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Summary

Preweaning data of 336 crossbred rabbits were used to study rabbit growth characteristics from birth to weaning at an average age of 47.73 ± 3.80 days and factors affecting growth traits. Rabbits were represented by 8 sire and 10 dam genetic groups. The colony was originated from Californian, New Zealand White and Thai native rabbits. All the young nursed their dams until 21 days of age when supplemental pelleted feed was fed. Traits studied were BW, W7, W14, W21, W28, W35, W42, ADG, ADG 1 and ADG2. DBG was an important source of variation in all weight traits($P < 0.1$) while SBG was important in BW, W14, W21, W28 and W35. No sex differences were observed. ADG, ADG1 and ADG2 were 19.45 ± .51, 12.27 ± .40 and 25.48 ± . 71 gm, respectively. Growth pattern of this set of rabbits was presented. Selection and crossbreeding programs for superior maternal performance was recommended for commercial rabbit production.

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Introduction

World rabbit production in 44 countries where FAO information is available is 205 million heads with an output 630,000 of tons of meat (Gallardo, 1984). Although these figures are in no way comparable to other short life cycle animals such as pigs and poultry, there is an increasing trend of rabbit production worldwide. The advantages of rabbits are high reproductive rate small body size, rapid growth rate and ability to utilize high roughage rations. Rabbit excreta are even considered valuable as animal feed (Feketa, 1984 and Fenderson *et al.,* 1985) Backyard system of rabbit production is suggested to be suitable in developing countries where strong market demand has not yet established.

Rabbit production in Thailand has gain increasingly recognition in terms of laboratory animals and protein source. Thai native rabbits are known to perform good mothering ability. They are, however, neither prolific nor productive meat producer. Thai native rabbits are small in size and have never been selected to be a meat breed. In an attempt to improve rabbit production in Thailand, two famous meat breeds of rabbit, Californian and New Zealand White, were imported by Kasetsart University and department of Livestock Development in 1978 and 1984, respectively.

Reports regarding rabbit production are admittedly insufficient even in Europe and The United States where most publications are made (May and Simpson, 1975; Cheeke, 1979). In Thailand, previous reports were mostly of nutritional background. In order to make rabbit production more efficient, more information concerning growth characteristics and other production traits are necessary.

The objectives of this study were to examine growth character istics and factors affecting growth traits in crossbred rabbits.

Material and Method

Data were collected from 336 rabbits born from 1981 to 1983 at the Department of Animal Husbandry Rabbit Colony, Nakorn Pathom. They descended from the original stock established in 1980 from Californian, New Zealand White and Thai native breeds. Several crossbreeding system among these three breeds have been conducted since then. Rabbits subjected to data analysis were offsprings of 8 sire genetic groups (SBG). They were 100% Californian (GI), 100% Native (G2), 100% New Zealand White (G3), 87.5% Californian (G4), 87.5% New Zealand White (G5), 75% Californian (G6), 75% New Zealand (G7) and 50% Californian (G8). Dam genetic groups (DBG) were represented by the same 8 genetic groups as well 50% as Californian and 50% New Zealand White (G9).

Feeding and Management: All rabbits nursed their dams since birth. At three weeks of age, they were fed pelleted feed consisted of 14% protein and fresh paragrass ad lib. They stayed the cage with the dams until weaning at the age of six to seven weeks.

Traits measured: Rabbits were weighted at brith (BW), day 9 (W7), day 14 (W14), day 28 (W28), day 35 (W35), day 42 (W42) and at weaning (WW). Average daily gain from birth to weaning (ADG) was calculated as actual (WW-BW) divided by weaning age. Two intermittent average daily gain from birth to 21 days of age (ADG 1) and from 21 days of age to weaning (ADG2) were also observed since rabbits were weaned at 6 to 7 weeks of age but started pelleted feed at 3 weeks of age.

Data analysis : Variation in growth traits were examined from 336 rabbits, 164 males and 172 females. Data were analysed using Harvey's least squares analysis for unequal subclass data (Harvey, 1975). Models included sire breed groups (SBG), dam breed

groups and sex of the youngs. Analyses for BW and WW were adjusted for litter size at birth (LZB) and litter size at weaning (LZW and weaning age (AGE), respectively.

General mathematical model :

$$X_{ijkl} = \mu + G_i + D_j + S_k + b\overline{X} + 1_{ijkl}$$

Where : Yijkl represents an observation on the 1^{th} rabbit of the k^{th} sex of the j^{th} dam breed group and the i^{th} sire breed group

μ = overall mean

G_i = effect of the i^{th} sire breed group

D_j = effect of the j^{th} dam breed group

S_k = effect of the k^{th} sex

$b\overline{X}$ = linear regression coefficient of Xijkl on LZB or LZW or WAGE

1_{ijkl} = random error.

The effects mentioned above were assumed to be fixed except for the random error. Records containing missing values were eliminated from that particular analysis.

Results

Least squares means and standard errors of estemates for BW, W7, W14, W21, W28, W35, W42, and WW were presented in table 1. BW was slightly higher than the report of Pornpotsupakis *et al.*, (1980a) but in good agreement with Lukefahr *et al.*, (1983a) who studied New Zealand White and Californian breeds. Least squares means for average daily gain were shown in table 2. Average weaning

age (WAGE) of the youngs was 47.73 ± 3.80 days. Average litter size at birth and at weaning were 6.30 ± 4.66 and 4.96 ± 1.57, respectively. The 21.26% preweaning mortality rate was observed which is relatively normal in commercial rabbit production (Partridge *et al.*, 1981).

SBG, DBG and LZB were significant sources of variation in BW ($P < .05$, $P < .01$ and $P < .05$, respectively). Negative linear regression coefficient (-.33) of LZB on BW suggested the negative relationship between LZB and individual BW. A young from a large litter tends to be smaller at birth than the one from a smaller litter. Sex did not appear to play a major role in determining BW. Results were shown in table 3. For W7, only DBG significantly affected W7.

Least squares analysis of variance for W14, W28, and W35 were summarized in table 4. SBG and DBG effects were important for all weight traits. As the rabbits grew older sex effect of the youngs was more recognizable ($P < .10$), though not significant.

DBG significantly affected W42 and WW ($P < .01$), SBG effect declined after six weeks of age. Significant linear regression of LZW and WAGE on WW ($P < .01$) were in the opposite directions. The greater the LZW the smaller the rabbits. WW was positively related to WAGE. The youngs that were older at weaning time were heavier. Results were in table 5.

Discussion

It was obvious from the analyses that the differences in genetic groups of bucks and does significantly affected growth characteristics of the youngs. Specific pair comparisons between certain genetic groups has not been attempted because they were too many mating schemes to be meaningful.

Table 1. Least squares means and standard errors for BW, W7, W17, W21, W28, W35, (gm), W44 and WW (kg).

Trait	LS means
BW	55.26 ± 1.29
W7	130.61 ± 3.83
W14	217.28 ± 7.12
W21	315.72 ± 8.53
W28	474.40 ± 12.62
W35	675.63 ± 16.06
W42	.85 ± .02
WW	1.00 ± .02

Table 2. Least squares means and standard errors for ADG, ADG1 and ADG2 (gm)

Trait	LS means
ADG	19.45 ± .51
ADG1	12,27 ± .40
ADG2	25.48 ± .71

Table 3: Degrees of freedom, residual mean squares and test of significance from the least squares analysis for birth weight and weight at seven days of age.

SOURCE	BW		W7	
	DF	MS	DF	MS
SBG 1/	7	309.60*	7	1571.18
DBG 2/	9	348.68**	9	3059.31**
SEX 3/	1	0.01	1	1010.40
Regression,				
LZB (linear)	1	715.20*	1	2081.87
Residual	246	124.89	246	1108.15

1/ Sire breed group.

2/ Dam breed group.

3/ Sex of the young.

* $P < .05$

** $P < .01$

Table 4: Degrees of freedom, residual mean squares and test of significance from the least squares analysis for W14, W21, W28, and W35.

Source	W14		W21		W28		W35	
	DF	MS	DF	MS	DF	MS	DF	MS
SBG 1/	7	7499.79*	7	19551.46**	7	33786.96*	7	49254.02
DBG 2/	8	11275.99**	9	28560.42**	9	75350.96*	9	108085.45**
SEX 3/	1	4088.03	1	21720.83 †	1	45278.98 †	1	75504.05 †
Residual	227	3037.93	306	6444.49	318	14755.02	315	23831.45

1/, 2/, 3/, See table 3.

† $P < .10$

* $P < .05$

** $p < .01$

Table 5: Degrees of freedom, residual mean squares and test of significance from the least squares analyses for W42 and WW.

Source	W42		WW	
	DF	MS	DF	MS
SBG 1/	7	$.67^{+}$	7	.06†
DBG 2/	8	.16**	9	.15**
SEX 3/	1	.09	1	.10†
Redression,				
LZW (linear)	-	-	1	3.05**
WAGE(linear)	-	-	1	2.04**
Residual	315	.04	313	.03

1/, 2/, 3/, See table 3.

† $P < .10$

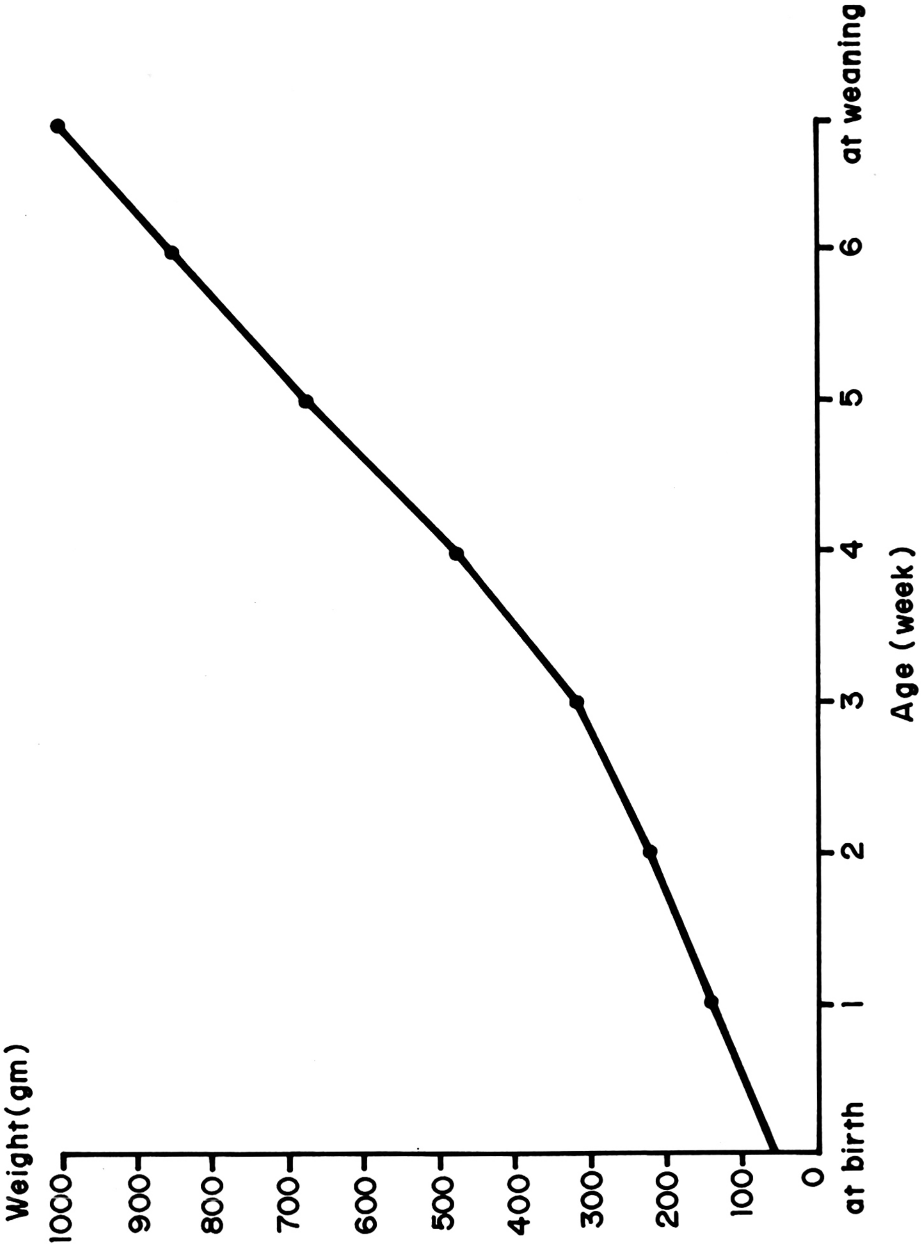

Figure 1 Least squares mean of weight by age from birth to weaning.

Sire breed group effects were important for all weight traits from birth to 35 days of age except W7. This suggested the genetic differences in preweaning growth potential of the youngs that were determined by their sires. Studies of Lukefahr *et al.*, (1983a) in New Zealand White, Californian and Flemish Giant purebreds demonstrated similar results in rabbits weight from birth to weaning at 28 days, when the young grew older the importance of SBG declined as seen in table 5. These findings were somewhat departure from the results in other mammal species such as beef cattle and swine which sire breed effects tend to be permanent especially after weaning when influence of the dams is removed. Lukefahr *et al.*, (1983b) reported significant sire breed in differences postweaning growtn traits (from 28 to 56 days of age) between large and mediam breeds but not between breeds of comparable size.

Maternal breed effects appeared to be very important in influencing preweaning growth of the youngs. All rabbit preweaning weights were consistently affected by DBG ($P < .01$). The findings are common for mammalians whose offsprings are dependent on their dams' milking and mothering ability. Studies in mice (Hanrahan and Eisen, 1970), rabbits (Venge, 1963), swine (Ahlschwede and Robinson, 1971) and beef cattle (Rutledge *et al.*, 1971) showed that dams strongly influence the growth of their youngs especially during preweaning period. The significant effects of DBG on growth in this study indicated variation among genetic groups of dams in milk production and maternal environment they provide for their youngs. Strong influence of milk yield of the dam on preweaning growth of the offspring was recognized in beef cattle (Rutledge *et al.*, 1971) and rabbit (Lukefahr *et al.*, 1983b). Results from these findings with reports regarding dam breed divergent (Venge, 1963 and Cowie, 1969) and significant heterosis (Lukefahr *et al.*, 1983 c) in milk produc-

tion suggested that in order improve rabbit production, selection among existing dam breeds for milk production and cross breeding program to make use of heterotic effects must be seriously considered.

Sex of the youngs was not important in any preweaning growth traits although there was a trend of sex becoming more important from 3 weeks of age onward ($P < .10$). It seems to be adequately reasonable to conclude that sex was not an important factor determining growth of fattening rabbits.

Naturally, WAGE positively affected WW white LZW negatively affected the same trait. WAGE is more of management practices that can be shortened or prolonged whatever suited the production situa tion. It may range from 28 days to 56 days. Number of the youngs that are weaned are dependend on number of the youngs born and mothering ability of the does.

Growth curve in figure 1. could be apparently divided into 2 stages. From birth to 3 weeks of age the curve was essentially linear. During this period the youngs were solely dependent on their dams. Average daily gain during this period (ADGI) was 12.27 ± .40 gm. From 3 weeks of age to weaning at 47.73 days the curve was steeper with the average daily gain (ADG2) of 25.48 ± .71 gm. This change in growth curve might be resulted from the implementation of supplemental feeding at 3 weeks of age. The overall growth pattern was similar to the one presented by Venge (1963) conducting in different genetic sources. Growth of the youngs from birth to about 3 weeks of age reflected milking ability of the dams for the peak of lactation curve occured at approximetely 19 days (Lukefahr *et al.*, 1983b).

Conclusion

Preweaning growth characteristics of rabbits were primarily determined by maternal breed differences. SBG effects declined at 42 weeks of age and at weaning. Sex was not important in determining growth traits. To improve rabbit production, selection for superior doe breeds which excel in maternal performance and appropriate cross-breeding program are absolutely necessary. Rabbit industry may adopt the terminal sire crossbreeding program which is widely utilized in swine production. Further studies based on successfully well designed breeding programs commercial to evaluate certain breedy performance and combining ability among them are recommended in order to improve meat rabbit production.

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