J. of Animal and Poultry Production, Mansoura Univ., Vol . 14(1):1 -5 , 2023

Journal of Animal and Poultry Production

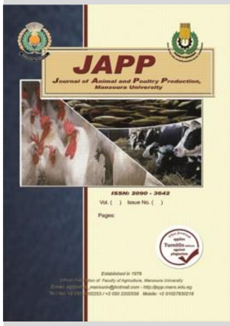
Journal homepage & Available online at: www.jappmu.journals.ekb.eg

Effect of crossing on some productive and reproductive traits between two varieties of Japanese quail.

Cross Mark

Abdel-Moutalib, A. A. *; D. I. Aboul-Seoud and M. A. Aboul-Hassan

Department of Animal Production, Faculty of Agriculture, Al-Azhar University, Nasr City, Egypt.



ABSTRACT

A crossbreeding experiment was carried out using two selected lines of Japanese quail (the brown line and the white line; lines were established for egg and meat production). A total of 2450 crossbred birds of quail produced from four mating groups (two groups for pure birds and other two groups for cross lines) among three hatches were used in the present study to estimate direct heterosis, direct additive, and maternal effects on the following traits: growth traits: body weight at 0, 2, 4, and 6 weeks of age and average daily gain at different growth intervals (ADG_{0-2}, ADG_{2-4}, ADG_{4-6}, and ADG_{0-6})and carcass traits: slaughter weight (SW), meat (M%), bone (B%), giblets (G%), and dressing percentages (D%). Results showed that crossing sires of BB with WW dams had the highest body weights and body weight gains recorded from hatch to 6 weeks of age, followed by reciprocal crossing between sires of WW with BB dams. Except for BW4 and body weight gains calculated between different growths periods studied, most body weights recorded at different ages showed a highly significant positive direct heterosis effect. Crossing sires of BB with WW dams had the highest carcass performance, followed by reciprocal crossing between sires of WW with BB dams. The majority of carcass traits studied showed a positive direct heterosis effect, with the exception of M% and G%, where direct heterosis was non-significant.

Keywords: crossing, two varieties, productive traits.

INTRODUCTION

Quails have the advantages of a rapid growth rate, good reproductive potential, a short life cycle, low feed requirements, good meat taste, better laying ability, and a shorter time for hatching as compared with different species of poultry, so it is considered a pilot animal for poultry breeding investigations (Shaban, 2021).

Crossing procedures typically result in better economic performance due to hybrid vigor. However, crossbreeding is a very effective method for obtaining different recombinations of genetic materials, resulting in increased heterozygosis and a tendency to cover up recessive genes, decreasing breeding purity, and eliminating families in one generation. Breeding usually improves the performance of the different characters by selection and/or crossing to obtain different degrees of heterosis. That is to say, by directing the additive and non-additive genes to better performance of the different traits. The additive nature of genetic variation for growth has resulted in dramatic body weight improvement in Japanese quail (Marks, 1978, 1990, and Nestor *et al.,* 1982).

The non-additive genetic effect is important in meat and laying strains because of the opportunities to combine strains that complement each other. This allows the development of mating combinations for rapid growth, yield, and other important economic traits (Marks, 1995). Most available estimates of heterosis for body weight in Japanese quail were observed in reciprocal crosses of two quail lines, both selected for high body weight (Biak and Marks, 1993 and 1995), or crossing lines of high and low body weight (Gerken *et al*., 1988; Barden and Marks, 1989; and Marks, 1993).

MATERIALS AND METHODS

Data used in the present study were collected on the flock of two lines of Japanese quail (BB&WW) were selected for egg and meat production maintained by the Department of Animal Production, Faculty of Agriculture, Al-Azhar University. Cairo, Egypt. Crossbreeding experiment was carried out using two selected lines of Japanese quail BB x WW, its reciprocal cross WW x BB.

The distribution of birds produced in each hatch and breed group are presented in Table (1).

Table 1. Distribution of birds produced from crossbreds among different lines and hatches.

Mating groups	BB		WW		BB X WW		WW X BB		Total	
Hatch	M	F	M	F	M	F	M	F	M	F
1	105	115	100	105	95	100	90	95	390	415
2	110	120	110	115	95	95	100	95	415	425
3	100	105	100	100	100	105	95	100	395	410
Total	315	340	310	320	290	300	285	290	1200	1250

M: Males, F: Females.

Eggs were collected for hatch when the females were 10 to 12 weeks of age, marked, and incubated for 15 days, after incubation the eggs were transferred to the hatcher, and 3 days later all chicks were removed from the hatcher. Immediately after hatching individual quail birds were permanently identified by wing - bands and placed in quail battery brooders, where they remained for 4 weeks period. All birds were housed in the same room in order to

* **Corresponding author.**
E-mail address: ahmedabd@azhar.edu.eg
DOI: 10.21608/jappmu.2023.183451.1065

that temperature, humidity, light intensity and other variables would be as similar as possible. However, environment and management practices were at conventional levels throughout the whole study. At 5 weeks of age, the males were separated from the females and at 6 weeks of age, birds were divided into four groups. (BB, WW, BB x WW and WW x BB)

All birds were sexed according to plumage color and pattern at the same time, all chicks were taken and moved to individual laying cages and stud mating started about two weeks later. Feed and water were provided *ad libitum*. The experimental diet contained 28% protein and 2920 kcal of ME/ Kg until two weeks of age and 25% protein with 2850 kcal of ME/Kg during 3-6 weeks of age, then changed to a ration containing 20% protein with 2820 Kcal of ME / Kg during the egg production period.

The temperature started at 36°c for the first week after hatching, then decreased 2-3°c weekly to 26-28°c at the fourth week of age till the end of the brooding period.

Statistical analysis:

Data of individual body weight, daily gains and carcass traits were analyzed using Henderson's Method III (Henderson, 1984) by using the following mixed model (Harvey 1990).

$$Y_{ikpmq} = \mu + G_i + S_k + SE_p + H_m + e_{ikpmq}$$

Where:

Y_{ikpmq} = the observation on the kpmq th trait;
μ = overall mean, common element to observations,
G_i = fixed effect of the i^{th} mating groups,
S_k = random effect of k^{th} sire,
SE_p = fixed effect of the p^{th} sex;
H_m =fixed effect of the m^{th} hatch,
e_{ikpmq} = random deviation of the q^{th} growth and carcass traits distributed, i.e. N.D (0, σ^2e).

Crossbreeding components for growth and carcass traits were estimated according to Dickerson (1992) was used to analyze the crossbreeding data as:

Pure lines differences:

$$PU_{BB \times WW} = [(BBxBB) - (WWxWW)].$$

Direct heterosis effect:

$$H^I_{BB \times WW} = [(BB \times WW) + (WW \times BB) - (BB \times BB) - (WW \times WW)].$$

$$H^I\% = H^I \text{ in units}/0.5[(BB \times BB) + (WW \times WW)] \times 100.$$

Direct additive effect:

$$(G^I_{BB} - G^I_{WW}) = [(BB \times WW) + (BB \times WW)] - [(WW \times WW) + (WW \times BB)].$$

Maternal additive effect:

$$(G^M_{BB} - G^M_{WW}) = (BB \times BB) - (WW \times WW),$$

where:

G^I and G^M represent direct additive and maternal additive effects, of the subscript breed (genetic) group.

RESULTS AND DISCUSSION

Crossbreeding effects:

Growth traits:

The least-square means and standard errors (SE) for body weights recorded at different ages and daily weight gain calculated among the different growth periods studied are given in (Tables 2 and 3). Crossing sires of BB with WW dams had the highest body weights and body weight gains recorded from hatch to 6 weeks of age, followed by reciprocal crossing between sires of WW with BB dams. However, significant differences in growth traits due to the mating group were observed

Table 2. Least-square means of body weight traits between different mating groups ± SE, heterosis (H^I), maternal additive effect (G^M) and direct additive effect (G^I).

Mating groups:	No.	BW_0 Mean ± SE	BW_2 Mean ± SE	BW_4 Mean ± SE	BW_6 Mean ± SE
BB x WW	460	10.2 ± 0.41	55.4 ± 4.22	106.8 ± 4.32	196.2 ± 7.17
WW x BB	400	9.3 ± 0.62	50.6 ± 4.96	98.9 ± 5.35	190.1 ± 6.31
Pure breed effect		11.28 ± 4.22***	9.21 ± 3.11**	2.18 ± 3.32^{ns}	20.21 ± 3.18***
Direct heterosis (H^i) Unit		9.86 ± 4.01*	17.28 ± 3.66***	2.22 ± 3.16^{ns}	18.96 ± 4.13***
Percentage		40.1 %	21.3 %	18.0 %	18.1%
Direct additive effect (G^i)		4.99 ± 3.22**	10.22 ± 2.21**	28.11 ± 3.69***	22.51 ± 2.14***
Maternal additive effect (G^m)		-2.11 ± .01^{ns}	2.17 ± 1.36^{ns}-	-6.23 ± 10.11*	-7.23 ± 2.63***

***=P≤ 0.05or **= P≤ 0.01or ***= P≤ 0.001, ^{ns}=Non- significant.**

Table 3. Least-square means of daily weight gain traits between the different mating groups ± SE, heterosis (H^I), maternal additive effect (G^M) and direct additive effect (G^I).

Mating groups:	No.	ADG_{0-2} Mean ± SE	ADG_{2-4} Mean ± SE	ADG_{4-6} Mean ± SE	ADG_{0-6} Mean ± SE
BB x WW	460	2.6 ± 1.22	4.6 ± 0.21	6.7 ± 0.71	4.3 ± 0.11
WW x BB	400	2.4 ± 2.01	4.3 ± 1.63	6.3 ± 0.90	4.0 ± 0.19
Pure breed effect		10.31 ± 1.22***	12.88 ± 2.11***	7.21 ± 1.12*	10.31 ± 2.11***
Direct heterosis (H^i) Unit		12.72 ± 1.98***	9.14 ± 1.66**	1.91 ± 0.98^{ns}	13.01 ± 2.56***
Percentage		17.2 %	13.6 %	10.2 %	7.31%
Direct additive effect (G^i)		4.36 ± 0.92**	7.21 ± 1.21**	10.17 ± 1.66**	8.11 ± 1.22***
Maternal additive effect (G^m)		-6.22 ± 1.92**	-0.20 ± 0.78^{ns}	-6.21± 1.33**	-0.19 ± 0.91^{ns}

***=P≤ 0.05or **= P≤ 0.01or ***= P≤ 0.001, ^{ns}=Non- significant**

The results of a significant effect of the mating guild (MG) on growth traits of Japanese quail strains were also confirmed by different authors **(**Larson *et al.,* 1986; El-Naggar *et al.,* 1992; Barbour and Liibum, 1995; Mandour *et al.,* 1996; Bahie El-Deen *et al.,* 1998; Sherif *et al.,* 1998; Aboul-Hassan, 2001; Abdel-Ghany *et al.,* 2004; Nofal, 2006).

Direct heterosis:

Estimates of direct heterosis calculated in units (g) and percentages (%) for body weights recorded at different ages and body weight gains calculated among different growth periods studied are presented in (Tables 2 and 3). However, these traits showed a highly significant positive direct heterosis effect for most body weights recorded at different ages, except BW4 and body weight gains calculated among different growth periods studied. *Estimated heterosis percentages for BW0 and BW2 were (40.1 and 21.3%), respectively, and fell to (18 and 18.1%) for BW4 and BW6.* However, heterosis percentage estimates for body weight gains were high at ADG0-2, ADG2-4 (17.2 and 13.6%), and fell to 10.2 and 7.31%) at ADG0-6 and ADG4-6.

Such superiority of cross lines over their parental lines points to considerable non-additive genetic line effects. In this respect, Bahie El-Deen *et al.,* (1998) and Aboul-Hassan (2001) observed that heterosis contrasts were significant for BW0, BW2, and BW4 (P≤0.001) and BW6 (P≤0.01).

Maeda *et al.*, (1988) and Sato *et al.*, (1990) indicated the presence of heterotic effects in the body weights of quail recorded at different ages. Marks (1995) crossed lines of quails over the long term for increased body weight, but that was dependent on both environments and age as well as the genetics of populations. He crossed medium-weight quails (selected for high BW4) with quails of heavy strain and reported that considerable heterosis was present for body weights.

Damme (1994) reported that heterosis for BW1 to BW6 ranged between 0.6 and 2.7%, and it was significant for BW2. Bahie El-Deen *et al.*, (1998) indicated that heterosis percentage estimates for body weight were high at BW2 (30.2%) and declined to 11.8% at BW6. Heterosis contrast was significant for BW2, BW4 (P≤0.001), and BW6 (P≤0.01) but not for ADG2–6. Furthermore, Bahie El-Deen, (1994) and Nofal, (2006) when crossing two lines of quails, one selected for high BW6 and the other selected for high egg production, noticed negative heterosis for growth traits.

On the contrary, Gerken *et al*., (1988) suggested that heterosis was not significant for body weight from 25 to 49 days of age in diallel crosses among two randomly bred control lines and a line selected for large body weight.

Direct additive effect:

The direct additive effect for all body weights recorded at different ages and all body weight gains calculated between different growth periods studied were significant, and they ranged between 4.99 for BW0 and 28.11 for BW4, and between 4.36 for ADG0-2 and 10.17% for ADG4-6 (Tables 2 and 3).

The same trend was also observed by Bahie El-Deen *et al*., (1998) and Nofal, (2006). They recorded that the direct additive effect on body weight at market age of M-sired quails was significantly different from quails sired by E-line. Sire-line linear contrasts indicate that E-sired quails were significantly superior in BW6 (P≤0.05) and ADG2-6 (P≤0.01). At 4 weeks of age, direct genetic effects were also pronounced in favour of E-sires, while at younger ages, M-sires were better than E-sires.

Aboul-Hassan, (2001) clarified that the body weights and body weight gains of B-sired quails were significantly different from quails sired by the W strain. Sire-line linear contrasts show that quails sired by the W strain were significantly superior in most growth traits studied (P≤0.01), with the exception of BW0 and BW2, which favoured quails sired by the B strain.

Maternal additive effect:

Maternal additive had a significant negative effect on most body weights recorded at different ages and body weight gains calculated between different growth periods studied, except for BW0, BW2, ADG2-4, and ADG4-6, and they ranged between -6.23 for BW4 and -7.23 for BW6 and between -6.22 for ADG0-2 and -6.21 for ADG4-6 (Tables 2 and 3). However, using BB quails as a dam line in crossbreeding programmes to produce quails with heavy weights and increased gains may be effective. The same trend was watched by Bahie El-Deen *et al*., (1998). Evidence for the significant maternal effects on body weight was obtained by Biak and Marks, (1993). They reported significant reciprocal effects between the HW and LW crosses in diallel crosses of Japanese quail lines divergently selected for BW.

On the contrary, Chahil *et al.,* (1975) found that no maternal effects in BW5 in a 3 x 3 diallel cross of three random quail mating populations. Nofal, (2006) crossed the M line (selected for meat production) and the E line (selected for egg production), and reciprocal crosses reported that maternal additive had a non-significant effect on all growth traits (BW0, BW6, and ADG0-6). However, this insignificant influence of the maternal additive could be expected since this component is being diminished as birds advance in age.

Carcass traits:

The least-square means and standard errors (SE) for carcass traits studied, i.e., slaughter weight (SW), meat% (M%), bone% (B%), giblets% (G%), and dressing percentages (D%) are given in Table (4). The crossbreds produced from siring BB with WW dams had the highest carcass traits except for B%, and the crossbreds produced from siring WW with BB dams had the lowest carcass traits except for B%. However, significant differences due to mating groups (MG) on carcass traits were observed. The same trend was reported by Shalan, (1998) and Abdel-Mounsif (2005).

On the other hand, Sharaf *et al.*, (2006), when they crossed three coloured varieties of Japanese quails (Brown, Golden, and White), stated that carcass traits did not express any significant values between purebreds, crossbreds, and reciprocals, while edible percentages were the highest in purebreds (8.99%).

Table 4. Least-square means of carcass traits among the different mating groups ± SE, heterosis (H^I), maternal additive effect (G^M) and direct additive effect (G^I).

Traits Mating groups:	No.	SWMean ± SE	M%Mean ± SE	B%Mean ± SE	G%Mean ± SE	D%Mean ± SE
BB x WW	6	190.6 ± 2.03	64.2 ± 2.89	13.2 ± 8.10	9.2 ± 4.18	73.2 ± 5.12
WW x BB	6	180.1 ± 2.99	62.7 ± 4.16	13.6 ± 10.12	8.0 ± 5.61	70.9 ± 6.01
Pure breed effect		-30.5 ± 4.92***	-14.6 ± 10.22**	-0.7 ± 2.82^{ns}	-2.0 ± .92^{ns}	-2.1± 1.68^{ns}
Direct heterosis (H^i) Unit		30.2 ± 9.81***	1.9 ± 5.11^{ns}	7.9 ± 6.22**	2.2 ± 0.72^{ns}	9.3 ± 1.99**
Percentage		20.8	14.6	30.2	16.0	14.6
Direct additive effect (G^i)		-42.6 ± 18.11***	-28.2 ±10.16***	-10.4 ±4.80**	-8.2 ± 0.92*	-3.2 ± 2.08^{ns}
Maternal additive effect (G^m)		26.3 ± 14.11***	12.8 ± 6.11***	7.8 ± 6.87**	2.8 ± 0.62^{ns}	2.6 ± 2.78^{ns}

***=P≤ 0.05or **= P≤ 0.01or ***= P≤ 0.001, ^{ns}=Non- significant**

Direct heterosis:

Most carcass traits studied showed a positive direct heterosis effect, except for M% and G% had no effect. Estimates of heterosis percentages for carcass traits were high for B% and SW% (30.2 and 20.8% respectively) and declined to (14.6 and 14.6%) for M% and D% (Table 4).

Direct additive effect:

The direct additive effect on all carcass traits studied was non-significant. Estimates of carcass traits of quails favouring the BB sire over those sired by the WW line (Table 4). The same trend was reported by Abdel-Mounsif (2005).

Maternal additive effect:

Maternal line effects (expressed as the differences between reciprocal crosses) on all carcass traits studied were non-significant. Estimated carcass traits of quails sired by the BB line were compared to those mothered by the WW line (Table 4).

CONCLUSION

The crossing of BB line sires with WW line dams was associated with improvements in all growth traits, egg production, reproduction, and carcass traits.

REFERENCES

Abdel-Ghany, A.M, Younis, H.H., Nofal, R.Y., 2004. Effect of crossing two Japanese-quail-lines selected seven generations for meat and egg production on growth traits. Agri., res., J. Suez Canal University, 3(1): 1-14 Ismailia, Egypt.

Abdel-Mounsef, N.A. 2005. Crossbreeding effects on some productive and reproductive traits among selected lines of Japanese quail. Ph.D. Thesis, Thesis. Fac. Agric. Al-Azhar Univ. Cairo, Egypt.

Aboul-Hassan, M.A. 2001. Crossbreeding effects on some growth and egg production traits among tow strains of Japanese quail (Coutrnix coturnnix japonica). Al-Azhar J. Agric. Res., Vol. 34 PP. 41-57.

Bahie El-Deen, M. 1994. Selection index and crossing as a tool for improvement meal and egg production in Japanese quail. Ph.D. Thesis, Fac. of Agric; Alex. Univ. Egypt.

Bahie El-Deen, M., Shebl, M.K., EI-Raffa, A.M. 1998. Heterosis, maternal and direct genetic effects for growth and egg production traits in quail crosses. Egypt. Poult. Sci. 18:153-165.

Barbour, G.W., Liibum, M.S. 1995. Characterization of growth development from 14 to 15 days of age in Japanese quail hens from two strains. Poult. Sci. 74: 1650-1658.

Barden, J.R., Marks, H.L. 1989. Divergent selection for growth in Japanese quail under split and complete nutritional environments. 3- Influence of selection for growth on heterotic effects for body weight, feed and water intake patterns. Abdominal fat and carcass lipid characteristics. Poult. Sci. 68: 34-45.

Biak, D.H., Marks, H.L. 1993. Divergent selection for growth in Japanese quail under split and complete nutritional environments. 7- Heterosis and combining ability among diallel crosses following twenty-seven generations of selection. Poult. Sci. 72: 1449-1458.

Chahil, P.S., Johanson, W.A., Schilling, P.E. 1975. Combining ability in a diallel cross of three lines of coturnix japonica. Poult. Sci. 54: 1844-1949.

Damme, K. 1994. Growth of medium-weight and heavy strains of quail and theiireciprocaf crosses. Archiv-fureflugelkunde. 58: 34-37.

Dickerson, G.E. 1992. Manual for evaluation for breeds and crosses of domestic animals. Publications Division, FAO, Rome, Italy.

El-Naggar, N.M., Sharaf, M.M., Mandour, M.A. 1992. Relationship of growth yields and some body measurements in different Japanese quail strains. Egypt. Poult. Sci. 12: 145-164.

Gerken, M., Zimmer, S., Petcrson, J. 1988. Juvenile body weight and gonad development in a diallel cross among lines of Japanese quail (Coturnix coturnix japonica). Theor. Appl. Genet. 76: 775- 780.

Harvey, W.R. 1990. Users guide for LSMLMW. Mixed Model Least Squares and Maximum Likelihood Computer Program. PC. Version 2. Ohio State Univ., Columbus, USA (mimeograph).

Henderson, C.R. 1984. Application of Linear Model in Animal Breeding. University of Guelph Press. Guelph, Canada.

Larson, J.E., Adams, R.L., Peng, I.C., Stadelman, W.J. 1986. Growth, feed conversion and yield of Japanese quail parts of three strains of hen Japanese quail as influenced by age. Poult. Sci. 65: 2076-2081.

Maeda, Y., Sato, K., okamoto, S., Hashiguchi, T. 1988. Heterosis in body weight and muscle protein turnover rate in coturnix quail. Biuehem. Genet. 26: 395-399.

Mandour, M.A., Abd-alla, G.A., Sharaf, M.M. 1996. Effect of crossbreeding on some growth traits of native and standard breeds of chickens. Egypt. Poult. Sci. 16 (1): 171-164.

Marks, H.L. 1978. Long-term selection four-week body weight in Japanese quail under different nutritional environments. Theor. Appl. Genet. 52: 105-111.

Marks, H.L. 1990. Abdominal fat and tests weights on diverse genetic lines of Japanese quail. Poult. Sci. 69: 1627-1633.

Marks, H.L. 1993. Divergent selection for growth in Japanese quail under split and complete nutritional environments. 6- Differential body weights in reciprocal crosses. Poult. Sci. 72: 1847-1854.

Marks, H.L. 1995. Heterosis and over dominance following long-term selection for body weight in Japanese quail. Poult. Sci. 74: 1730-1744.

Nestor, K.E., Bacon, W.L., Lambio, A.L. 1982. Divergent selection for body weight and yolk precursor in Coturnix coturnix japonica. 1. Selection responses. Poult. Sci. 61: 12-17.

Nofal, R.Y. 2006. Crossbreeding parameters of females in two lines of Japanese quail for some growth and sexual maturity traits. Egypt. Poult. Sci. 26 (1): 69-85.

Sato, L., Fukuda, H., Maeda, Y., Hedianto, Y.E., Ino, T. 1990. Heterosis for growth in reciprocal crosses of highly inbred lines of Japanese quail. A.B.A. 58: No. 1812.

Shaban, A. R. 2021. Effect of crossing two selected lines for early and lately age at sexual maturity on some growth and carcass traits in Japanese quail. *Department of Animal Production, Faculty of Agriculture, Al-Azhar University, Nasr City, Egypt.*

Shalan, H.M. 1998. Independent culling levels selection and crossing for improving meat and egg production in Japanese quail. Ph. D. Thesis, Fac. Agric., Alex. Univ.

Sharaf, M.M., Mandour, M.A., Taha, A.E. 2006. Effect of diallel crossing on some growth performance, carcass traits and immune response againest new castle disease virus vaccine of Japanese quail. Egypt. Poult. Sci. 26 (4): 1451-1470.

Sherif, B.T., El-Wardany, A.M., Abdou, F.H. 1998. Prediction of abdominal fat in live birds of some local breeds of chickens. Egypt. Poult. Sci. 18 (1): 103-121.

تأثيرالخلط على بعض الصفات الإنتاجية والتناسلية بين طرزان مظهريان في السمان الياباني

أحمد عبدالمطلب على محمد، دياب إبراهيم أبوالسعود و محمد أبو الحسن أحمد حسن

قسم الإنتاج الحيواني، كلية الزراعة جامعة الأزهر، القاهرة.

الملخص

تم خلط ذكور الخط (BB) مع إناث الخط (WW) والتلقيح العكسي بين الخطين. تم أخذ عدد 2450 طائر تم إنتاجها خلال ثلاث فقسات لتقييم الأداء الإنتاجي وصفات الذبيحة وقياس تأثير كل من الخلط والتأثيرات المضيفة المباشرة والأمية على الخلطان للصفات الآتية: صفات النمو وتشمل: أوزان الجسم عند عمر الفقس و 2 و 4 و 6 أسابيع ومعدلات النمو اليومية خلال الفترات الآتية: صفر-2 و 2-4 و 4-6 و صفر-6 أسبوع. وصفات الذبيحة والتي اشتملت على: وزن الذبح والنسب المئوية لكل من اللحم – العظم – الأجزاء المأكولة – التصاقي. وكانت النتائج كالتالي: بالنسبة لصفات النمو: صاحب الخلط بين ذكور (BB) وإناث (WW) تفوق في صفات أوزان الجسم وكذلك في صفات معدلات النمو اليومية خلال الأعمار المختلفة. وكانت قوة الخلط المباشرة عالية المعنوية في معظم صفات وزن الجسم المدروسة من عمر الفقس حتى عمر 6 أسابيع ما عدا صفة وزن الجسم عند عمر 4 أسبوع وكانت قوة الخلط المباشرة عالية المعنوية في صفات معدلات النمو اليومية خلال فترات النمو المختلفة وكانت نسبة الخلط لهذه الصفات مرتفعة في فترتي النمو من الفقس حتى عمر 2 أسبوع ومن 2- 4 أسابيع وانخفضت في فترتي النمو من 4-6 أسبوع ومن الفقس - 6 أسابيع. وبالنسبة لصفات الذبيحة: صاحب الخلط بين ذكور (BB) وإناث (WW) تفوق في كل صفات الذبيحة المدروسة. وكانت قوة الخلط المباشرة عالية المعنوية في معظم صفات الذبيحة ماعدا صفتي % للحم والأجزاء المأكولة من الذبيحة ولم يكن لقوة الخلط المباشرة تأثيراً معنوياً عليها وكانت نسبة الخلط لهذه الصفات مرتفعة بالنسبة لصفتي % للعظام ووزن الذبيحة وانخفضت بالنسبة لصفتي % للحم و% للتصافى.

وبناء على نتائج هذه الدراسة تبين تفوق الخط المكون من B sire * W dam على الخط العكسي والخطوط النقية.

الكلمات الاسترشادية: الخلط، طرزان مظهريان، الصفات الانتاجية