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LITTER WEIGHT AND MEAN BUNNY WEIGHT PER LITTER IN TWO STANDARD BREEDS OF RABBITS RAISED IN ADVERSE ENVIRONMENT

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SUMMARY

Records of 464 litters from New Zealand White (NZW) and 443 litters from Californian (Cal) were collected from the Suez Canal University Experimental Rabbitry located in Ismailia, Ismailia Governorate, Egypt, to investigate the rabbit doe performance concerning genetic and non-genetic aspects of litter weight (LW) and mean bunny weight per litter (MBW).

NZW rabbits recorded relative superiority in performance for traits studied over that of Cal ones. Litter weight showed moderate coefficients of variation which was relatively higher than those obtained for mean bunny weight per litter in both breeds. The relatively high magnitude of phenotypic variation for most studied traits revealed the possibility of phenotypic selection for those traits especially associated with high or moderate heritability estimates. Year-season combination affected significantly litter traits under study in the two breeds except MBWW in NZW and MBWB, MBW14, MBW21 and MBWW in Cal rabbits. Also, the performance of these two breeds of rabbits increased a lot in winter and autumn seasons compared to summer season (hot weather) irrespective of the year of production. Parity failed to prove any significant effect on all doe traits in the two breeds except MBW at 14 and 21 days of age in Cal rabbits. Paternal half-sib heritability estimates varied from low to moderate in Cal (0.046 to 0.344) while they were generally lower in NZW compared to those of Cal (0.034 to 0.309).

Keywords: Rabbits, litter weight, bunny weight, restricted maximum likelihood, genetic and non-genetic aspects

INTRODUCTION

Development of breeding programs depends upon accurate knowledge of both genetic and environmental parameters as well as genetic trends. Little is known about the estimates of genetic and phenotypic parameters for the economically important traits in rabbits as compared to other livestock animals. Estimation of co-variance components is important for animal breeders since these components are required for the estimation of genetic parameters and the design of breeding programs. Heritability which is a function of genetic component of variance, provides information about the genetic nature of traits and is extremely needed for genetic evaluation and selection strategies. Maximum Likelihood (ML) method presented by Hartley and Rao (1967) was used for the estimation of co- variance components in the general linear mixed model was followed by the Restricted Maximum Likelihood, REML (Patterson and Thompson, 1971). REML is preferably used for unbalanced data (with unequal subclass numbers) the case commonly found in biological experiments, for non-linear equations and could be used to remove bias due to selection along with accounting efficiently for the relationship genetic ties (Henderson, 1975).

The present study was undertaken to evaluate and to quantify the non-genetic fixed effects affecting preweaning litter weight and mean bunny weight traits in New Zealand White and Californian rabbits (the two commonly and widely exotic breeds raised nowadays in Egypt) and to estimate the genetic variances and heritabilities for these traits (applying the sire model, unrelated sires) using REML procedure.

MATERIALS AND METHODS

Data of the present study consisted of 464 New Zealand (NZW) and 443 Californian (CAL) rabbit field records collected on litter traits for genetic and environmental evaluation from the Rabbitry of the Faculty of Agriculture, Suez Canal University, Ismailia, Egypt.

Rabbits used belong to New-Zealand White (NZW) and Californian (Cal) breeds. Females within each breed were randomly divided into groups of five to seven does per each. A buck from the same breed was assigned at random for mating each doe group with the restriction of avoiding parent-offspring and sib matings. Matings started in winter-1992 and stopped at the end of spring-1994. All-over the period of the study each buck was allowed to sire all litters from his assigned female-group.

Data of NZW and Cal rabbit does pertaining to litter weight and mean bunny weight per litter recorded at birth, 7, 14, 21and 35 days of age (i.e. weaning) were analyzed separately using the mixed model of the Least Squares and Maximum Likelihood Computer Program PC version 2 (Harvey, 1990). The sire model adopted for analyzing the data comprised the effect of sire of doe (as random effect) in addition to the effects of year-season combination and parity (as fixed effects). Because of the presence of many empty cells due to the limitation of the data, it was not possible to include the possible interactions between factors of the model of analysis. Accumulative orthogonal set of three contrast statements (SAS, 1990) were used to separate the season effect from the year season combination. Single degree of freedom contrast statements were also used for separation of season means.

Heritability estimates were computed for each breed separately, using paternal half sib relationships, as four times the intra-class correlation coefficient between sire groups using variance components estimated by restricted maximum likelihood procedure: $h^2_s = 4\sigma^2 s \ / \ (\sigma^2 s + \sigma^2 e)$. The standard errors of heritability were calculated according to Swiger *et al.*, 1964 and cited by Harvey (1990) as:

$$SE\,(h^2_s) = 4\,[\{2(n.-1)(1-t)^2[1+(k-1)t]^2\}/\{k^2(n.-s)(s-1)\}]^{0.5}$$

where; n. = total number of observations; t = sire intraclass correlation; k = weighing value of sire groups and s = number of sires.

RESULTS AND DISCUSSION

Means and coefficients of variation of uncorrected records:

Actual means, standard deviations (SD) and coefficients of variation (CV%) for litter weight (LW) and mean bunny weight per litter (MBW) in New Zealand White (NZW) and Californian (Cal) rabbits at different post-kindling stages (i.e. at birth, 7, 14, 21, and weaning) are given in Table 1.

Table 1. Actual means, standard deviations (SD) and coefficients of variations (CV%)*for Litter weight and mean bunny weight per litter trait in New Zealand White and Californian rabbits

Trait	New Zealand White				Californian			
	N	Mean	SD	CV%	N	Mean	SD	CV%
LWB	464	382.94	124.33	31.13	443	353.90	107.73	29.82
LW7	413	639.78	228.17	34.28	401	596.83	352.17	58.27
LW14	409	1032.72	1032.72	32.21	392	964.27	332.09	32.86
LW21	396	1428.94	445.18	29.61	380	1342.59	431.57	30.56
LWW	394	2841.71	980.95	33.36	380	2601.80	952.29	35.24
MBWB	464	56.43	12.33	21.77	443	50.94	9.91	19.43
MBW7	413	117.84	31.20	25.06	401	105.35	23.27	21.07
MBW14	409	206.07	206.07	26.17	392	185.85	47.19	24.34
MBW21	396	300.86	300.86	29.30	380	273.76	73.02	25.77
MBWW	394	617.15	155.93	24.61	380	554.69	125.36	22.11

* Coefficient of variation computed as the square root of the residual mean square divided by the actual mean of a given litter trait according to Harvey (1990).

LWB= Litter weight at birth; LW7 = Litter weight at 7 days; LW14 = Litter weight at 14 days; LW21 = Litter weight at 21 days; LWW = Litter weight at weaning ; MBWB = Mean bunny weight per litter at birth; MBW7 = Mean bunny weight per litter at 7 days; MBW14 = Mean bunny weight per litter at 14 days; MBW21 = Mean bunny weight per litter at 21 days; MBWW = Mean bunny weight per litter at weaning, ** Weaning was performed at 35 days post kindling.

Means of LW and MBW for the present work are within the ranges reviewed in different Egyptian studies (e.g. El-Maghawry *et al.*, 1988; Yamani 1991a,b; Afifi *et al.*, 1992;Youssef., 1992; Abdel-Raouf, 1993 ; Khalil.,1993a and Khalil *et al.*, 1995) and are relatively lower than those reported in non-Egyptian studies (e.g. Lukefahr *et al.*, 1984; Ferraz *et al.*, 1991b; Roberts and Lukefahr, 1992 and Nofal *et al.*, 1996). Therefore, it could be mentioned that the genetic potentialities of the two standard breeds (NZW and Cal) raised in Egypt have not been fully expressed.

Data of LW and MBW also demonstrated that most means of the two breeds studied reveal that NZW rabbits had slightly better means than Cal ones without any exception. These results are in agreement with those obtained by some investigators (e.g. Roberts and Lukefahr, 1992 and Abdel-Raouf, 1993). This superiority of NZW does may be due to their superior genetic background and their advanced selection stages. Blasco *et al.*, (1992) and Khalil (1993a) ascribed the superiority of NZW does to their excellence in their prenatal (ovulation rate, fetal survival, uterine capacity, intra-uterine environment, ... etc.) and postnatal (milk production, maternal behavior, caring ability, ... etc.) maternal abilities.

Coefficients of variability (CV%) in the present study (Table 1) are mostly moderate in litter traits under consideration (i.e. LW and MBW) for each of the two breeds (ranged from 29.61 to 34.28% in LW and from 21.77 to 29.30% in MBW in NZW rabbits while the corresponding ranges in Cal were 29.82- 58.27 and 19.43- 24.34 %). Moderate variabilities (CV%) of post-natal LW and MBW traits indicate the possibility of phenotypic selection particularly in cases associated with high heritability estimates.

As expected, variability in LW traits were higher in all cases compared with those of MBW ones this could be due to that the variability in means are less than the variability in individual values. High CV % of post-natal litter traits may be due to the presence of high phenotypic variations in milk production which in turn increases with advance of age (Ahmed, 1997). Khalil *et al.* (1987) attributed the high coefficient of variation of litter traits to be due to the maternal differences in milk production which exert their effects on the offspring during the pre-weaning period when the mother's milk is the main supply of nutrients. Blasco *et al.* (1992) attributed the high variation in litter traits at birth to high variation in ovulation rate, embryo and fetus survival and uterine capacity.

Year Season effect

Least squares analysis of variance revealed that year-season combination effect on LW in both NZW and Cal rabbits were consistently significant at all ages studied (Table 2). Similarly, year-season effects were reported to be a significant source of variation on most litter weight traits by Ferraz *et al.* (1991a&b); Khalil *et al.* (1995) and Ahmed (1997). On the contrary, Abdel-

Raouf (1993) was not able to detect any significant effect of year-season on LWB in NZW and Cal rabbits. Also Khalil (1993b) reported that year-season effect did not compose any significant source of variation in LW21 and LWW in Giza White rabbits. Season effect determined by cumulative orthogonal contrast was proven to be a significant factor on studied LW traits in both breeds except on LWB and LWW in NZW. Yamani *et al.* (1991a) with NZW and Youssef (1992) with NZW, Baladi Red and their crosses illustrated that litter weight at birth, 21 days and weaning was significantly affected by season of kindling.

Table 2. F-ratios of least squares analysis of variance of different factors affecting litter weight traits in New Zealand White and Californian rabbits

Source of variation	F-Ratio									
	df	LWB	df	LW7	df	LW14	df	LW21	df	LWW
New Zealand White										
Sire of doe	22	2.38***	22	1.15	22	0.83	22	1.03	22	0.98
Year-season	5	3.61**	5	4.02**	5	4.11**	5	4.96***	5	2.25*
Parity	8	0.80	8	0.50	8	0.17	8	0.56	8	0.93
Remainder df	428		377		373		360		358	
Remainder MS		14207.99		48107.90		110656.11		179048.40		898889.19
Californian										
Sire of doe	20	1.08	20	0.43	20	1.17	20	1.38	20	1.12
Year-season	5	3.06*	5	2.92*	5	3.81**	5	3.90**	5	2.90*
Parity	8	1.69	8	1.07	8	1.16	8	0.84	8	0.59
Remainder df	409		367		358		346		346	
Remainder MS		11138.46		120967.18		100428.39		168377.86		841055.01

LWB= Litter weight at birth; LW7 = Litter weight at 7 days; LW14 = Litter weight at 14 days; LW21 = Litter weight at 21 days; LWW = Litter weight at weaning

* Significant at ($P \leq 0.05$), ** Significant at ($P \leq 0.01$), *** Significant at ($P \leq 0.001$), otherwise they were not significantly differ.

Considering least squares analysis of MBW traits (Table 4), data revealed that year-season constituted a significant source of variation at all ages studied except at weaning in NZW while in Cal it failed to prove their importance except on MBW7. Khalil *et al.* (1995) with NZW and Baladi Red and Ahmed (1997) with NZW and Cal reported that MBWB and MBW21 varied significantly with year-season. Yamani *et al.* (1991a) with NZW and Youssef (1992) with NZW, Baladi Red and their crosses noted that mean bunny weight per litter was significantly affected by season at birth, 21 days and weaning.

The season least squares means determined by contrasts indicated that the significant lightest litter weights at all ages studied, were generally given by does kindled during summer season in the two breeds except LWB in Cal. Also, The heaviest LWs were in general, acquired by litters kindled during winter and autumn in NZW and winter in Cal rabbits, which also can be seen from the least squares means of the year-season combinations (Table 3). Considering least squares means of MBW in both breeds (Table 5), the highest figures were reached by does kindled during Winter at most ages studied.

Table 3. Least squares means (± SE) of litter weight traits* of New Zealand White and Californian rabbits as affected by different year-seasons and parity

Independent variable	N	LWB Mean±SE	N	LW7 Mean±SE	N	LW14 Mean±SE	N	LW21 Mean±SE	N	LWW Mean±SE
New Zealand White										
Year-season										
Winter 92	64	415 ±30	59	687 ±52	59	1188 ± 77	59	1603 ±100	59	3046 ±223
Spring 93	131	420 ±24	119	638 ±37	118	1084 ± 55	110	1444 ± 74	110	2858 ±165
Summer 93	69	336 ±23	60	507 ±37	59	882 ± 55	59	1183 ± 70	59	2387 ±157
Autumn 93	47	373 ±24	41	665 ±39	41	1073 ± 57	40	1502 ± 74	40	2753 ±166
Winter 94	69	350 ±23	60	614 ±37	60	955 ± 54	58	1353 ± 71	57	2589 ±158
Spring 94	84	353 ±25	74	576 ±42	72	929 ± 64	70	1295 ± 84	69	2609.±187
Parity										
1	116	360 ±26	108	633 ±42	109	1005 ± 63	108	1404 ± 83	108	2799.±185
2	101	400 ±24	93	674 ±38	92	1045 ± 56	89	1486 ± 74	88	2978 ±165
3	88	395 ±23	79	670 ±37	78	1069 ± 55	72	1489 ± 73	72	2930 ±162
4	54	370 ±23	43	636 ±39	41	1030 ± 58	39	1446 ± 77	39	2957 ±171
5	38	364 ±25	31	617 ±42	31	1007 ± 63	31	1343 ± 80	31	2586 ±179
6	22	373 ±31	20	565 ±541	20	1018 ± 81	20	1367 ±104	20	2587 ±232
7	20	351 ±33	17	590 ±60.	16	1004 ± 93	16	1399 ±119	16	2630 ±266
8	12	358 ±41	10	547 ±78	10	1011 ±117	10	1223 ±150	10	2132 ±335
≥9	13	401 ±41	12	597 ±74	12	975 ± 111	11	1430 ±147	10	2766 ±342
Californian										
Year-season										
Winter 92	56	408 ±24	55	656 ± 81	55	1084 ± 76	55	1501 ±100	55	6013 ±219
Spring 93	109	386 ±17	100	536 ± 61	96	927 ± 58	91	1314 ± 79	91	2617 ±170
Summer 93	83	338 ±16	77	420 ± 54	75	806 ± 52	70	1127 ± 71	70	2274 ±152
Autumn 93	61	324.±16	56	611 ± 54	55	923 ± 52	55	1239 ± 70	55	2354 ±149
Winter 94	71	352 ±17	61	626 ± 60	59	997 ± 57	58	1355 ± 77	58	2584 ±165
Spring 94	63	349 ±22	52	559 ± 81	52	897 ± 75	51	1215 ± 99	51	2338 ±217
Parity										
1	113	319 ±18	110	613 ± 65	110	1000 ± 61	110	1388 ± 82	110	2665 ±176
2	88	367 ±18	80	671 ± 63	79	1071 ± 60	75	1422 ± 81	75	2702 ±175
3	71	365 ±17	66	628 ± 58	61	974 ± 56	54	1382 ± 77	54	2692 ±164
4	51	366 ±17	44	697 ± 61	43	903 ± 58	42	1301 ± 78	42	2522 ±168
5	40	370 ±18	34	543 ± 64	34	910 ± 60	34	1344 ± 80	34	2576 ±173
6	30	349 ±21	28	456 ± 71	28	842 ± 67	28	1147 ± 80	28	2227 ±192
7	23	337 ±26	18	467 ± 97	17	840 ± 91	17	1193 ±120	17	2443 ±263
8	16	412 ±30	12	496 ±114	11	975 ± 108	11	1293±142	11	2664 ±313
≥9	11	352 ±37	9	540 ±141	9	934 ± 130	9	1157 ±169	9	2279 ±376

* Traits as defined in Table 2.

Table 4. F-ratios of least squares analysis of variance of different factors affecting mean bunny weight per litter traits in New Zealand White and Californian rabbits

Source of variation	F-Ratio									
	df	MBWB	df	MBW7	df	MBW14	df	MBW21	df	MBWW
New Zealand White										
Sire of doe	22	2.20**	22	1.77*	22	1.60*	22	1.31	22	1.52
Year-season	5	2.30*	5	3.63**	5	2.74*	5	3.66**	5	1.29
Parity	8	0.45	8	1.04	8	1.20	8	1.16	8	0.49
Remainder df	428		377		373		360		358	
Remainder MS		150.96		871.81		2908.36		7772.44		23066.15
Californian										
Sire of doe	20	1.48	20	1.98**	20	2.39***	20	2.30**	20	1.69*
Year-season	5	1.15	5	3.76**	5	1.98	5	1.92	5	1.42
Parity	8	0.77	8	1.56	8	2.31*	8	1.98*	8	1.53
Remainder df	409		367		358		346		346	
Remainder MS		97.99		492.77		2047.06		4976.67		15036.78

MBWB= Mean bunny weight per litter at birth; MBW7 = Mean bunny weight per litter at 7 days; MBW14 = Mean bunny weight per litter at 14 days; MBW21 = Mean bunny weight per litter at 21 days; MBWW = Mean bunny weight per litter at weaning.

* Significant at (P≤ 0.05), ** Significant at (P≤ 0.01), *** Significant at (P≤ 0.001), otherwise they were not significantly differ.

Parity:

No significant effect was detected for parity on LW and MBW traits in NZW or Cal rabbits except at MBW14 and MBW21 (Table 2&4). Similarly, El-Maghawry *et al.*, (1988), Ferraz *et al.*, (1991a), Afifi *et al.*, (1992) and Hassan (1995) with NZW and Cal rabbits reported no detectable significant effect for parity on litter weight at birth, 21 days and at weaning. On the contrary, some studies on NZW and Cal rabbits (e.g. McNitt and Moody 1990., Ferraz *et al.*,1991b., Yamani *et al.*, 1991a&b; Nasr, 1994) reported that differences in litter weight, in different ages, due to parity were significant. El-Maghawry *et al.* (1988) with NZW and Cal rabbits reported that parity did not affect significantly mean bunny weight per litter either at birth or at weaning. McNitt and Moody (1990) with NZW, Cal, White Satin and Palomino, found that parity affected significantly mean bunny weight at three weeks post kindling and at weaning.

Sire variance component:

Least squares analyses of variance (Table 2) revealed that sire of doe contributed non-significantly to doe litter weight traits, except LWB in NZW. Mean bunny weight per litter (Table 4) varied significantly with sire of doe effect at all ages studied in both breeds, except at birth in Cal and at 21 days and at weaning in NZW rabbits. Results of LW are in harmony with those reported by Afifi *et al.* (1992) who found that sire of doe did not affect significantly litter weight traits in NZW. Also, Ahmed (1997) showed that sire of the doe did not influence significantly litter weights in NZW and Cal rabbits except LWB in NZW. Studies on MBW done by Khalil and Afifi (1991) with Bouscat and Giza White rabbits, showed that sire of doe affected significantly

MBWW. Ahmed (1997) showed that there were significant effects due to sire of doe on mean bunny weight per litter at birth, 21 days and weaning in Cal rabbits while only at birth in NZW rabbits. However, sire of the doe effects when proved to be significant, improvement in these traits could be achieved through selection of the sires based on the performance of their daughters.

Table 5 . Least squares means (± SE) of mean bunny weight per litter traits* of New Zealand White and Californian rabbits as affected by different year-seasons and parity

Independent variable	MBWB N	MBWB Mean±SE	MBW7 N	MBW7 Mean±SE	MBW14 N	MBW14 Mean±SE	MBW21 N	MBW21 Mean±SE	MBWW N	MBWW Mean±SE
New Zealand White										
Year-season										
Winter 92	64	54 ± 3	59	127 ± 7	59	229 ±13	59	356 ±22	59	666 ±38
Spring 93	131	55 ± 2	119	117 ± 6	118	210 ±10	110	310 ±16	110	615 ±29
Summer 93	69	52 ± 2	60	109 ± 6	59	198 ±10	59	294 ±16	59	610 ±28
Autumn 93	47	58 ± 2	41	120 ± 6	41	207 ±10.	40	309 ±16	40	599 ±29
Winter 94	69	60 ± 2	60	130 ± 6	60	225 ±·9	58	335 ±16	57	641 ±28
Spring 94	84	57 ± 3	74	116 ± 6	72	198 ±11	70	283 ±18	69	588 ±33
Parity										
1	116	59 ± 3	108	120 ± 6	109	210 ±11	108	293 ±18	108	616 ±32
2	101	57 ± 2	93	118.± 6	92	209 ±10	89	310 ±16	88	638 ±29
3	88	57 ± 2	79	115 ± 6	78	196 ±10	72	287 ±16	72	599 ±29
4	54	56 ± 2	43	113.± 6	41	192 ±11	39	281 ±17	39	598 ±30
5	38	56 ± 3	31	123 ± 6	31	212 ±11	31	317±18	31	620 ±31
6	22	54 ± 3	20	110 ± 8	20	204 ±14	20	310 ±22	20	614 ±39
7	20	53 ± 3	17	131 ± 9	16	232 ±16	16	344 ±25	16	639 ±44
8	12	58 ± 4	10	129 ±11	10	230.±20	10	353 ±32	10	650 ±55
≥9	13	55 ± 4	12	119 ±10	12	215 ±19	11	334 ±31	10	603 ±56
Californian										
Year-season										
Winter 92	56	51 ± 3	55	108 ± 6	55	181 ±12	55	266 ±19	55	588 ±31
Spring 93	109	50 ± 2	100	104 ± 5	96	184 ±10	91	271 ±15	91	598 ±26
Summer 93	83	49 ± 2	77	95± 4	75	168 ± 9	70	254 ±14	70	561 ±23
Autumn 93	61	51 ± 2	56	101 ± 4	55	192 ± 9	55	286 ±14	55	553 ±22
Winter 94	71	53 ± 2	61	111 ± 5	59	190 ± 10	58	279 ±15	58	539 ±24
Spring 94	63	50 ± 2	52	97 ± 6	52	176 ±12	51	246 ±19	51	488 ±31
Parity										
1	113	51 ± 2	110	109 ± 5	110	198 ±10	110	289 ±16	110	556 ±25
2	88	53 ± 2	80	109 ± 5	79	194 ±10	75	286 ±16	75	549 ±25
3	71	52 ± 2	66	105 ± 4	61	176 ±10	54	258 ±15	54	521 ±24
4	51	49 ± 2	44	97± 5	43	163 ±10	42	243 ±15	42	513 ±24
5	40	50 ± 2	34	105 ± 7	34	180 ±10	34	268±16	34	572 ±25
6	30	52 ± 2	28	107 ± 5	28	191 ±11	28	275 ±17	28	586 ±27
7	23	50 ± 3	18	99 ± 7	17	190 ±14	17	281 ±22	17	600 ±36
8	16	48 ± 3	12	88 ± 8	11	163 ±16	11	226 ±25	11	507 ±43
≥9	11	52 ± 4	9	102 ± 9	9	182.±19	9	275 ±30	9	587 ±51

* Traits as defined in Table 4.

REML variance component estimates due to sire of the doe (σ^2_s) and the remainder(σ^2_e) along with their percentages (V%) for LW and MBW traits in

NZW and Cal rabbits are given in (Table 6). These results showed that percentage of sire component of variance of litter weight traits ranged from 0.86 to 7.72 % in NZW and from 1.17 to 2.66 % in Cal ones. Corresponding values related to MBW traits ranged from 2.87 to 6.17 and 2.27 to 8.61, respectively. In this concern, Afifi *et al.* (1992) reported that V% of litter weight traits, due to sire of doe ranged from 0.9 to 2.4 % in NZW and 2.2 to 7.8% while estimates reported by Ahmed, (1997) ranged from 0.31 to 7.77 % in NZW and 1.05 to 1.23 % in Cal. Concerning MBW traits, Ahmed (1997) reported estimates which ranged from 2.22 to 4.87% in NZW and 3.43 to 7.1% in Cal rabbits. El-Zanfaly (1996) reported low or moderate percentages of variation in doe traits due to sire of doe and concluded that systems of feeding and management practices of does might have masked the full expression of the genetic paternal differences of sire.

Table 6. Heritability estimates ±standard errors(S.E) and percentages of variance (V%) for litter weight and mean bunny weight per litter based on paternal half-sibs (h^2_S) in New Zealand White and Californian rabbits using REML (Unrelated sires)

Trait	N	Variance component				$h^2_s \pm$ S.E
		Sire		Remainder		
		σ^2_s	%	σ^2_e	%	
New Zealand White						
LWB	464	1179.68	7.72	14091.59	92.28	0.309 ± 0.177
LW7	413	673.03	1.39	47885.55	98.61	0.056 ± 0.034
LW14	409	a	a	109824.49	100.00	a
LW21	396	1550.54	0.86	177896.68	99.14	0.34 ± 0.021
LWW	394	a	a	896985.86	100.00	a
MBWB	464	9.92	6.17	150.87	93.83	0.246 ± 0.143
MBW7	413	44.24	4.84	869.72	95.16	0.193 ± 0.114
MBW14	409	28.80	4.27	2884.30	95.73	0.171 ± 0.101
MBW21	396	227.45	2.87	7701.31	97.13	0.115 ± 0.069
MBWW	394	930.13	3.89	22973.33	96.11	0.156 ± 0.092
Californian						
LWB	443	168.79	1.51	11031.85	98.49	0.060 ± 0.038
LW7	401	a	a	119865.55	100.00	a
LW14	392	1888.74	1.86	99671.04	98.14	0.074 ± 0.175
LW21	380	4581.37	2.66	167916.09	97.34	0.106 ± 0.067
LWW	380	9909.70	1.17	837970.31	98.83	0.046 ± 0.030
MBWB	443	2.28	2.27	98.26	97.73	0.091 ± 0.057
MBW7	401	32.62	6.21	492.94	93.79	0.248 ± 0.151
MBW14	392	192.66	8.61	2043.74	91.39	0.344 ± 0.204
MBW21	380	451.42	8.32	4971.58	91.68	0.333 ± 0.198
MBWW	380	650.69	4.15	15045.61	95.85	0.166 ± 0.103

a = Negative estimates of sire component of variance were set to be zero

Sire heritability estimates:

Sire heritabilities for doe traits estimated using REML components of variance in NZW and Cal rabbits given in table 6 show that estimates of heritability of litter weight traits were low except that of LWB in NZW and ranged from 0.034 to 0.309 in NZW and from 0.046 to 0.106 in Cal. These estimates are in agreement with those reported by some investigators (e.g. Ferraz *et al.*, 1991a; Afifi *et al.*, 1992., Farghaly and El-Darawany, 1994 and Ahmed, 1997). Estimates of heritability for mean bunny weight per litter ranged from 0.115 to 0.246 and from 0.091 to 0.344 in NZW and Cal rabbits, respectively (Table 6). Heritability estimates of mean bunny weight per litter were to some extent higher in Cal rabbits compared to those of NZW ones.

Most of the discrepancies between estimates of different studies on the same breeds may be attributed to the differences in breed samples of rabbits reared under different particular environmental conditions during definite periods of time, size of data and variation in the statistical models and methods adopted. Small or negative estimates of heritability might be attributed to sampling variation (McCarteny, 1962), sampling error (Thompson and Moor, 1963), small number of progeny per sire (Gill and Jensen, 1968 and Afifi *et al.*, 1992), small sampling size per generation (Narayan, 1985) and non-randomness in the distribution of daughters within sire groups (Khalil and Soliman, 1989). However, the heritability estimates of most doe LW and MBW traits in NZW and Cal rabbits were not sufficiently high to indicate that direct selection for these traits would yield effective genetic improvement in the herd of the study. However the moderate h^2 estimates concerning LWB and MBWB in NZW and MBW7 MBW14 and MBW21 in Cal rabbits imply that direct selection for these traits would yield effective genetic response. The reasonable precision of the estimates, as judged by their approximate standard errors, indicate that these estimates will be useful in scheming the selection programs.

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وزن خلفة البطن و متوسط وزن الأرنب فى البطن لسلالتين من الأرانب القياسية مرباة تحت ظروف بيئية مناوئة

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أجريت هذه الدراسة لتقدير المعالم الوراثية وغير الوراثية لصفات وزن خلفة البطن ومتوسط وزن الأرنب فى البطن فى سلالتى النيوزيلندى الأبيض والكاليفورنيا. كان معامل الإختلاف متوسطاً فى كل الصفات المدروسة إلا أن هذه الإختلافات كانت أقل نسبياً فى صفات متوسط وزن الأرنب في البطن فى كلا السلالتين. وقد أظهر حجم قيم معامل الإختلاف إمكانية إجراء الإنتخاب المظهرى لمعظم الصفات المدروسة خاصة تلك التى أعطت تقديرات متوسطة المكافئ الوراثى. أظهر التأثير المشترك لفصل وسنة الميلاد تأثيراً معنويا على الصفات المدروسة فى كلا السلالتين (ما عدا صفات متوسط وزن الأرنب فى البطن عند الفطام فى النيوزيلندى وكذلك متوسط وزن الأرنب فى البطن عند الميلاد و ١٤ و ٢١ وعند الفطام فى الكاليفورنيا). أوضحت النتائج أفضلية البطون المولودة فى فصلى الخريف والشتاء عن تلك المولودة فى فصل الصيف (المناخ الحار) بغض النظر عن سنة الإنتاج. لم يظهر ترتيب الولادة أى تأثير معنوى على الصفات المدروسة فى هاتين السلالتين ما عدا متوسط وزن الأرنب فى البطن عند عمر ١٤ و ٢١ يوم فى الكاليفورنيا.

وقد تراوحت قيم تقديرات المكافئ الوراثى فى كلا الصفتين من مكون التباين الأبوى والمحسوبة بإستخدام طريقة معظمة الإحتمال المقيدة (REML) من المنخفضة إلى المتوسطة فى الكاليفورنيا (من٠,٠٤٦ إلى ٠,٣٤٤) بينما كانت أقل من ذلك فى النيوزيلندى (من ٠,٠٣٤ إلى ٠,٣٠٩).