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CORRELATED RESPONSE ON LITTER TRAITS AND MILK YIELD IN NEW ZELAND WHITE RABBITS SELECTED FOR LITTER SIZE AT BIRTH

Mahmoud M. El-Attrouny[1] and Walid S. Habashy[2]

[1]Dep. of Anim. Prod., Fac. of Agric. at Moshtohor, Benha Uni., Egypt

[2]Dept. of Anim. and Poult. Prod, Fac. of Agric., Damanhour Uni., Egypt

Corresponding author:: Mahmoud M. El-Atrouny E-mail: Mahmoud.elatrouny@fagr.bu.edu.eg

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ABSTRACT: The current study evaluated the influence of selection for litter size at birth on litter traits and milk yield of New Zealand White (NZW) rabbits. A total of 2231 litters produced from 360 does and 72 bucks were used to assess litter size at birth (LSB) and weaning (LSW), litter weight at birth (LWB), litter weight at 21 d (LW21) and litter weight at weaning (LWW), as well as mortality percentage (MOR%) from birth (total alive) till weaning age, milk yield at lactation intervals of 0–7 d (MY07), 7-14 d (MY14), 14-21 d (MY21), 21-28 d (MY28) and 0-28 d (TMY) and milk conversion ratio during 21 d of lactation (MCR021). Multi-trait animal model was used to data analysis using VCE6 programe. Estimates of heritability for litter traits were low and ranging from 0.05 for LSB to 0.14 for LWB. Also, estimates for milk yield traits were low and ranged from 0.08 for MY7 to 0.22 for MY21. The contrast among these generations were significant ($P<0.05$), favoring the selected generations over the base population. Estimates of genetic correlations between litter traits were positively and ranged from low (0.06) between LSW and LWB to moderate (0.51) between LWB and LW21. Genetic correlation between milk yield traits at different periods of lactation ranged from low (0.19) between MY7 and MY28 to high (0.84) between MY21 and TMY , while negative correlation between MY7 and TMY (-0.29). The accumulative correlated selection responses were positively and significant for litter traits and milk traits, while neagative and significant for MOR % , positive and non significant for MCR%. *Conclusively,* The selection of NZW does for litter size at birth could be efficient to improve litter traits and milk yield traits.

Keyword: correlated response, contrast, litter traits, milk yield, heritability, selection

INTRODUCTION

Rabbits used in many countries around the world as a source of white meat. According to FAOSTAT (2017), the largest-producer of rabbit meat in the world is China followed by Korea, Egypt, Spain and Italy. Moreover, several countries in Europe and some countries in North African countries consume rabbit meats (FAOSTAT, 2017) . In most of these nations, rabbit meats have a significant role in raising national economy.

Rabbit meats are recognized to be an excellent source of nutrients and have dietetic properties (Dalle Zotte, 2002; Combes, 2004; Hernàndez and Gondret, 2006). Rabbit meats are favorable mainly for reasons involving low fat and cholesterol (3.4g/100g meat), high protein (approxametly 22%), high essential amino acid concentration and constant of mineral content (1.3g/100g meat). Also, it provides moderately high energy (751 KJ/100 g meat), a good source for vitamin B, low sodium level and rich in phosphorus. (Dalle Zotte, 2002 ; Dalle Zotte and Szendro, 2011) it can replace chicken in most of the cases. From the above,it is clear the importance of rabbits as a source of animal protein and national income, which requires further studies and development of programs for genetic improvement of rabbits.

It has been reported that there were three directions of selection to improve the productivity in rabbit. Basically, the first direction of selection is mainly used to improve profilicacy and lactation in maternal line. The second direction is genetic selection in paternal line to improve growth and carcass traits. The last one is selection in multi purpose lines to improve litter and growth traits together (Khalil and Al-Saef, 2008). However, many authors reported that the most common direct parameter used in maternal lines selection programs was related to either litter size at birth or at weaning (El-Raffa, 2000; Al-Saef *et al.*, 2008).

Litter size is one of the most economic important traits in rabbit production (Abou Khadiga, 2004 ; Belhadi, 2004 ; Nofal *et al.*, 2005) which should be given concern in rabbit breeding programmes. Litter size is affected by many component traits such as ovulation, fertilization, embryo development, and fetal survival (Argente, 2016).

Milk production of doe rabbit can be strongly affected by number of sulking kits and kits weight at birth (El-Maghawry *et al.,* 1993 ; Pascual *et al.*, 1996). Many studies stated that milk production of rabbit doe can be increased with heavier litter weight at birth, due to the increase of uterine induction or suclking kits number (Bolet *et al.*, 1996 and Petersen *et al*., 1996). Does' milk production plays a major factor affecting on litter weight and pre weaning litter growth (Khalil *et al.*, 2004). Milk production could be limited by additive gene effects and positively correlated with litter weight at birth (Ayyat *et al.*, 1995; Lukefahr *et al.*, 1996)

Improving the productivity of the rabbits depends on the estimation of genetic parameters (e.g; heritability, genetic and phenotypic correlations) for economic traits (Khalil *et al.*, 1987). Hence, this study aimed to investigate the selection effect for litter size at birth on litter traits and milk yield traits, to estimate genetic parameters, to estimate selection correlated responses for unselected traits.

correlated response, contrast, litter traits, milk yield, heritability, selection

MATERIALS AND METHODS

Animals, Population structure and housing and feeding

The current study was carried out at the commercial Rabbitry Farm in Qalyubia Governorate, Egypt, during the period from January 2019 to March 2020 on New Zealand White (NZW) rabbits. New Zealand White maternal rabbit selected during two generations for litter size at birth. Data from 2231 litters produced from 360 does and 72 bucks (base population and two selected generations), fathered by 102 sires and mothered by 288 dams were used in this experiment. Growing rabbits were weaned at four weeks of age and were raised in a semi-closed rabbitry. Breeding sires and does were housed individually in a separate wire cages (50 × 50 × 30 cm^3). All animals, in the rabbitry, were kept under controlled environmental conditions with temperature ranged from 22 °C to 30 °C, relative humidity from 24% to 50% and lighting program of 16 hr light and 8 hr dark. Each buck was mated to 5 does. Actually, the average age of rabbits used at the first mating was around 4.5-5 months-old and, after delivering, the new mating was tried 10 days later. Does were mated in the bucks' cage and logged individually. Sire-daughter , full and half sib matings were avoided. Each doe was palpated after 10 days for pregnancy detection. Those does failed to conceive were returned to the same mating-buck at the day of test. Metal nest boxe was provided for each doe at 26 days from conceiving fertile mating .

Growing rabbits were fed a commercial pelleted diet, containing 17.9% crude protein, 15.52% crude fiber, 2.45% ether extract, 58.5 nitrogen free extract, and 6.29% ash, while breeding rabbits were provided with a pelleted rabbit diet containing 17.4 % crude protein, 13 % crude fiber and 2.54 % fat on dry matter basis, according to NRC (1977), during the whole experimental period. Feed and drinking water were provided ***ad libitum***. All growing and breeding rabbits were kept under the same managerial, hygienic and environmential contions.

Data collection

Milk yield (MY) of does was recorded during the first seven days (MY7), 7-14 days (MY14), 14-21 days (MY21), 21-28 days (MY28) and 0-28 days (TMY) using weigh-suckle-weigh method described by Lukefahr *et al*. (1983) and Khalil (1994). Briefly, the kits were separated from their dams in the evening to prevent suckling for a period of 12 h, weighed in the morning and then placed in the nest box of the doe's cage. Afterthat, each doe entered the box, nursed the litter and left within 3 to 5 min. The litters and the dam were reweighed separately and returned to the nest box and cage, respectively. For avoiding any biased estimates of MY (e.g., in case the kits or the does urinated), the MY of each doe was estimated by the average difference between the pre- and post-suckling weight of both the litter and doe. Data collected were litter size at birth (LSB, kids) and weaning (LSW, kids), litter weight at birth (LWB, g), litter weight at 21 d (LW21, g) ; and litter weight at weaning (LWW, g), mortality percentage %, milk yield at lactation intervals of 0–7d (MY7, g), 7–14 d (MY14, g), 14–21 d (MY21,g), 21-28(MY28) and 0-28(TMY028), milk conversion ratio as g of litter gain per g of milk suckled during 21 d of lactation (MCR021, g/g).

Statistical analysis

Data of litter and milk traits were analysed using the multi-trait animal model as follows:

$y = Xb + Z_a u_a + e$

Where y = The vector of observations; b = The vector of fixed effects of generation (two levels); X and Za= Incidence matrices corresponding to fixed and additive random effects of the dam (u_a), respectively; e = Vector of random residual effects. The VCE6 software was used to estimate the variance components of random effects and heritabilities (Groeneveld *et al.,* 2010). These estimates were used to solve the corresponding mixed model equations, obtaining solutions for the generation effects and their error variance - covariance matrix using the PEST software (Groeneveld, 2006). Estimates of the contrasts between the three generations of selection were obtained by the least-squares analysis using the VCE6 software. The correlated selection response (CSR) at generation (n) was calculated by the following equation of Falconer and Mackay (1996):

$CSRy= i_X h_x h_y r_g \sigma_{py}$

Where: CSRy = The correlated selection response in trait y, i = The selection intensity for trait x, hx and hy = Square roots of heritability for traits x and y, respectively, r_g = The genetic correlation of traits x and y, and σ_{py} = The phenotypic standard deviation of trait y.

RESULTS AND DISCUSSION

Actual means and Coefficient of variability

Actual means, standard deviations (SD) and and coefficients of variation (CV%) for litter and milk yield traits are presented in Table 1. Averages of LSB, LSW,LWB, LW21 and LWW were 7.87 kids, 6.96 kids, 518 g, 1825 g and 3132 g, respectively. These results higher than those reported by many researchers (Iraqi , 2008 ; Okoro et al., 2012; EL-Deghadi, 2019; Rabie *et al.,* 2019) . In contrast, results in these study were lower than previous study observed by Costa *et al.* (2004) and Ziadi *et al.*, (2013). Mean of LW21was 1825 g which is similar to that findings by Iraqi (2008), while lower than those reported by EL-Deghadi (2019) in NZW rabbits. Al-Saef *et al.,* (2008) stated that the actual means for LSB, LSW, LWB, LW21 and LWW were 9.26 young, 7.69 young, 438g, 1748 g and 3370 g, respectively in rabbits.

Coefficients of variability (CV %) ranged from 12.0 to 23.8% for litter traits. These trends are similar to that findings by (El-Maghawry, 1999; Youssef *et al*.,2008 and Iraqi, 2008 and Okoro *et al*., 2012). These results confirm the hypothesis that the selection for litter size increase the number of total born these traits.In addition, these results may indicate higher reproductive performance of doe.

Means of mortality percentage from 1 to 28 days was 13.25% slightly higher than showed by Johnson *et al.* (1988). This mortality may be likely to poor nursing ability of doe , lack of suckling drive by the kits, non specific enteritis and increase of litter size (Rashwan and Marai,2000).

In the present study, actual means for MY7, MY14, MY21, MY28 days and TMY were 670, 979,1214, 939 and 3779 g , respectively. Similar results showed by (Youssef *et al.,* 2008 ; Abou Khadiga *et al.,* 2012 ;El-Deghadi,2019). The same trend showed by Iraqi and Youssef (2006) who reported that the means for MY1, MY2, MY3, MY4 wks and TMY were 644.1, 963.8, 1136.7, 877.0 and 3538 g, respectively in NZW rabbits.

Coefficients of variability (CV %) ranged from 25.19 to 37.56 % for milk production traits. This verifies that these traits in rabbits are influenced by various effects such as genetic make up of the does, non-genetic effects. These results agree with the findings of El-Maghawry (1999) , Ramadan (2005) and Iraqi (2008) . El-Deghadi (2019) reported that coefficients of variability for milk yield through the intervals of lactation were modeate and varied from 36.09% to 66.39%

Contrasts between selected generations and base population

Table 2 shows the contrasts employed between selected generations and base population for litter and milk traits, was superior to selected generations for LSB, LSW, LWB, LW21 and LWW when comparision with base population (differences of 1.62 young, 1.56 young, 84 g, 143 g and 452 g, respectively (α= 0.05). Similar results were reported by García and Baselga, (2002); Ragab and Baselga, (2011). Estimates of contrast between selected generations and base population for milk traits are given in Table 2. The contrast among estimates of these generations was significant ($P \leq 0.05$) for MY7 (145g), MY14 (117g), MY21 (197g), MY28 (96g) and TMY (555g), favoring the selected generations.

Heritability estimates

In the present study, estimates of heritability (h^2) for LSB, LSW, LWB, LW21 and LWW are low and ranging from 0.05 to 0.14 (Table 2). These estimates were within the range of the literature estimates (ranged from 0.0 to 0.17) for litter traits reported by (Ferraz and Eler, 1996; Sorensen *et al.,* 2001, Iraqi , 2008; Al-Saef *et al.,* 2008; Iraqi *et al.*, 2010). Similarly, low estimates of h^2 for litter size and weight traits ranging from 0.0 to 0.13 were repoted by Johnson *et al.* (1988), Baselga *et al.* (1992), Khalil, (1994), Lukefahr and Hamilton, (1997), Baselga and Garcia, (2002) and Nofal *et al.* (2002). Iraqi *et al.* (2010) reported that h^2 estimate for LSB and LSW was 0.06 and 0.07 in rabbits. Iraqi *et al.* (2006) found that estimates of h^2 was low and values were 0.04, 0.01, 0.08, and 0.09 for LSB, LWB, LSW and LWW, respectively. Ayyat *et al.* (1995) found that estimates of h^2 for litter size traits ranging from 0.09 (LSW) to 0.22 (LSB) in NZW rabbits. However, Fayeye and Ayorinde, (2016) found that heritability for LSB, LWB, LSW and LWW were 0.60, 0.96, 0.84 and 0.92, respectively In this stdudy, hertability for MOR ratio was (0.04 %). Johnson *et al.* (1988) found that percent mortality from 1 to 28 days was 0.08 in NZW rabbits. Low and moderate heritability estimates for these traits may likely due to lower additive gene effect for these traits

In the current study estimates of heritability (h^2) for MY7, MY14, MY21, MY28 and TMY traits were 0.08, 0.19, 0.22, 0.17 and 0.21, respectively (Table 2). Some authors have reported estimates similar to ours (El-Maghawry *et al.*, 1993 ; Ayyat *et al.*, 1995; Al-Saef *et al.*, 2008 ; El-Deghadi, 2019).

Iraqi and Youssef (2006) reported that estimates of h^2 for milk production traits were low and ranged from 0.001 for total milk yield during 4^{th} wks to 0.05 for total milk yield during 3^{rd} wk. Iraqi (2008) reported that estimates of h^2 for milk production traits ranged from 0.0 to 0.11 for milk yield traits in NZW rabbits. Youssef *et al*.(2008) reported that h^2 estimates for milk production traits in NZW and Baladi Black rabbits were low and ranged from 0.01 to 0.12. Al-Sobayil *et al.* (2005) reported that h^2 for MY traits were moderate, ranging from 0.18 to 0.22 in rabbits. Gómez -Ramos *et al.*

(2010) showed that the h^2 of milk yield was low (0.12). Khalil *et al.* (1986) and Ayyat *et al.* (1995) mentioned that maternal and environmental effects are the main variation sources and the cause of low estimates of h^2 estimates for MY in rabbits. Differences between h^2 estimates might also be due the type of breed, environmental conditions, management and statistical methods used. In the present study, heritability estimates for MCR021 was low (0.09). these results agree with the findigs of Iraqi (2008), Al-Saef *et al*. (2008) and El-Deghadi (2019).

Genetic and phenotypic correlations

Estimates of genetic (r_G), correlations between litter size traits are given in Table 3. Estimates of r_G were positively and very different (ranged from 0.06 to 0.51). Litter size at birth had moderate genetic correlation (0.41) with litter weight at 21 day. This result indicates that selection for litter size at birth will increase LW21. This finding agree with the findings of Odubote and Somade (1992) and Sorensen *et al. (*2001). Hassan *et al*. (2015) found that all estimates of genetic correlations between LWB and LWW were high and positive. Based on the results of the present study, we can suggest that selection for LSB would be effective to improve other litter traits. On the other hand, phenotypic correlations among litter traits were positive and ranged from low (0.11) to moderate (0.31) (Table 3).

In the current study, genetic correlation between milk yield traits at different periods of lactation ranged from moderate (0.19) between MY7 and MY28 day to high (0.86) between MY21 and TMY. This indicates that milk production during the 3rd wk of lactation is closely correlated with TMY. Thus, one would recommend the rabbit breeders to select the does according to milk yield of the third week of lactation to obtain genetic progress of total milk production in NZW does. This agrees with the findings by Iraqi and Youssef (2006).

Hassan (2005) showed that milk production traits in NZW rabbits were mostly genetically correlated. On the other hand, moderate and negative genetic correlation (-0.29) between milk yield during the first and fourth weeks of lactation was obtained in the present study. This indicates that as milk production increased during the first week (because increasing the activity of mammary gland gradually), the milk lactation decreased during the 4th wk because of the inhibition of the prolactin hormone by oestrogens and progesterone which due to that most of the does were in the late periods of pregnancy at that time (Lebas, *et al*. 1997) and the increase of dry ration consumed by the young simultaneously. In general, the similar trend for phenotypic correlations between milk production traits was obtained (Table 4).

A ccumulative selection responses

A ccumulative selection response after two selected generations was favorable for all unselected litter traits and showed the superiority of the selected generations compared to the base population (Table 5). Responses were significant ($P<0.05$) for LSW(1.34 kids), LWB (70.6 g), LW21 (113 g) and LWW (314 g), while was significant and negative for MOR (-1.21 %) after two selected generations. This demonstrated that, selection for LSB was correlated with an increase other litter traits. Blasco et al., 1993 reported that direct selection for litter size in pigs and rabbit did not observe an expected success. García and Baselga (2002) reported that approximately 0.1 young per generation in rabbits has been identified as selection response for litter size. On the other hand, accumulative selection response for milk yield traits was superiority of selected generation Table 5. Responses were significant ($P<0.05$) for MY7 (137g), MY14 (124 g), MY21 (189 g), MY28 (102 g) and TMY (537 g). This reflects , the selection for LSB in NZW rabbits through two selection generations increased with advanced generations.

CONCLUSION

Although estimates of heritability for traits of LSB, LSW, LWB, LW21 and LWW were low, these are the highest estimates of heritability compared to the other traits under the current study. Therefore, the selection of NZW does rabbits could be effective for improving these traits. Also, estimate of heritability for milk yield in the 3rd wk of lactation was the highest compared with the other traits. Consequently, it is recommended that selection of NZW does rabbits at that week could be effective to improve TMY in NZW rabbits.

Superiorities in the selected generations indicated that selection for LSB in NZW rabbits was associated with an improvement in other litter traits and milk yield traits .In addition, the cumulative correlated responses of selection for LSB in rabbits through two selection generations increased with generations.

Table (1): Descriptive statistics for litter size and milk traits (mean, standard deviation (SD) , coeffient of variation (CV%) and extreme values).

Traits	No.	Mean	SD	CV	Minimum	Maximum
Litter traits[a]						
LSB (kids)	3214	7.87	1.87	23.8	2	13
LSW (kids)	3109	6.96	1.11	16.0	1	9
LWB (g)	3214	518	100.0	19.30	134	859
LW21 (g)	3136	1825	242.0	13.26	541	3214
LWW (g)	3088	3132	371.0	12.0	541	5241
MOR (%)	387	13.25	3.63	27.31	1	5
Milk traits[b]						
MY7 (g)	448	670	200	29.85	350	953
MY14(g)	448	979	312	31.86	589	1352
MY21(g)	447	1214	456	37.56	652	1758
MY28(g)	446	939	321	34.18	349	1365
TMY(g)	443	3779	952	25.19	2752	5635
MCR021 (g/g)	447	0.46	0.23	49.21	0.17	0.67

[a] LSB = Litter size at birth; LSW = Litter size at weaning; LWB = litter weight at birth; LW21 = Litter weight at 21 d; LWW = Litter weight at weaning age; Mortality % of kids [from birth (total alive till weaning)

[b] MY7= Milk yield at lactation intervals of 0–7 d (MY7); 7-14d (MY14); 14-21D (MY21) ;21 - 28 (MY28) and 0-28 (TMY). MCR021 = Milk conversion ratio as g of litter gain per g of milk suckled during 21 d of lactation.

Table (2): Contrast (±Standard errors) between selected and base population, and heritabilities and their standard errors ($h^2 \pm se$) for the studied traits.

Traits	Contrast Selected vs. Base	$h^2 \pm se$
Litter traits[a]		
LSB (kids)	1.62*	0.05
LSW (kids)	1.56*	0.07
LWB (g)	84*	0.14
LW21(g)	143*	0.09
LWW (g)	452*	0.06
MOR (%)	-1.42	0.04
Milk traits[b]		
MY7 (g)	145*	0.08
MY14(g)	117*	0.19
MY21(g)	197*	0.22
MY28(g)	96*	0.17
TMY(g)	555*	0.21
MCR021 (g/g)	0.04	0.09

*Significance of the contrast at $P \leq 0.05$

Table (3): Estimates of genetic (above the diagonal) and phenotypic correlations (below the diagonal) and standard errors (in parenthesis) between the litter traits of NZW rabbits.

Traits correlated	LSB	LSW	LWB	LW21	LWW	MOR
LSB	-	0.32(0.14)	0.38(0.15)	0.41(0.16)	0.18(0.12)	0.13(0.06)
LSW	0.14(0.07)	-	0.06(0.07)	0.32(0.14)	0.37(0.17)	-0.21(0.10)
LWB	0.23(0.08)	0.11(0.08)	-	0.51(0.22)	0.27(0.12)	0.15(0.09)
LW21	0.18(0.02)	0.14(0.07)	0.25(0.15)	-	0.39(0.15)	0.16(0.11)
LWW	0.15(0.07)	0.21(0.11)	0.31(0.16)	0.23(0.09)	-	0.17(0.05)
MOR	0.16(0.07)	-0.16(0.12)	0.13(0.07)	0.19(0.11)	0.22(0.11)	-

Table (4): Estimates genetic (above the diagonal) and phenotypic correlation (below the diagonal) correlations and standard errors (in parenthesis) between traits of milk yield of NZW rabbits.

Traits correlated	MY7	MY14	MY21	MY28	TMY	MCR021
MY7	-	0.31(0.12)	0.34(0.14)	0.19(0.16)	0.41(0.19)	0.21(0.11)
MY14	0.24(0.11)	-	0.47(0.17)	0.21(0.14)	0.63(0.21)	0.24(0.11)
MY21	0.23(0.11)	0.32(0.18)	-	0.28 (0.17)	0.86(0.22)	0.22(0.13)
MY28	0.27(0.13)	0.19(0.12)	0.27(0.14)	-	0.48(0.15)	0.21(0.10)
TMY	0.41(0.17)	0.54(0.18)	0.76(0.18)	0.39(0.16)	-	0.20(0.11)
MCR021	0.12(0.08)	0.14(0.07)	0.10(0.05)	0.11(0.05)	0.13(0.02)	-

Table (5): Estimates of cumulative selection response (CSR) and their (±standard errors) for the unselected traits through two generations of selection.

Traits	CSR
Litter traits	
LSW	1.34±0.34*
LWB (g)	70.6±16.5*
LW21 (g)	113±10.3*
LWW (g)	314±34.2*
MOR (%)	-1.21±0.07*
Milk traits	
MY7(g)	137±18.6*
MY14 (g)	124±24.5*
MY21 (g)	189±31.2*
MY28 (g)	102±20.2*
TMY0-28 (g)	537±47.2*
MCR021 (g/g)	0.03±0.002

*Significance at $P \leq 0.05$

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الملخص العربي

الإستجابة المرتبطه لصفات الخلفة ومحصول اللبن في أرانب النيوزيلندي الأبيض المنتخبة لحجم الخلفة عند الميلاد

محمود مصطفي الاطروني[1] – وليد شعبان حبشي[2]

[1] قسم الإنتاج الحيواني – كلية الزراعة – جامعة بنها – مصر

[2] قسم الإنتاج الحيواني والداجني – كلية الزراعة – جامعة دمنهور - مصر

هدفت هذه الدراسة إلي تقييم أثر الإنتخاب لحجم الخلفة عند الميلاد علي صفات الخلفة ومحصول اللبن في ارانب النيوزيلندي الأبيض. تم استخدام عدد 2231 خلفة إنتجت من 360 أم و 72 ذكر لتقييم صفات الخلفة : حجم الخلفة عند الميلاد والفطام، وزن الخلفة عند الميلاد ، وزن الخلفة عند عمر 21 يوم ، وزن الخلفة عند الفطام ، محصول اللبن خلال فترات الرضاعة المختلفة : الأسبوع الاول والثاني والثالث والرابع وكذلك محصول اللبن الكلي خلال فترة الرضاعة . تم تحليل البيانات بإستخدام نموذج الحيوان متعدد الصفات باستخدام برنامج VCE6.

أظهرت تقديرات المكافئ الوراثى قيماُ منخفضة لصفات الخلفة حيث تراوحت من 0.05 لصفة حجم الخلفة عند الميلاد إلي 0.14 لصفة وزن الخلفة عند الميلاد ، أيضا كانت التقديرات لصفات محصول اللبن منخفضة وتراوحت من 0.08 لصفة محصول اللبن خلال الأسبوع الاول إلي 0.22 لصفة محصول اللبن خلال الأسبوع الثالث من الإنتاج . كما أظهرت التضادات المستقلة Contrasts بين الإجيال المختلفة اختلافاً معنوياً أظهرت فيه الأجيال المنتخبة تفوقاً لمعظم الصفات مقارنة بعشيرة الأساس. أظهرت الإرتباطات الوراثية قيماً موجبة بين صفات الخلفة حيث تراوحت من منخفضة 0.06 بين حجم الخلفة عند الفطام ووزن الخلفة عند الميلاد إلي متوسطه 0.51 بين وزن الخلفة عند الميلاد ووزن الخلفة عند 21 يوم، أظهرت أيضا الإرتباطات الوراثية قيماً موجبة بين صفات محصول اللبن خلال فترات الإدرار المختلفة حيث تراوحت من منخفضة 0.19 بين محصول اللبن خلال الاسبوع الاول ومحصول اللبن الكلي خلال فترة الرضاعة إلي مرتفعة 0.84 بين صفات محصول اللبن خلال الاسبوع الثالث ومحصول اللبن الكلي خلال فترة الرضاعة ، بينما كان الارتباط سالب بين محصول اللبن خلال الاسبوع الاول ومحصول اللبن الكلي خلال فترة الرضاعة0.29 - . أظهرت الإستجابة الإنتخابية المحققة والمصاحبة بعد جيلين إنتخابين زيادة تراكمية لكلاً من صفات الخلفة ومحصول اللبن بينما كانت سالبة ومعنوية لصفة نسبة النفوق وموجبة وغير معنوية لصفة نسبة تحويل الحليب.

الخلاصة : يمكن التوصية بأن إنتخاب إناث ارانب النيوزيلاندي الأبيض لحجم الخلفة عند الميلاد يمكن أن يحسن صفات الخلفة ومحصول اللبن.