EFFECT OF RECIPROCAL CROSS BETWEEN ROSS 308 AND ARBOR ACRES BROILER BREEDER LINES ON GROWTH PERFORMANCE OF PROGENY

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ABSTRACT

There are many commercial broiler breeders used widely for produce hatching eggs to supply hatcheries within the broiler industry in Iraq, such as Hubbard, Cobb, Ross 308 and Arbor Acres. The aim of this study was evaluating the performance of broiler result from diallelcross among the parent lines of Ross 308 and Arbor Acres. The diallel crosscombinations were made between Ross 308 male line (R) or Arbor Acres male line (A) with Ross 308 female line (r) or Arbor Acres female line (a). The chicks from the four genetic groups of crosses were reared up from hatch to 35 days of age.The process was replicated for three hatches. The results showed that the cross R×a had a significant heaviest body weight (2766 g) at five weeks of measurement compared with other crosses of Ross 308 lines R×r and Arbor Acreslines A×a, which recorded 2246 and 2453 g respectively. With respect to the cross A×r had a significant heaviest body weight at five weeks measurement compared with the cross R×r, while there were no significant differences between A×r and all other crosses at five weeks measurement. Heterosis estimates for body weight recorded positive heterosis for R×a and its reciprocal cross A×r, andthe R×a cross record had higher estimations than A×r. The body weight uniformity of the R×a chicks at hatching had significantly high uniformity percentage compared with other crosses. In conclusion, the crossbreeding between Ross 308 male line and Arbor Acres female line had improved the broiler performance and can be used effectively for commercial production.

Key words: Parent lines crosses, Heterosis, Body weight, Ross 308, Arbor Acres.

INTRODUCTION

The broiler chickens represent the main source of poultry meat in the world (Hassan, 2011). Muchadeyi *et al.* (2007) reported that the poultry meat represents a cheaper protein source compared to the other animal protein sources. The broiler industry in Iraq depends mainly on the local production of hatching eggs or importing hatching eggs, of some widely used commercial broiler breeder as Ross 308, Arbor Acres, Lohmann and Hubbard (Hassan,

2009). The commercial broiler performance for many genotypes was studied in the environment of Iraq, such as Iraqi Fawbro (1670.0 g), Hubbard (2041.5 g) and Lohmann (2141.0 g) which recorded significant differences among body weight measurement at six weeks of age (Hassan and Jasim, 2009). Crossbreeding is widely used in commercial chicken production to exploiting heterosis when the desired phenotype is a combination of existing lines through using specialized sire and dam lines. Saadey *et al.*, (2008) reported that exploitation of heterosis by crossing genetically diverse stocks were used to improve economic traits such as body weight. Al-Shalaan *et al.*, (2012) reported a significant superiority in body weight at six weeks old for the hybrid result from the Ross sire line and the dam line of Arbor Acres compared to the commercial Arbor Acres cross, and all specific combining ability estimations for this hybrid cross were positive, while it was negative for its reciprocal cross. Body weight uniformity is an important trait when managing broiler breeders. When a flock is uniform, hatching egg will meet the nutrient requirements of a greater number of individual birds during feeding (Carneiro, 2016), and also the uniformity represents important for broiler, the body weight uniformity calculated as the percentage of birds in a flock with body weight measurement within +/- 15% of the sample mean body weight (Bennett and Leeson, 1989), and also evaluated by calculating the coefficient of variation (CV) which calculated by dividing the standard deviation by the average body weight and multiplying the result by 100 (Cobb-Vantress, 2008). The aim of this study was to evaluate the performance of broiler result from diallelcross among the parent lines of commercial broiler breeder Ross 308 and Arbor Acres.

MATERIAL AND METHODS

Study location

This study was conducted at the poultry house in the Animal production Department, College of Agriculture, University of Diyala, Iraq. Mean temperature during Autumn season (Sept. to Dec.) range between 15 to 38℃. The annual rainfall ranges between 5 to 25 mm.

Birds and management

The source of the broiler breeder chickens were used from a private company for hatching eggs, it is include 30 hens and 10 cocks from each Ross 308 and Arbor Acres parents. Individually cages were used to house the birds and the data recorded individually for each bird, and the parents flock was fed *ad libitum* using the standard diet for parents. Reciprocal crosses were made between Ross 308 male line (R) or Arbor Acres male line (A) with Ross 308

female line (r) or Arbor Acres female line (a). The Artificial insemination used to inseminate the hens weekly, and the eggs were collected and recorded daily according to the hybrids and their crosses, and the eggs hatched separately according to each cross, and the procedure replicated for three hatches. The four genetic groups of chicks were obtained and banded to identify the hybrids and the cross progeny. The chicks groups were reared until 35 days of age on a litter floor, in a semi-open chicken house. During the brooding period (first 21 days) the chicks were fed using commercial starter diet, 23% crude protein and 2950 kcal kg^{-1} metabolic energy, and during the rearing period (22-35 days) the chickens were fed a grower diet, 21% crude protein and 3050 kcal kg^{-1} metabolic energy.

Statistical analysis

The collected data were analyzed using general linear model (GLM) by using SPSS software (Landau and Everitt, 2004) according to the following model:

$$Y_{ij} = \mu + \tau_i + \rho_j + \varepsilon_{ij}$$

Where μ = the overall mean, τ_i = the *i*th genetic group, ρ_j = the *j*th hatch, and ε_{ij} = the random error.

The multiple comparisons for significant differences between means were compared by Tukey test at significance level 0.05.

Heterosis was calculated by the following formula:

H (%)= Ar – (0.5Aa+0.5Rr) / (0.5Aa+0.5Rr) × 100

Where Aa represents the Arbor Acres parents, Rr represents the Ross 308 parents, and Ar represents the hybrid cross between Arbor Acres and Ross 308 parents.

The body weight uniformity calculated as the percentage of birds in a flock with body weight measurement within +/- 10% of the sample mean body weight.

RESULTS

The mean of live body weights at different weeks of age represented in the Table 1 which show that the means differed significantly ($P \leq 0.05$) among the four genetic groups at the four and five weeks of age. The means show that the Ra cross had a significantly higher body weight at five weeks of age (2766.70 g) compared with the commercial hybrids Aa and Rr which recorded 2453.92 and 2246.97 g respectively. However, there was no significant superiority of Ra crosscompared with the reciprocal crossAr at all weeks of the study. Results also

show that there were no significant differences between body weights of commercial hybrids Aa and Rr at all week periods.

Table 1. The live body weight (g) at various ages of progeny result from different crosses (Means± SE)

Crosses	Ages (week)					
	One day	1	2	3	4	5
A×a	51.03± 1.16	168.73± 10.18	464.33± 45.88	914.26± 15.02	1660.45± 78.36 ab	2453.92± 57.10 bc
A×r	51.51± 0.36	170.28± 12.13	472.13± 13.07	983.45± 52.01	1757.41± 39.21 a	2556.06± 46.59 ab
R×r	51.04± 1.16	170.93± 14.63	459.57± 40.89	890.54± 19.61	1462.58± 49.32 b	2246.97± 67.02 c
R×a	52.92± 1.09	178.19± 10.21	497.33± 22.88	983.75± 4.09	1775.43± 61.79 a	2766.70± 81.19 a
Significance	N.S.	N.S.	N.S.	N.S.	*	*

Means with different letters in the same column are significantly differ from each other at probability 0.05.

* mean there is a significant effects P≤0.05 of genetic groups in the ANOVA table.

N.S. mean there is no significant effect of genetic groups.

Body weight uniformity for the progeny in the four genetic groups represented in table 2, and the measurements reveal significant differences among genetics groups at hatching age and four weeks age, hence the Ra cross progeny have the best body weight uniformity (95.04 %) at one day old age and different significantly with Ar and Rr crosses, whereas there was no significant difference in body weight uniformity between Ar and Ra crosses at four weeks of age which record 81.89 and 78.32% respectively.

Table 2. Thebody weight uniformity (%) at various ages of progeny result from different crosses (Means± SE)

Crosses	Ages (week)					
	One day	1	2	3	4	5
A×a	82.64± 8.49 ab	64.84± 2.89	40.73± 8.81	72.08± 1.71	72.91± 10.00ab	72.98± 8.66
A×r	68.51± 5.96 b	69.00± 2.56	69.74± 6.19	58.63± 19.05	81.89± 9.23 a	88.13± 8.07
R×r	66.36± 3.02 b	59.39± 10.51	56.23± 6.17	75.44± 11.27	53.89± 15.14 b	77.07± 14.16
R×a	95.04± 3.12 a	83.47± 4.27	72.66± 5.59	80.67± 5.63	78.32± 12.23 a	89.07± 5.71
Significance	*	N.S.	N.S.	N.S.	*	N.S.

Means with different letters in the same column are significantly differ from each other at probability 0.05.

*mean there is a significant effects P≤0.05 of genetic groups in the ANOVA table.

N.S. mean there is no significant effect of genetic groups.

The growth traits measurements at market age (35 days) including weight gain, feed intake, feed conversion and mortality represented in table 3, which show a significant (P≤0.05) differences among genetic groups in the weight gain, hence, Ra cross records best weight gain (2713.78 g 35 days^{-1}) followed by Ar cross (2504.55 g 35 days^{-1}). There are no significant differences among the crosses in other traits.

Table 3. The accumulative traits (Five weeks of age) of weight gain, feed consumption, feed conversion and mortality of progeny result from different crosses (Means± SE)

Crosses	Accumulative Traits			
	Weight gain (g)	Feed intake (g bird^{-1})	Feed conversion	Mortality (%)
A×a	2402.89± 56.55 bc	4256.99± 298.68	1.77± 0.12	3.65± 2.05
A×r	2504.55± 46.91 ab	4754.34± 66.68	1.90± 0.05	3.69± 2.33
R×r	2195.93± 67.83 c	4094.04± 488.85	1.86± 0.27	4.09± 2.17
R×a	2713.78± 80.41 a	4929.91± 431.56	1.82± 0.19	0.37± 0.37
Significance	*	N.S.	N.S.	N.S.

Means with different letters in the same column are significantly differ from each other at probability 0.05.

* mean there is a significant effects P≤0.05 of genetic groups in the ANOVA table.

N.S. mean there is no significant effect of genetic groups.

Heterosis estimates for live body weight are presented in Fig. 1. The results showed that the cross Ra and its reciprocal cross Ar had positive heterosis estimations at all weeks of age included in the study.

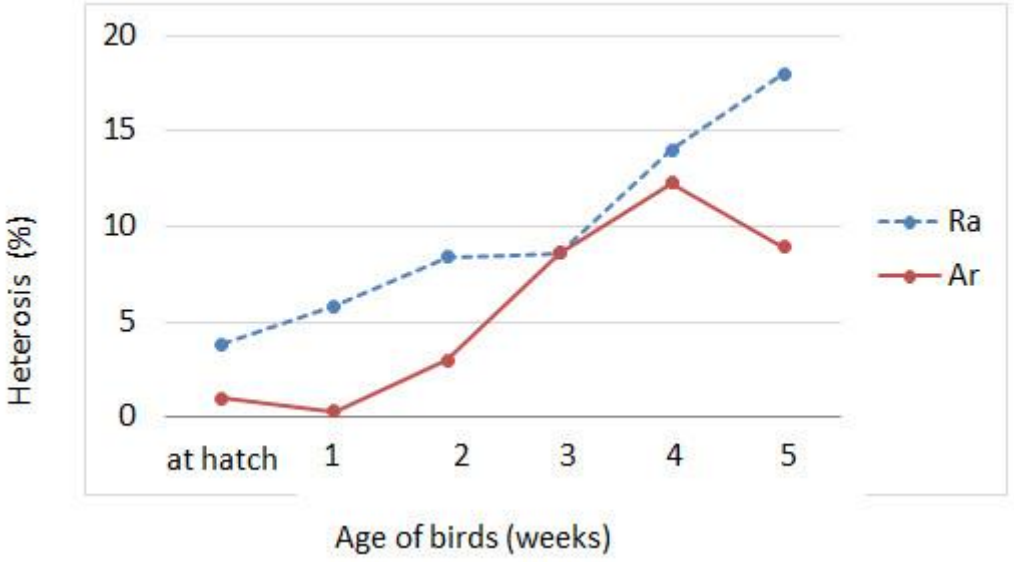

Fig. 1. Heterosis (%) for body weight of the cross and reciprocal cross between Arbor Acres and Ross 308 lines

The heterosis estimates for the cross Ra are higher than Ar in all periods from hatch to five weeks, and the highest difference between the two crosses are recorded at the five weeks of age. Heterosis estimates for the accumulative traits, including live body weight, weight gain, feed intake, feed conversion, and body weight uniformity during the five weeks of the experiment are found in table 4. Results revealed positive heterosis estimates for all traits of the two hybrid crosses, except for feed conversion of cross Ra which shows negative heterosis estimates. The heterosis estimates for Ra show higher heterosis compared with Ar for all traits except for feed conversion.

Table 4. Heterosis (%) for accumulative traits (Five weeks of age) of weight gain, feed consumption, feed conversion and uniformity of progeny result from different crosses

Crosses	Accumulative Traits				
	Body Weight	Weight gain	Feed intake	Feed conversion	Body weight uniformity
A×r	8.93	1.77	30.54	31.82	18.89
R×a	17.74	25.64	20.17	-3.83	20.11

DISCUSSION

The live body weight measurements of cross Ra are recorded higher values in all weeks of age compared with other three crosses, although the statistical analysis appeared significant differences among the crosses at four and five weeks of age only, hence the cross Ra had significantly higher body weight (2766.70 g) compared to commercial hybrid crosses Ross 308 and Arbor Acres (2246.97 and 2453.92 g respectively), the result agrees with Al-Shalaan *et al.*,

(2012) with respect to their report of high specific combining ability and heterosis of the cross sire Arbor Acres and dam Ross 308 compared with other crosses in their study.

The study recorded higher body weight uniformity for Ra in all weeks of age compared with commercial hybrid crosses Ross 308 and Arbor Acres, which reveal good genetic expression of body weight in all individuals of Ra genotype.

Heterosis effects for body weight represented in Fig. 1 is all positive and for cross Ra ranged from 3.7 to 17.74% during different weeks of age included in the study. Siwendu *et al.*, (2013) reported heterosis for body weight ranged from -37.69 to 11.01% during period from hatch to 13 weeks for complete diallel cross (3×3) included two local breeds, Venda (V) and Naked Neck (N) and one commercial broiler breeder named Ross 308 (R), the crosses V×N and V×R revealed positive heterosis at all weeks of the study. There are many studies reported that body weight of crossbred chicken genotypes was related to positive heterosis effect for growth traits (Khawaja *et al.*, 2016), and that confirms the use of crossbreeding as a tool to invest the genetic variations to produce heterosis which improves growth traits and fitness in the flock.

CONCLUSION

The crossbreeding between Ross 308 male line and Arbor Acres female line (Ra) had improved the broiler performance compared with Ross 308 and Arbor Acres and can be used effectively for commercial production. In other hand, the reciprocal cross (Ar) had significant heaviest body weight compared with commercial Ross 308.

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تاثير التضريب التبادلي بين خطوط امات فروج اللحم Ross 308 وArbor Acres في صفات النمو في الابناء

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المستخلص

تستخدم صناعة فروج اللحم في العراق العديد من الامات التجارية بشكل واسع لانتاج بيض التفقيس لتجهيز المفاقس مثل Hubbard، Lohmann، Ross 308 وArbor Acres. استهدفت هذه الدراسة تقييم الاداء الانتاجي لفروج اللحم الناتج عن التضريب التبادلي بين خطوط الآباء روز (Ross 308) واربر (Arbor Acres). اجريت توليفات التضريب التبادلي بين خط الذكور روز (R) او خط الذكور اربر اكرز (A) مع خط الاناث روز (r) او خط الاناث اربر (a). وتم تربية الافراخ الناتجة عن تضريبات المجاميع الوراثية الى عمر 35 يوما، وكررت العملية لثلاث فقسات (مكررات). اظهرت النتائج ان فروج اللحم الناتج عن التضريب R×a سجل تفوق معنوي في وزن الجسم (2766 غم) بعمر خمسة اسابيع مقارنة بالتضريبات R×r و A×a التي سجلت قياسات لوزن الجسم 2246 و2453 غم على التوالي. اما بخصوص التضريب A×r فقد تفوق معنويا في وزن الجسم في عمر خمسة اسابيع على التضريب R×r، بينما لم تلاحظ فروق معنوية بين التضريب A×r وبقية التضريبات عند عمر خمسة

اسابيع. سجلت تقديرات قوة الهجين لوزن الجسم قوة هجين موجبة للتضريب R×a وتريبه العكسي A×r، وتفوق التضريب R×a في تقديرات قوة الهجين على التضريب A×r. اظهر التضريب R×a تفوقا معنويا في نسبة التجانس لوزن الجسم مقارنة مع بقية التضريبات. نستنتج من الدراسة ان التضريب بين خط الذكور روز وخط الاناث اربر ادى الى تحسن معنوي في اداء فروج اللحم ويمكن استخدامه بكفاءة في الانتاج التجاري.

الكلمات المفتاحية: تضريبات خطوط الاباء، قوة الهجين، وزن الجسم، Ross 308، Arbor Acres.