيب الوراثية الأخرى. وقد أخذت الزيادة فى وزن الجسم نفس الاتجاة حيث حقق النيوكلس الأبيض أعلى زيادة في وزن الجسم في الجيل الأول عند معظم الأعمار المدروسة بينما حقق الخليط 3/4W x 1/ 4 B فى الجيل الثانى و الخليط 7/B W x 1/8 B فى الجيل الثالث أعلى .زيادة فى وزن الجسم مقارنة بالتراكيب الوراثية الأخرى فى الجيلين.

حقق الرومي البلدى الأسود نموا أسرع من النيوكلس الأبيض و الخليط والخليط العكسى خلال فترة النمو فى الجيل الأول والثانى بينما فى الجيل الثالث حقق الرومى البلدى الأسود والنيوكلس الأبيض أعلى معدل نمو مقارنة بالتراكيب الوراثية الأخرى، وعلى العكس فى فترة الرعاية (١٢- ٢٠ اسبوع) حيث كانت سرعة نمو البلدى الاسود أقل مقارنة بالتراكيب الوراثية الأخرى. تفوقت الذكور عن الإناث فى معدل النمو فى الفترات (٤- ١٢ و ١٢- ٢٠ و ٤- ٢٠) أسابيع من العمر. حققت طيور الرومى المحلى الأسود أعلى كفاءة نمو خلال مرحلة النمو فى الثلاث أجيال عدا الفترة ٤ - ٨ أسابيع من العمر بالجيل الثالث حيث كانت طيور النيوكلس الأبيض والخليط الرجعي (7/8 W x 1/8B) الأفضل بالنسبة لفترة الرعاية لأنة قد حدث تباين فى تفوق التراكيب الوراثية المختلفة خلال تلك الفترة. تفوقت الذكور عن الأناث فى الثلاث أجيال (٤,٢ مقابل ٣,٩%) و (٤,٣ مقابل%٣,٨) و (٤,٩ مقابل ٤,٦%) على الترتيب. ومن نتائج قياس قوة الهجين ومتوسط درجة قوة الهجين ومقياس درجة السيادة لكل من التراكيب الوراثية(1/2 w x 1/2B) و(1/2B x 1/2W) يتضح عدم وجود سيادة إتجاة الأب الأعلى فى وزن الجسم ولكن كان هناك سيادة جزئية وسيادة كاملة إتجاة الأب المنخفض فى وزن الجسم فيما عدا ذكور الخليط (1/2 W x 1/2B) عند عمر ٤ أسابيع التى حققت قيم موجبة.

تفوق الخليط 3/4 W x 1/4 B فى قوة الهجين لوزن الجسم عند ٨ أسابيع عن الخليط 3/4 w x 1/4 B ولكن وجد العكس عند عمر ٤ أسابيع وتفوق أيضا عنه فى قيمة مقياس درجة السيادة مما يدل أن هناك سيادة فائقة إتجاه الأب الأعلى فى وزن الجسم عند أعمار ٤ و ٨ و ٢٠ أسبوع من العمر ، ولكن كان هناك سيادة كاملة إتجاة الأب الأعلى فى وزن الجسم عند عمر ١٢ و ١٦أسبوع من العمر .

انخفض متوسط درجة السيادة لوزن الجسم فى الجيل الثالث عن الجيل الثانى عند كل الأعمار التى تم درستها فيما عدا وزن الجسم عند عمر ٨ أسابيع. بصفة عامة حقق الجيل الثانى أعلى قيم لقوة الهجين ومتوسط قوة الهجين ومقياس درجة السيادة لصفة الزيادة فى وزن الجسم لكل من االخليط والخليط العكسى. بالنسبة لصفة كفائة النمو دلت النتائج أن هناك سيادة فائقة إتجاه الأب الأعلى فى الجيل الأول، وكان هناك سيادة كاملة أتجاة الأب المنخفض فى الجيل الثانى والثالث أعتمادا على قيم مقياس درجة السيادة لكل جيل .

يمكن القول أن خلط رجعى لمدة جيل واحد فقط باستخدام ذكور النيوكلس الأبيض وذكور الرومى البرونزى مع إناث الخليط (1/2 w x 1/2B) و (1/2B x 1/2W) يؤدى الى تحسين وزن الجسم والزيادة فى وزن الجسم ومعدل النمو علاوة على أن الأبناء فى F2 ذات ريش أسود مما يقبل عليها المستهلك المصرى .