Egyptian Journal of Rabbit Science, 18 (2) 135 – 144 (2008)

EVALUATION OF CROSSBREEDING EFFECTS FOR SOME LITTER TRAITS IN CROSSING OF CALIFORNIAN WITH EGYPTIAN BALADI RED RABBITS

M.M.S. Mabrouk*; M.A. Aboul-Hassan*; G.E.Y. Attalah*; A. Farid ** and M. G. Gharib*

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

***Animal Production Research Institute, Ministry of Agriculture, Dokki, Cairo, Egypt.*

A crossbreeding experiment [between Californian, CAL, and Baladi Red, BR, rabbits] was carried out during two consecutive years of production starting in September 2005 to August 2007 to estimate direct (individual) and maternal heterosis (H^I & H^m), direct and maternal additive effect (G^I & G^m). Also direct recombination effects (R^I) were genetically evaluated for some litter traits [litter size at birth and at weaning (LSB&LSW), number born alive (NBA), litter weight at birth and at weaning (LWB & LWW) and litter weight gain and Daily litter weight gain (LWG&DLWG)]. Estimates of (H^I) were positive and significant (P<0.05 or P<0.01) for all litter traits studied except LSW. Estimates of H^m were found to be positive and significant (P<0.05 or P<0.01) for LWB, LWW, LWG and DLWG. Estimates of G^I and G^M were significant (P<0.01) for LWB, LWW and LWG, with superiority of CAL sires and dams over BR ones. R^I effects were positive in all traits and were significant (P<0.01) for LWB, LWW, LWG and DLWG.

Key words: Baladi Red rabbits, crossing, heterosis, additive effect, direct recombination effects.

Performance comparisons among breeds and their crosses are justified because genetic differences among breeds or strains are large relative to genetic variation within breeds (Dickerson, 1992). These differences are an important potential source of genetic improvement in the efficiency of human food production from rabbits through gains in performance from complementary breed effects and hetrosis in crossbreeding (El-Deghady, 2005). Crossing local Egyptian breeds of rabbits with exotic ones was associated, in most cases, with an improvement in doe litter traits (Khalil *et al.*, 1995). Crossbreeding among available Egyptian breeds (e.g. Baladi, Baladi Red, Baladi Black, Gabali, Giza White) with foreign breeds (Bauscat, Californian, Giant Flander, New Zealand White, V-Line, White Flander) has been extensively used in Egypt (Afifi and Emara, 1987; Afifi and Khalil, 1989; El-Desoki, 1991; Khalil, *et al.*, 1995; Nayera, *et al.* 1999; Abou-Khadiga, 2004 and Khalil *et al.*, 2005) where by existing breed differences from a heterotic and complementary standpoint are utilized. Breed differences, direct and maternal heterosis, maternal additive affects and direct additive effect from crossbreeding experiments of rabbits were shown to be important for improving the reproductive performance of rabbits.

The objectives of the present work were to study crossbred effects produced from crossing Baladi Red rabbits (as an induced Egyptian local breed) with Californian rabbits (as an exotic breed), i.e. direct and maternal heterotic effects and direct and maternal additive effects as well as recombination effects.

MATERIALS AND METHODS

The experimental work of this study was carried out in the Experimental Rabbit flock maintained by the Department of Animal Production, Faculty of Agriculture, Al-Azhar University, Nasr City, Cairo, Egypt during two consecutive years of production starting from September 2005 to August 2007, used Baladi Red (BR) as local breed of rabbit and Californian (CAL) breed raised under the Egyptian conditions as exotic breed of rabbit. According to the breeding plan, bucks were assigned at random to breed the does with a restriction to avoid full-sib, half-sib and parent offspring mating. Each buck was allowed to sire all litters given by 3-4 does throughout the study. Culled or dead does and bucks during the experimental period were replaced by their substitutes from the same breed from the original stock. Mating groups, number of sires, dams, does, bucks and litters born used in the analysis for different genetic groups are presented in Table 1.

Rabbits were raised in a semi-closed rabbitry. Breeding does and bucks were housed separately in individual wire-cages with standard dimensions arranged in double-tier batteries of type. According to the breeding plan, each doe was transferred to the cage of the assigned buck to be mated and returned back to her own cage after being mated. Each doe was palpated 10 days thereafter to determine pregnancy. Does that failed to

Table 1. Mating groups and number of sires, dams, does, bucks and litters used in different genetic groups of the study.

Breed of			Number of				
Doe	**Sire of doe**	**Dam of doe**	**Doe**	**Sire of doe**	**Dam of doe**	**Buck**	**Litter**
CAL	CAL	CAL	49	28	36	27	231
BR	BR	BR	41	19	26	20	199
1/2CAL 1/2 BR	CAL	BR	33	15	20	15	162
1/2 BR 1/2 CAL	BR	CAL	38	15	26	15	167
3/4 CAL 1/4 BR	CAL	1/2 CAL 1/2BR	39	13	30	15	164
3/4 BR 1/4 CAL	BR	1/2BR1/2 CAL	37	12	21	16	136
			237	101	159	61	1059

CAL= Californian, BR= Baladi Red.

conceive were returned to the same mating buck to be re-mated until a service was observed. Weaning occurred at 28 days after birth, and young rabbits were sexed and tattooed and transferred to other batteries to be housed in groups of 3 to 4 individuals in standard progeny wire cages equipped by feeding hoppers and drinking nipples. The rabbits were fed *ad-libitum* on commercial pelleted ration, which could provide 16.3% crude protein, 13.2% crude fibers and 2.5% fat. Rabbits were kept under the same managerial, hygienic and environmental conditions.

Data and models of analysis:

The crossbreeding components for litter traits included litter size and weight at birth and weaning (four weeks), number born alive, pre-weaning daily and litter weight gain (LSB, LWB, LSW, NBA, DLWG and LWG; respectively) were estimated using a universal program for crossbreeding effect (CBE) version 4.0 (Wolf, 1996). Coefficients of expected contribution for genetic effects of six genetic groups were computed according to Dickerson (1969 and 1973) and presented in Table 2.

Direct heterosis effect (H^I):

$H^I_{CAL \times BR}$= 0.5 [(CAL x BR) + (BR x CAL) – (BR x BR)-(CAL x CAL)]

H^I % = {H^I in units / 0.5 [(CAL x CAL) + (BR x BR)]} x 100.

Maternal heterosis effect (H^m):

H^m_{CALxBR} = 0.5 [(CAL x ½ CAL ½ BR) + (BR x ½ BR ½ CAL)] – 25 [(CAL x CAL) + (BR x BR) + (CAL x BR) + (BR x CAL)]

H^m % = {H^M in units / 0.25 [(CAL x CAL) + (BR x BR) + (CAL x BR) + (BR x CAL)]} x 100.

Table 2. Coefficients of expected contribution for genetic effects in different genetic components groups of purebreds and crossbreds as computed by Dickerson (1969& 1973) model.

Breed of		H^I	H^m	G^I	G^m	R^I
Sire	**Dam**					
CAL	**CAL**	-0.5	-0.25	0.5	0	-1
BR	**BR**	-0.5	-0.25	-0.5	0	-1
CAL	**BR**	0.5	-0.25	0.5	-0.5	-1
BR	**CAL**	0.5	-0.25	-0.5	0.5	-1
CAL	**1/2CAL 1/2BR**	0	0.5	0	0	2
BR	**1/2BR 1/2CAL**	0	0.5	0	0	2

CAL= Californian, BR= Baladi Red rabbits, $\mathbf{H^I}$ = Direct heterosis, $\mathbf{H^m}$ = Maternal heterosis, $\mathbf{G^I}$ = Direct additive effect, $\mathbf{G^m}$ = Maternal additive effect, $\mathbf{R^I}$ = Direct recombination effect.

Direct additive effect (G^I):

$(G^I_{CAL}-G^I_{BR})$ =0.5{[(CAL x CAL)+(CAL x BR)] – [(BR x BR) +(BR x CAL)]}.

Maternal additive effect (G^m):

$(G^m_{CAL}-G^m_{BR})$ = (BR x CAL) - (CAL x BR).

Direct recombination effect (R^I):

R^I = 2[(CAL x 1/2CAL1/2BR) + (BR x 1/2BR1/2CAL)] – [(CAL x CAL) + (BR x BR) + (CAL x BR) + (BR x CAL)].

RESULTS AND DISCUSSION

Direct heterosis (H^I):

Estimates of direct heterosis indicated that crossing between Californian (CAL) with Baladi Red (BR) rabbits were positive and significant (P<0.05 or P<0.01) for all traits studied except LSW (Tables 3 & 4).

Many crossbreeding experiments were carried out in Egypt (e.g. Afifi and Khalil, 1989; Khalil and Afifi, 2000; Khalil *et al.* 2002, Abou-Khadiga, 2004; El-Deghady. 2005; Khalil *et al.* 2005; Gharib, 2004 and others) reported that heterotic effects were evident in most of the possible crossbred combinations for litter.

Heterotic effect was lower at birth than at weaning for litter weight (9.1% vs. 17.6%). This is expected since maternal and milking ability effects decreased with advance of litter's age and consequently the non-additive

Tables 3. Means of litter size traits among the different mating group's±SE, direct heterosis (H^I), maternal heterosis (H^m), maternal additive effect (G^m), direct additive effect (G^I) and direct recombination effect (R^I).

Mating groups	No.	LSB	NBA		LSW
		Mean ± SE	Mean ± SE	No.	Mean ± SE
Significant		**	**		***
CAL X CAL	231	7.6 ± 0.17	6.4 ± 0.17	220	5.0 ± 0.18
BR X BR	199	6.4 ± 0.19	5.8 ± 0.18	١٨٤	4.2 ± 0.19
CAL X BR	162	7.6 ± 0.20	6.8 ± 0.20	١٥٠	5.1 ± 0.21
BR X CAL	167	8.5 ± 0.20	7.2 ± 0.19	١٦١	5.4 ± 0.20
CAL X 1/2CAL1/2BR	164	8.0 ± 0.20	7.1 ± 0.19	147	5.3 ± 0.21
BR X 1/2BR 1/2CAL	136	7.9 ± 0.22	7.0 ± 0.21	١١٩	5.1 ± 0.22
H^i Unit		$1.05 \pm 0.42^{**}$	$0.90 \pm 0.41^{*}$		0.65 ± 0.41^{ns}
Percent		15.0 %	14.8 %		14.1 %
H^m Unit		0.43 ± 0.37^{ns}	0.50 ± 0.35^{ns}		0.28 ± 0.36^{ns}
Percent		5.7 %	7.6 %		5.7 %
G^i		0.07 ± 0.35^{ns}	9.99 ± 0.33^{ns}		0.23 ± 0.34^{ns}
G^m		0.49 ± 0.27^{ns}	0.20 ± 0.27^{ns}		0.16 ± 0.27^{ns}
R^i		1.7 ± 1.4^{ns}	2.00 ± 1.4^{ns}		1.1 ± 1.4^{ns}

CAL= Californian, BR= Baladi Red rabbits, LSB = Litter size at birth, NBA = Number born alive, LSW = Litter size at weaning,*= P<0.05, ** = P<0.01, *** =P<0.001, ns = Non- significant,

genetic effects could express those selves later at weaning age more than earlier at kindling. Similar findings were obtained by Abd El-Aziz (1998).

Maternal heterosis (H^m):

Estimates of maternal heterosis were positive and significant (P<0.05 or P<0.01) for LWB, LWW, LWG and DLWG, and non – significant for litter size traits (Tables 3 & 4).

The positive estimates of maternal heterosis for litter traits in the present study are agreement with resultus of Khalil *et al.* (2002) on LSW. The same authers reported that this is favourable and indicating that crossbred dams could produce larger litter size associated with lighter litter weight at weaning than their crossbred daughters.

Results obtained from the different crossbreeding experiments carried out in Egypt (e.g. Nofal *et al.,* 1996; Khalil *et al.,* 2002; Abou-Khadiga, 2004 and Khalil *et al.*, 2005) revealed that maternal heterotic effects were evidenced in most of the crossbred dams for litter size and litter

Tables 4. Means of litter weight traits among the different mating groups±SE, direct heterosis (H^I), maternal, heterosis (H^m), maternal additive effect (G^m), direct additive effect (G^I) and recombination effect (R^I) on litter weight traits.

Mating group	No.	LWB	No.	LWW	LWG	DLWG
		Mean±SE		Mean±SE	Mean±SE	Mean±SE
Significant		**		**	**	**
CAL X CAL	231	343±04.8	220	1960±67.5	1598±62.0	55.9±2.20
BR X BR	199	319±10.7	184	1669±72.8	1365±66.8	49.4±2.30
CAL X BR	162	354±11.9	150	2108±79.9	1692±73.4	59.9±2.60
BR X CAL	167	368±11.6	161	2161±77.0	1701±70.8	60.4±2.50
CAL X 1/2CAL1/2BR	164	364±11.9	147	2150±78.8	1785±72.6	61.3±2.60
BR X 1/2BR 1/2CAL	136	359±11.6	119	2032±78.8	1673±79.3	58.4±2.80
H^i Unit		29.95±2.2**		320.20±2.18**	215.2±8.21**	7.50±1.48**
Percent		9.1%		17.6 %	14.5 %	14.2 %
H^m Unit		15.43±1.89**		116.45±1.89**	140.1±1.89**	3.45±1.29**
Percent		4.5 %		5.6%	8.8 %	6.1 %
G^i		7.14±1.41**		118.67±1.78**	112.1±1.78**	3.0±1.21**
G^m		4.76±1.78**		26.62±1.41**	4.5±1.41**	0.27±0.96ns
R^i		61.70±7.56**		465.80±7.56**	560.4±7.56**	13.8±5.14**

CAL= Californian, BR= Baladi Red rabbits, LWB = Litter weight at birth, LWW = Litter weight at weaning, LWG = Litter weight gain, DLWG = Daily litter weight gain, * = P<0.05, ** = P<0.01, *** =P<0.001, ns = Non- significant, weight. Moreover, Nofal *et al.* (1996) reported that maternal heterosis appeared to be more important than direct heterosis in most litter traits.

Direct additive effect (G^i):

Estimates of direct additive were found to be significant (P<0.01) for LWB, LWW, LWG and DLWG, while, they were not significant for litter size traits and favour of CAL bucks (Tables 3&4). The superiority of CAL bucks over BR ones encourage breeders to use CAL bucks as terminal sires in crossbreeding experiments in Egypt. Abou-Khadiga (2004) found a significant G^i effect (P<0.05 or P<0.01) on litter traits with superiority of line V bucks over Baladi Black ones, encourage breeders to use line V bucks as terminal sires in crossbreeding experiments in Egypt. Khalil and Afifi (2000) and Khalil *et al.* (2002) reported that New Zealand White rabbits had higher estimates of G^i than Gabaly rabbits for litter weight at birth and weaning (P<0.01 or P<0.001) in crossbreeding experiment involving the two breeds. While, Abd El-Aziz, (1998), Nayera *et al.* (1999), El-Deghady, (2005) found non-significant breed-of-buck effect on most litter traits studied.

Maternal additive effect (G^m):

Estimates of maternal additive effect was found to be significant (P<0.01) for LWB, LWW and LWG, while, it was not significant for LSB, NBA, LSW and DLWG, which were favour to CAL dams (Tables 3 & 4).

The superiority of Californian dams over Baladi Red ones could be attributed to be favorable maternal abilities, presumably due to increasing milk production levels compared to BR does. Abou-Khadiga (2004) found significant (P<0.01) maternal additive effect for litter traits (LSB, NBA, LWB, LW at 7, 14, 21 days, LWW) except LSW and showed that superiority of line V dams over Baladi Black ones. These results confirmed well with the previous ones obtained by the Egyptian researchers who reported a general trend indicating that litters motherd (direct plus maternal additive effects) by exotic breeds (e.g. New Zealand White, Californian, V… etc) recorded better performance than litters motherd by native breeds (e.g. Giza White, and Baladi rabbits). Also the present results are in agreement with those obtained by Khalil *et al.* (1995) who concluded that the crossbred litters resulted from crossing Baladi Red bucks with New Zealand White does were generally associated with superiority compared to its reciprocal cross.

Direct recombination effects (R^i):

Estimates of direct recombination effect were significant (P<0.01) for LWB, LWW, LWG and DLWG, while, they were not significant for LSB, NBA and LSW (Tables 3 & 4). Khalil *et al.*, (2002) found that estimates of R^i effects were significant (P<0.01) for LSB and LWG. However, Khalil *et al.* (2005) and El-Deghady (2005) reported that the estimates of R^i for all pre-weaning litter traits (LSB, LSW, LWB, LWW) in crossbred does were non-significant.

Conclusively, it could be recommended to use Californian (CAL) rabbit breeds as a terminal sire and dam in the cross breeding plane when native breed is used In Egypt.

REFERENCES

Abd El-Aziz, M.M. (1998). Crossbreeding between Al-Gabali and New Zealand White rabbits in the North coast-belt of the Egyptian Western desert. Ph.D. Thesis, Faculty of Agriculture, Moshtohor, Zagazig University, Banha Branch, Egypt.

Abou-Khadiga. S. (2004). Performance of the Spanish synthetic line (V) and the local Baladi Black rabbits and their crosses under Egyptian conditions. M. Sc. Thesis, Faculty of Agriculture, Kafr El-Sheikh, Tanta University, Egypt.

Afifi, E.A. and Emara, M.E. (1987). Litter size in local Egyptian and exotic breeds of rabbits and their crosses. *Journal Applied Rabbit Research*, **10** (1): 26-29.

Afifi, E.A. and Khalil, M.H. (1989). Observations on purebred and crossbred litters of Giza White and Grey Giant Flander rabbits in Egypt. *Journal Applied Rabbit Research*, **12**: 373-277.

Dickerson, G.E. (1969). Techniques for research in quantitive genetic. *Techniques and procedures in Animal Science, Research, American Society of Animal Science*, Champaign, II. C.F.

Dickerson, G. E. (1973). Inbreeding and heterosis in animals. In: Proc. Animal Breeding and Genetics Symp. In honor of Dr. Jay L. Lush. *American Society of Animal Science*, pp. 54-77.

Dickerson, G. E., (1992). *Manual for Evaluation of Breeds and Crosses of Domestic Animals.* Publications Division , FAO, Rome, Italy.

El-Deghady. S. A. (2005). Genetic evaluation for some productive traits in rabbits. Ph.D. Thesis, Faculty of Agriculture, Moshtohor, Zagazig University, Banha Branch, Egypt.

El-Dessoki, A.E.M. (1991). Study of the effect of some genetic and environmental factors affecting meat yield from some foreign and local breeds of rabbits and their crosses. M.Sci. Thesis, Faculty of Agriculture., Mansoura Univ., Egypt.

Gharib, M.G. (2004). A comparative study of reproductive traits and growth rates in Baladi Red and Bauscat rabbits and their crosses. M.Sci. Thesis, Faculty of Agriculture, Al-Azhar University, Nasr-City, Cairo, Egypt.

Khalil, M. H. and Afifi, E. A. (2000). Heterosis, maternal and direct additive effects for litter performance and postweaning growth in Gabali rabbits and their F_1 crosses with New Zealand White. *7th World Rabbit Congress*, Valencia, Spain. Vol., **A**: 431-437.

Khalil, M. H.; Afifi, E. A.; Farid, A. and Youssef, Y. M. K. (2002). Estimation of crossbreeding effects for some litter traits in crossing of New Zealand White with Egyptian Gabali rabbits. *Egyptian Journal Rabbit Science*, **12**(2): 143-153.

Khalil, M.H.; Afifi, E.A.; Youssef, Y.M.K. and Khadr, A.F. (1995). Heterosis, Maternal and direct genetic effects for litter performance and reproductive intervals in rabbits crosses. *World Rabbit Science*, **3**(3): 99-105.

Khalil, M.H.; Garcia, M.L.; El-Dobaib, S.N.; Al-Homidan, A.H. and Baselga, M. (2005). Genetic evaluation of crossbreeding project involving Saudi and Spanish V-Line rabbits to synthesize new maternal lines in Saudi Arabia: 1. Pre-weaning litter, lactation traits and feeding parameters. *The 4th International Conference On rabbit Production In Hot Climate*, Sharm El-Sheikh, Egypt, 89-99 (2005).

Nayera, Z. Bedier; Afifi, E.A. and Gad, S.M. (1999). Genetic study of litter and doe reproductive traits in Gabali, Californian rabbits and their crosses under semi-arid conditions of Egypt. *Minufiya Journal of Agriculture Research*, **24** (5): 1651-1666.

Nofal, R.Y.; Toth, S. and Virag, G.Y. (1996). Evaluation of seven breed groups of rabbits for litter traits. *6th World Rabbit Con.,* Toulouse, France, Vol. **2**: 335-339.

Wolf, J. (1996). *User's Manual for the Software Package (CBE)*. Version 4.0. A universal program for estimating crossbreeding effects. Research Institute of Animal Production, Department of Genetics and Biometrics, Praha Uh? ?nçves, Czech Republic.

تقييم تأثير الخلط على بعض صفات خلفة البطن في خلطة أرانب الكاليفورنيا مع البلدي الأحمر

محمد منير شعبان مبروك[١], محمد آبو الحسن احمد[١], جمال الدين يوسف عطاالله احمد فريد محمود[٢], محمود غريب غريب محمد[١]

[١]قسم الإنتاج الحيواني- كلية الزراعة- جامعة الأزهر- القاهرة- ج. م. ع.

[٢]معهد بحوث الإنتاج الحيواني- مركز البحوث الزراعية- الجيزة- ج.م.ع.

أجريت هذه الدراسة في مزرعة الأرانب البحثية بكلية الزراعة- جامعة الأزهر بمدينة نصر- القاهرة - مصر خلال سنتين إنتاجيتين متتاليتين بدأت في سبتمبر ٢٠٠٥م إلي أغسطس ٢٠٠٧. استخدم في هذه الدراسة سلالتين من الارانب:- الكاليفورنيا CAL (سلالة أجنبية) و البلدي الاحمر BR (سلالة محلية) لانتاج ٦ مجموعات تربوية (CALCAL, BRBR, ١/٢CAL١/٢BR, ١/٢BR١/٢CAL, ٣/٤CAL١/٤BR, ٣/٤BR١/٤CAL)

و ذالك لتقدير تأثير قوة الهجين فى الخلطان و فى الأم و التأثيرات المضيفة المباشرة و الأمية وأيضا تأثير إعادة توليف الجينات فى الفرد على بعض صفات خلفة البطن.

و أوضحت الدراسة النتائج الآتية:-

- أدى الخلط بين سلالتي البلدي الاحمر و الكاليفورنيا إلى تحسين كل الصفات المدروسة و كانت القيم موجبة .
- أدى الخلط الرجعى بين إناث الجيل الأول الخليط والآباء النقية من كلا النوعين إلى وجود قوة خلط أمية موجبة و أظهرت تأثير معنوي على صفات حجم البطن عند الميلاد و عند الفطام و معدل الزيادة في وزن خلفة البطن من الميلاد حتى الفطام و معدل الزيادة اليومية في وزن خلفة البطن من الميلاد حتى الفطام.
- كان التأثير المباشر المضيف معنويا على صفات حجم البطن عند الميلاد و حجم البطن عند الفطام - معدل الزيادة من الميلاد حتى الفطام و معدل الزيادة اليومية من الميلاد. وفى صالح ذكورارانب الكاليفورنيا .
- كان التأثير آلامي الضيف غير معنوي بالنسبة لصفات حجم البطن عند الميلاد و حجم البطن عند الفطام - معدل الزيادة من الميلاد حتى الفطام وفى صالح اناث الارانب الكاليفورنيا .
- كان الفقد موجبا نتيجة لإعادة اتحاد التداخل بين التأثيرات المضيفة و أظهرت تأثير معنوي على صفات حجم البطن عند الميلاد و حجم البطن عند الفطام - معدل الزيادة من الميلاد حتى الفطام و معدل الزيادة اليومية من الميلاد.