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IMPROVING GROWTH TRAITS AND ESTIMATING HETEROSIS, ADDITIVE AND MATERNAL EFFECTS A CROSS DIALLEL MATING AMONG THREE LINES SELECTED HEAVIEST BODY WEIGHT UNDER HEAT CONDITION

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ABSTRACT: A crossbreeding experiment was executed between three breeds were selected three generation for heavy body weight under high temperature condition Sinai (SI) and Rhode Island Red (RI) and Fayoumi breeds. 900 crossing meals from each genotype were recorded singular body weight and body weight gain at hatch, 4, 8 and 12 weeks of age. crosses SI XRI and reciprocal RI x Si significant heaver body weight and body weight gain compared than other crosses and pure breed. On the other hand body weight and body weight gain were significant heaver for pure line Sinai or Rod iland read and crosses SI x F, F x RI, Fx SI and RI xF compared to Fayoumi pure line. Heterosis was positive significant on body weight at hatch, 4,8 and 12 weeks of ages. As the same trend results of body weight gain but, negative significant at the intervals from 4wks to 8wks only. It could be observed that the hybrid vigor of body weight was significant positive effect for crosses SI X RI and reciprocal crosses RI XSI and RI XF ones.

While, the hybrid vigor of body weight gain was significant positive effect for all diallel crossing except F X RI crosses. the direct additive effects were negative for line Fayoumi both body weight and weight gain taits at diferent age of these study. But these reciprocal effect were significant positive for Sinai and Rodiland red lines both body weight and body weight gain. These resuls shown that the croses RI XSI beter than SI X RI for both body weight and body weight gain. Maternal effect of body weight and body weight gain were significant positive effect at hatcher , for FF and SI SI. While, it was significant negative effect for RIRI. On the other hand, were significant positive for body weight at hatcher and 4 weeks of age only. While, maternal effect was significan positive at the intervals 0-4weeks only. The last shown that the maternal effect had a play essential role on body weght and body weight gain.

Recommended used crosses Sinai and rod Iland red to produce commercial meat strains in hot climated countery.

Key words: Heterosis - Additive effect - Maternal effect -Thermal tolerance.

INTRODUCTION

Global Warming leads to heat stress in poultry and caused tremendous economic losses in poultry industry due to increased mortality rate in poultry general particular broilers. The heat stress was negative major effect of economic traits such as body weight, growth rate, feed efficiency, meat yield , susceptibility to disease and mortality percentage (Amrutkar *et al*., 2014; Lowman *et a*l., 2014). Some researcher had studed effect heat stresse for muscle development and estimated gene expression responsible for this (Radwan et al., 2018); who reached that decrease gene expression of both Myogenin and UCP genes reflected that growth muscle and depression carcass weight. The local breeds were distinguish high adaptation for environment due to the increased gene expression of genes responsible for adapted and those genes inherited from generation to generation (Radwan and Mahrous 2018).

Nawar and Bahie El-Deen (2000) and Iraqi (2002) recorded that general local breeds had high genetic variance for non-additive genetic so recommended the possibility improvment these breeds by crossbreeding programs. Khalil et al. (2010) sayed that must be utilized crossbreeding approach for improvement meat traits in native breeds similar production environment. Crossbreeding brings some changing of genetic variance and permits consolidating the significant traits of parent lines in their offspring lines (Lalev et al., 2014). A target assessment of the estimation of a given strain or lines and its correct place in blends is performed based on diallel cross examinations. The investigation of results adds to set up the mixes with at least one heterotic traits (Mekky et al., 2008). The parameters of genetics and maternal effect concerning strains or breeds participate in improvement economic traits (Lalev et al., 2014).

The aim of this study is to estimate genetic parameter of diallel crosses among three lines selected three generation for heavy body weight under high temperature condition Sinai (SI) and Rhode Island Red (RI) and Fayoumi breeds.

MATERIALS AND METHODS

This study was done in a private farm (belongs to El-Barka Company). Three adapted and local strains of chickens Fayoumi (F), Sinai (S) and Roid Island Red (RIR) formally selected for three generation to achieve the heaviest body weight under heat stress conditions. At 34 weeks of age these three lines were introduced into 3X3 diallel mating in order to obtain all possible crosses and also their reciprocals. The mating design as follows table 1. 5000 chicks were produce by mating artificial insemination 108 sires and 650 dams.All crossing produce from the last mating system were reared similar management and inveronment condition. Since begin to end experimental the all crossing were reared under high temperature ranged from 35.5°C to 36.5°C.

Growth performance traits

Estimates and measurements were taken on male progeny only (900 male progeny, 100 progeny from each class or cell). These measurements included body weight trait at hatch, 4, 8 and 12 weeks of age. Also, body weight gain calculated at different age intervals (0-4) , (4-8), (8-12) and 0-12 weeks.

Heterosis - Additive effect - Maternal effect -Thermal tolerance.

Genetic crossbreeding parameters:

The different genetic cross breeding parameters were measured. These parameters included heterosis, direct additive effect and maternal effect.

Heterosis was calculated on percentage of midparents from the equation (Williams et al., 2002) as: {F1-[(P_1 + P_2)/2] / [(P_1 + P_2) / 2] x 100} using mean, Where : F1 = the first cross and P_1 or P_2 is a parent in diallel and reciprocal crosses. While, the Heterosis percentage for crosses calculated for diferent crocess as equation example (SI×F) = {(SI×F) - [(SISI + FF)/2] / [(SISI + FF) / 2] x 100}.Direct additive effect was calculated by used Dickerson (1992) as equation follow :

D_E for (SISI) =1/3[(SISI) + (SIxF) + (SI×RI)] – ¼ [(FF) + (RIRI) + (FxSI) + (RI×SI)].

D_E for (FF) =1/3[(FF) + (FxSI) + (F×RI)] – ¼ [(SISI) + (RIRI) + (SIxF) + (RI×F)].

D_E for (RIRI) =1/3[(RIRI) + (RIxSI) + (RI×F)] – ¼ [(SISI) + (FF) + (SI X RI) + (F×RI)].

Moreover, the Maternal effect was estimated by used Dickerson (1992) as the mean deviation of progeny for a particular dam from mean calculated from a particular sire selected line (i.e. mj= (y.i-yi), where y.i=mean of dam selected line and yi=mean of sire selected line. Maternal effect for SI SI= 1/3[(SISI) + (F×SI) + (RI×SI)] –1/3[(SISI) +(SI×F) +(SI×RI RI)].

Statistical analyses:

Data were statisticly analayssed according to general liner model by SAS Institute (2005) wheres two way analysis as follow:

$Y_{ijk} = \mu + C_i + A_j + (C*A)_{ij} + e_{ijk}$

Where;

μ= the overall mean, G_i= the effect of the i^{th} Crosses. A_j = Age effect, $(C*A)_{ij}$ = Interaction between crosses and age, e_{ijk} = Experimental error.

Differences which considered significant were compared by Duncan Test (Duncan, 1955).

RESULTS AND DISCUSSION

From table (2), it could be seen that both SI X RI cross and its reciprocal (RI X SI) had a heavier body weight and weight gain than other counterparts (crosses and pur lines). This means that Fayoumi pure line occupied the lastest degree a the lightest body weight than other counterparts. Its obvious that introducing Fayoumi stains in any crossing progeny reduces the specific heterosis. The reduaction male was more pronounced when using Fayoumi females them Fayoumi.

Table (3) showed the specific heterosis for body weight and body weight gain resulted from 3X3 diallel crossing. Heterosis was positive significant on body weight at hatch, 4,8 and 12 weeks of ages. As the same trend results of body weight gain at (0-4), (8-12) and (0-12) but not at (4-8) weeks of age. It could be observed that the hybrid vigor of body weight was significant positive effect for crosses SI X RI and reciprocal crosses RI XSI and RI XF ones.While, the hybrid vigor of body weight gain was significant positive effect for all diallel crossing except F X RI crosses. Thes results reflected better hybrid vigor when used RIR with Sinai (RI XSI crosses and also the reciprocal SI X RI) due to RIR and Sinai benefited the heaver body weight compared to Fayoumi one. Under heat condition, RIR affical more its body weight depressed compared to Sinai line (Radwan and Mahrous 2018). They also observed under these circumstances Sinai line achieved better adaptation than RIR one and produced more level HSP90 and these preferable trait inherited to next generations. So, Significant better heterosis of body weight recorded for SI XRI and RI X SI crosses followed by RI X F.

The degree of heterosis was inversely related to the degree of genetic resemblance between parental populations (Williams et al., 2002; Khalil et al., 2010 and Iraqi et al., 2013).

Mekky et al., 2008 recorded that the highest positive heterosis for body weight noticed crossing between Sinai Sire line with White Leghorn dam line; the same trend occurred results when crossing in done between Fayoumi Sire line with Sinai dame line.

Table (4) illustreted that direct additive effects for body weight and body weight gain traits of 3X3 diallel crossing. The results indicated that the direct additive effects were negative for Fayoumi line for both body weight and weight gain taits at diferent age of these study. But the reciprocal effects were positive and significant for Sinai and RIR lines for both traits (body weight and body weight gain). Because the normal lighter weight of Fayoumi line besides the depression effect on its body weight resulted from heat stress condition. The direct additive effect of Fayoumi was less than that of both RIR and Sinai ones. Its also less and negative. On the other hand , may be genetics responsible tolerance heat stress nonadditive effect in fayoumi line. These resuls shown that the RI XSI cross was beter than SI X RI one for both body weight and body weight gain traits.Iraqi et al., 2002, 2011 and Lalev et al., 2014 recorded that additive genes had a positive effect of body weight and growth rate but this trend reflexed and become negative at age sexual maturity (26 weeks of age).Maternal effect of body weight and body weight gain were significant positive effect at hatcher , for FF and SI SI. While, it was significant negative effect for RIRI. On the other hand, were significant positive for body weight at hatcher and 4 weeks of age only. While, maternal effect was significan positive at the intervals 0-4weeks only. The last shown that the maternal effect had a play essential role on body weght and body weight gain. These results agreement with (Khalil et al., 1999; Mekky et al.; 2008; Iraqi, 2008 and Lalev et al., 2014). Also, the results reflect that favorable Fayoumi and Sinai lines maternal effect of body weight and body weight gain under high temperature condition.Barbato and Vasilatos-Younken (1991) observed had a blends have an alternate body weight as for utilized dam and sire strains in breeding schedules. One the other hand, the maternal effect in chickens had changed with age could be expected to endoplasmatic heredity which assumes a part of the indication of the particular maternal effect between the strains (Lalev et al., 2014).

CONCLUSION

Better hybrid vigor was noticed when used Rod iland read with Sinai (RI XSI Crosses and reciprocal SI X RI). The direct additive effects croses RI XSI were better than SI X RI for both body weight and body weight gain.

Favorable was notice for F and Si lines maternal effect of body weight and body weight gain under high temperature condition.

Recommended, used crosses Sinai and rod Iland red to produce commercial meat strains in hot climated countery.

Conflict of interest

To the best of our knowledge there is no conflict of interest associated to this publication.

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The mating design as follows **Table(1):**

Males* \ Females	SI	F	RI
Sinai (SI)	SI×SI	FXSI	RI × SI
Fayoumi (F)	SI X F	FXF	RI X F
Rod Island (RI)	SI × RI	F X RI	RI × RI

Table (2): Means± SE for male body weight at the different ages from the diallel crossing of Sinai (SI SI), Fayoumi (FF) and Read Iland lines selected body weight under high ambient temperature.

Genotype	Body weight (g/weeks)				Overall	Prob.		
	Hatch	4wks	8wks	12wks		Age (A)	Crossing (C)	A*C
Pure breed								
SI x SI	40.01±0.49	534.39±39.01	888.12±54.01	1421.43±85.32	720.99^{b}			
F ×F	35.26±0.45	357.19±32.07	649.87±43.9	1212.98±76.98	563.83^{c}			
RI ×RI	42.49±0.38	603.54±28.93	918.95±32.98	1465.21±59.32	757.58^{b}			
Crosses								
SI x F	38.04±0.54	391.98±25.32	759.87±21.03	1355.43±54.11	636.33^{b}			
SI x RI	44.09±32	691.78±23.98	959.43±12.03	1623.32±43.12	829.66^{a}	0.03	0.01	NS
F x RI	40.02±29	529.93±31.03	689.21±23.01	1298.65±62.99	639.45^{b}			
Reciprocal								
F x SI	39.76±0.29	412.34±29.8	719.98±31.04	1306.99±65.32	619.77^{b}			
RI x SI	43.12±0.12	676.98±12.76	985.65±20.11	1699.32±39.99	851.27^{a}			
RI x F	41.98±0.47	559.94±29.19	834.98±17.99	1365.45±55.96	700.59^{b}			
Overall	40.53^{d}	528.67^{c}	822.90^{b}	1416.53				

Continue Table (2):

Genotype	Body weight at different ages (g/weeks)				Overall	Prob.		
Pure breed	From Hatch to 4wks	From 4wks to 8wks	From 8wks to 12wks	From Hatch to 12wks		Age (A)	Crossing (C)	A*C
SI x SI	494.38±2.54	353.73±8.32	533.31±2.87	1381.42±49.43	690.71[b]			
F × F	321.93±8.43	292.68±7.12	563.11±7.87	1177.72±55.21	588.86[c]			
RI × RI	561.05±7.32	315.41±9.76	546.26±14.54	1422.72±30.54	711.36[b]			
Crosses								
SI x F	353.94±7.54	367.89±11.07	595.56±10.21	1317.39±20.43	658.70[b]			
SI X RI	647.69±12.87	267.65±6.98	663.89±11.32	1579.23±17.76	789.62[a]	0.02	0.04	NS
F X RI	489.91±11.07	159.28±3.87	609.44±12.01	1258.63±21.21	629.32[b]			
Reciprocal								
F x SI	372.58±19.02	307.64±12.21	587.01±8.92	1267.23±17.32	633.62[b]			
RI x SI	633.86±10.11	308.67±10.01	713.67±16.11	1656.20±42.43	828.10[a]			
RI x F	517.96±7.97	275.04±4.98	530.47±9.93	1323.47±43.32	661.74[b]			
Overall	488.14[c]	294.22[d]	593.64[b]	1376.00[a]				

Table (3): Means± SE Specific heterosis of body weight and body weight gain traits from the diallel crossing of Sinai (SI SI), Fayoumi (FF) and Read Iland lines selected body weight under high ambient temperature.

Genotype	Age				Overall	Prob.		
	Hatch	**4wks**	**8wks**	**12wks**		**Age (A)**	**Crossing (C)**	**A*C**
Specific heterosis for body weight								
SI X F	1.063±0.01	-12.07±0.13	-1.19±0.02	2.90±0.06	-2.32^{d}			
SI X RI	6.88±0.03	21.58±0.34	6.19±0.11	12.47±0.23	11.78^{a}			
F X RI	2.93±0.01	10.32±0.41	-12.14±0.41	-3.02±0.18	-0.48^{c}			
Reciprocal						0.001	0.001	NS
F X SI	5.63±0.09	-7.54±0.32	-6.37±0.25	-0.78±0.08	-2.27^{d}			
RI XSI	4.53±0.04	18.98±0.76	9.09±0.12	17.74±1.11	12.59^{a}			
RI XF	7.97±0.08	16.57±0.54	6.45±0.14	1.97±0.1	7.75^{b}			
Overall	4.83^{b}	7.97^{a}	0.34^{c}	5.21^{b}				
Specific heterosis for body weight gain								
Genotype	**Intervals of the age**				**Overall**	**Prob.**		
	From Hatch to 4wks	**From 4wks to 8wks**	**From 8wks to 12wks**	**From Hatch to 12wks**		**Age (A)**	**Crossing (C)**	**A*C**
SI X F	-13.28±0.32	13.83±1.21	8.64±0.65	2.96±0.76	3.04^{c}			
SI X RI	22.73±1.65	-20.00±1.32	22.99±3.21	12.64±2.43	9.59^{a}			
F X RI	10.97±0.87	-47.61±4.76	9.87±0.89	- 3.20± 0.65	-29.97^{d}			
Reciprocal						0.001	0.001	NS
F X SI	10.97±0.98	- 4.82±0.76	7.08±0.79	- 0.96±0. 22	3.07^{c}			
RI XSI	-8.72±0.69	-7.71±0.93	32.21±2.98	18.13±0.43	8.48^{b}			
RI XF	17.32±2.98	-3.11±0.45	-4.37±0.65	1.79±0.34	2.91^{c}			
Overall	6.67^{b}	-69.42^{d}	12.74^{a}	5.23^{c}				

Table (4): Means± SE direct additive effects for body weight and body weight gain traits from the diallel crossing of Sinai (SI SI), Fayoumi (FF) and Read Iland lines selected body weight under high ambient temperature**.**

Genotype	**Age**				**Overall**	**Prob.**		
	Hatch	**4wks**	**8wks**	**12wks**		**Age (A)**	**Crossing (C)**	**A*C**
Direct additive effect for body weight								
SI SI	0.15±0.001	21.48±1.99	41.84±3.87	30.93±7.76	23.60[b]	0.0001	0.001	NS
F F	-2.67±0.04	-93.64±4.65	-170.99±5.97	- 141.74±9.87	-102.26[c]			
RI RI	2.26±0.07	79.03±6.43	107.40±7.11	105.80±8.43	73.62[a]			
Overall	-0.087[b]	2.29[a]	-7.25[d]	-1.67[c]				
Direct additive effect for body weight gain								
Genotype	**Intervals of the age**				**Overall**	**Prob.**		
	From Hatch to 4wks	**From 4wks to 8wks**	**From 8wks to 12wks**	**From Hatch to 12wks**		**Age (A)**	**Crossing (C)**	**A*C**
SI SI	21.33±7.77	20.36±8.98	-10.90±4.76	30.79±7.54	15.40[b]	0.0001	0.0001	NS
F F	-90.97±6.98	-77.35±8.54	29.25±6.87	-139.07±7.87	-69.54[c]			
RI RI	76.77±7.87	28.37±2.43	-1.61±0.09	103.54±9.98	51.77[a]			
Overall	7.13[b]	-28.62[d]	16.74[a]	-4.74[c]				

Table (5): Means± SE maternal effect for body weight and body weight gain traits from the diallel crossing of Sinai (SI SI), Fayoumi (FF) and Read Iland lines selected body weight under high ambient temperature.

Genotype	Age				Overall	Prob.		
	Hatch	4wks	8wks	12wks		Age (A)	Crossing (C)	A*C
Maternal effect for body weight								
SI SI	0.25±0.006	1.83±0.03	-4.51±0.87	9.09±2.54	1.67[b]	0.0001	0.001	NS
F F	1.21±0.04	16.62±2.87	34.94±2.87	6.06±0.87	14.71[a]			
RI RI	0.33±0.005	-5.02±3.05	-56.76±5.54	-47.14±3.65	-27.31[c]			
Overall	0.38[b]	4.48[a]	-8.78[c]	-10.66[d]				

Maternal effect for body weight gain

Genotype	Intervals of the age				Overall	Prob.		
	From Hatch to 4wks	From 4wks to 8wks	From 8wks to 12wks	From Hatch to 12wks		Age (A)	Crossing (C)	A*C
SI SI	1.59±0.32	-6.35±1.43	13.61±1.98	8.85±1.76	4.43[a]	0.001	0.001	NS
F F	15.41±0.89	18.32±2.65	-28.88±3.54	4.84±0.87	2.42[b]			
RI RI	-4.69±0.96	-51.73±4.65	9.63±1.07	-46.80±5.65	-23.40[c]			
Overall	4.10[a]	-39.76[d]	-1.88[b]	-11.04[c]				

Heterosis - Additive effect - Maternal effect -Thermal tolerance.

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Heterosis - Additive effect - Maternal effect -Thermal tolerance.

الملخص العربى

تحسين صفات النمو وتقدير قوة الهجين ، وتاثيرات المضافه وتاتاثير الامى بين خطوط المنتخبه لزيادة وزن الجسم تحت الاجهاد الحرارى.

لمياء مصطفى رضوان ، محمود يوسف محروس

قسم إنتاج الدواجن ، كلية الزراعة ، جامعة عين شمس

تم تنفيذ تجربة تهجين بين ثلاثة سلالات تم انتخابها لمدة ثلاثة أجيال لوزن الجسم الثقيل تحت ظروف درجة الحرارة المرتفعة سيناء (SI) و الرودايلاند (RI) وسلالات الفيومى (F) . عدد الكلى للهجن 900 مائه من كل نمط وراثي تم تسجيل وزن الجسم المفرد وزيادة وزن الجسم في الفتره ، 4 و 8 و 12 أسبوعا من العمر. الهجن SI XRIوالهجن العكسى RI X Si وزن الجسم اثقل وزيادة وزن الجسم مقارنة مع غيرها من الصلبان ونقية الصرفة. ومن ناحية أخرى ، كان وزن الجسم ووزن وزن الجسم هامين لخط نقي سيناء أو رود آدل قراءة وتقاطع SI x Fو F x RI و Fx SI و RI xF مقارنة بخط فيومي الخالص. كان الارتجاع موجباً معنوياً على وزن الجسم عند الفقس ، 8،4 و 12 أسبوعاً من العمر. كما نفس نتائج الاتجاه من زيادة وزن الجسم ولكن ، سلبية كبيرة في الفواصل الزمنية من 4 إلى 8 اسابيع فقط. يمكن ملاحظة أن القوة الهجين لوزن الجسم كان له تأثير إيجابي معنوي للصلبان SI X RI والصلبان العكسيه RI XSI و RI XF. في حين كانت القوة الهجين لزيادة وزن الجسم تأثير إيجابي كبير لجميع معبر diallel باستثناء الصلبان F X RI. كانت التأثيرات المضافة المباشرة سلبية للخط الفيومى على حد سواء وزن الجسم والوزن مكاسب في عمر مختلف من هذه الدراسة. لكن هذه التأثيرات المتبادلة كانت إيجابية بالنسبة لخطوط سيناء ورودلاند الحمراء لكل من وزن الجسم ووزن الجسم. أظهرت هذه التوزيعات أن التلاعب RI XSI beter من SI X RI لكل من وزن الجسم ووزن الجسم. كان تأثير الأمهات من وزن الجسم وزيادة وزن الجسم تأثير إيجابي كبير عند الفقس ، ل FF و SI SI. في حين ، كان له تأثير سلبي كبير ل RIRI. من ناحية أخرى ، كانت إيجابية كبيرة لوزن الجسم عند الفقس و 4 أسابيع من العمر فقط. في حين أن تأثير الأمهات كان إيجابيا في الفترات الفاصلة بين 0 و 4 أسابيع فقط. أظهر الأخير أن تأثير الأمومة كان له دور أساسي في الجسم وزيادة وزن الجسم .أوصى الصلبان المستخدمة سيناء و رود آلاند باللون الأحمر لإنتاج سلالات اللحوم التجارية في الأجواء الحارة.