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STUDY OF THE INTERRELATIONSHIPS BETWEEN PRODUCTION CHARACTERISTICS OF RABBIT DOES

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Introduction

Genetic improvement of maternal characteristics is a slow and tedious work. The breeding work may be difficult, if we lack appropriate informations from the genetic parameters of our stock or from the nature of interrelationships. In order to simplify the selections and to make it more effective, we record the litter size at birth and at day 21, the % of raised rabbits and the weight gain of the litter and of the individual rabbits up to day 21.

The subject has been dealt with in several reviews (Rudolph and Kalinowski, 1982; Rouvier, 1980 and 1982; Holdas and Szendrő, 1982 and 1984; Baselga et al., 1982) and papers (Holdas and Suschka, 1978; Matheron, 1982; Matheron and Brun, 1982; Matheron and Poujardieu, 1984; Matheron and Rouvier, 1977; Lahiri, 1984; Lahiri and Mahajan, 1982; Lukefahr et al., 1983 a, b and 1984).

Material and Methods

The investigations were performed in our experimental rabbit farm with two New-Zealand White lines (G and H) and a Californian stock (K line). Breeding and suckling rabbits were housed in wire cages, the stalls were heated in winter. The rabbits were fed granulated compound feed ad libitum, with free access to water.

The does were first bred at 5 to 6 months of age, then immediately after parturition or 10 days thereafter. Data from initial and 21 day litter sizes and weight gains were collected from the stock recording and were

used for the calculation of survival rate and individual gain up to day 21. Only does were included into the study that raised 8 to 10 litters during life. Mortality of whole litters was not considered during the evaluation. Beside the means of production data we calculated the relationships between earlier and later performances, e.g. the correlations between the first parturition and the subsequent 7 ones, between the first two parturitions and the subsequent 6 ones, the first 3 and the subsequent 5 ones and the first 4 and the subsequent 4 ones. Repeatability was determined for each of the characteristics from parturitions 3 to 10. Regression equations and correlations were also calculated. By multiple regression analysis the variance of litter gain up to day 21 was investigated as affected by other characteristics. Calculations were performed with an IBM Series I computer. Data of survival rate showed no normal distribution which might result in distortions during evaluation.

Results

Correlation coefficients between earlier and later performances are summarized in Table 1. Generally, if more characteristics are used for the assessment of later production, the correlation of the interrelationship somewhat increases. The closest correlation was found between the litter size at birth, the gain of litter weight and the individual gain. Values of correlation coefficients between litter sizes at day 21 are lower and for the survival rate only one significant relationship was obtained. Higher repeatability values (Table 2.) were obtained, if they were calculated from a higher number of parturitions, resulting in a more exact breeding value. Among the characteristics examined, highest values were obtained for the initial litter size, weight gain of the litters and the individual gain. Repeatability of survival rate was the lowest. Interrelationships between the characteristics examined have been summarized in Table 3. To the regression curve a second power function always fitted better than a straight line, because the interrelationships were not linear. In several cases the exponential, logarithmic or power functions fitted even better than the parabola, however, the latter was also satisfactory and easier to interpret, and therefore, the formula of straight lines or second power functions were given only.
Initial litter size showed a weak negative correlation with survival rate and individual weight gain, a moderately negative correlation with initial

litter size and litter size at day 21. The closest positive correlations were found between the initial and 21 day litter sizes and between the 21 day litter size and the litter weight gain.

Between the individual and litter weight gains there is a significant interrelationship according to the second power function. The initial litter size is more weakly correlated with the litter weight gain than with the 21 day litter size. The survival rate shows a moderately positive correlation both with the 21 day litter size and litter weight gain. For 84 to 87 % the variance of litter weight gain the examined characteristics are responsible, where the 21 day litter size is the main factor (47 to 54 %), followed by the survival rate (14 to 17 %), the initial litter size (7 to 15 %) and the individual weight gain (5 to 14 %).

Conclusions

From the studies the following conclusions were drawn:

- By increasing the number of parturitions higher repeatabilities were achieved and closer correlations were found between earlier and later production values. By the examination of the production at 3 or 4 parturitions, more exact breeding values are obtained, than with 1 or 2 parturitions.
- Among the characteristics examined, genetic improvement of the initial litter size may be effective, due to the relatively high repeatability of the characteristic and the interrelationships between the production cycles. By doing so, the number of weaned rabbits will also be increased, but the survival rate will slightly decrease and the individual weight gain will markedly decline. As in the stocks examined 8 to 9 rabbits were born per litter, the increase of the initial litter size is not of primary importance.
- Improvement of 21 day litter size allows a slower genetic progress. However, it can be improved by indirect selection, due to its positive interrelationship with the initial litter size and with the litter weight gain, as it has been shown by multiple regression analysis, but the individual weight gain will be decreased.
- We have the least possibility for the genetic improvement of survival rate (vitality). This characteristic has a low repeatability and the earlier results provide little information for the later performance. Although

the increase of initial litter size increases the mortality, too, the improvement of litter weight gain (milk production) affects this parameter advantageously.

- Litter weight gain achieved up to day 21 belongs to the maternal characteristics that can be improved easily. There is an intermediate interrelationship between earlier and later performances with one of the highest repeatability values. It is in positive correlation with all the other characteristics, and its improvement, therefore, is not disadvantageous.
- The present study does not analyze all the maternal characteristics. According to our earlier studies, improvement of litter size at birth and of the frequency of parturitions has the highest importance.

Remark to the Table 1. Average performances: 11 = first parturition, 12 = first two parturitions, 13 = first three parturitions, 14 = first four parturitions, 15 = first five parturitions, 28 = from the second to the eighth parturition, 38 = from the third to the eighth parturition, 48 = from the fourth to the eighth parturition, 58 = from the fifth to eighth parturition, 210 = from the second to the tenth parturition, 310 = from the third to the tenth parturition, 410 = from the fourth to the tenth parturition, 510 = from the fifth to the tenth parturition, 610 = from the sixth to the tenth parturition.

Level of significante: $^{xxx}P < 0,001$, $^{xx}P < 0,01$, $^{x}P < 0,05$

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Table 1.

Interrelationship between earlier and later performances of rabbit does

(Number of animals)

(n) = A: G = 134, H = 107, K = 62

B: G = 65, M = 57, K = 35

Production period	Stock	Characteristics				
		Litter size at birth	Litter size at day 21	Survival rate	Weight gain of the litter	Individual weight gain
		Correlation coefficients				
		Calculated from 8 litters (A)				
11 - 28	G	0,43^{xxx}	0,09	0,09	0,27^{xx}	0,20^{x}
	H	0,21^{x}	0,24^{x}	0,14	0,32^{xxx}	0,20^{x}
	K	0,38^{xx}	0,36^{xx}	-0,06	0,23	0,41^{xxx}
12 - 38	G	0,38^{xxx}	0,13	0,19	0,29^{xx}	0,35^{xxx}
	H	0,22^{x}	0,23^{x}	0,08	0,29^{xx}	0,32^{xxx}
	K	0,33	0,32^{x}	-0,06	0,32^{x}	0,32^{x}
13 - 48	G	0,46^{xxx}	0,17	0,24^{x}	0,27^{xx}	0,34^{xxx}
	H	0,29^{xx}	0,38^{xxx}	0,15	0,46^{xxx}	0,40^{xxx}
	K	0,45^{xxx}	0,27^{x}	0,07	0,47^{xxx}	0,38^{xx}
14 - 58	G	0,45^{xxx}	0,31^{xx}	0,25^{x}	0,35^{xxx}	0,51^{xxx}
	H	0,38^{xxx}	0,43^{xxx}	0,22^{x}	0,51^{xxx}	0,47^{xxx}
	K	0,41^{xxx}	0,25^{x}	0,17	0,50^{xxx}	0,36^{xx}
		Calculated from 10 litters (B)				
14 - 210	G	0,39^{xx}	0,13	-0,05	0,31^{x}	0,29^{x}
	H	0,12	0,22	0,34^{xx}	0,36^{xx}	0,30^{x}
	K	0,41^{x}	0,49^{xx}	-0,15	0,24	0,36^{x}
12 - 310	G	0,53^{xxx}	0,15	0,05	0,27	0,47^{xxx}
	H	0,14	0,14	0,35^{xx}	0,24	0,39^{xx}
	K	0,47^{xx}	0,55^{xxx}	-0,07	0,36^{x}	0,27
13 - 410	G	0,49^{xxx}	0,20	0,14	0,29^{x}	0,52^{xxx}
	H	0,25	0,26^{x}	0,37^{xx}	0,34^{xx}	0,45^{xxx}
	K	0,55^{xxx}	0,44^{xx}	0,07	0,50^{xx}	0,36^{x}
14 - 510	G	0,47^{xxx}	0,30^{x}	0,14	0,34^{xx}	0,51^{xxx}
	H	0,31^{x}	0,34^{xx}	0,41^{xxx}	0,49^{xxx}	0,51^{xxx}
	K	0,49^{xx}	0,42^{xx}	0,13	0,52	0,41^{x}
15 - 610	G	0,52^{xxx}	0,34^{xx}	0,20	0,38^{xx}	0,48^{xxx}
	H	0,43^{xxx}	0,33^{xx}	0,43^{xxx}	0,47^{xxx}	0,49^{xxx}
	K	0,46^{xx}	0,37^{x}	0,09	0,48^{xx}	0,44^{xx}

Remarks see on the 4th page

Table 2.

Repeatability of production characteristics of rabbit does in function of the number of parturitions in two New-Zealand White (G and H) lines and in a Californian stock

Characteristics	Stock	Number of parturitions							
		3	4	5	6	7	8	9	10
		Repeatability values							
Litter size at birth	G	0,18	0,19	0,21	0,26	0,28	0,33	0,36	0,41
	H	0,14	0,10	0,13	0,14	0,20	0,26	0,34	0,30
	K	0,17	0,29	0,28	0,29	0,33	0,35	0,37	0,45
Litter size at day 21	G	0,04	0,06	0,11	0,17	0,18	0,20	0,23	0,30
	H	0,13	0,15	0,19	0,20	0,24	0,28	0,31	0,26
	K	0,21	0,21	0,21	0,20	0,20	0,20	0,23	0,32
Survival rate between 0 and 21 days	G	0,03	0,08	0,07	0,08	0,11	0,15	0,18	0,23
	H	0,09	0,03	0,09	0,10	0,13	0,15	0,19	0,21
	K	0,04	0,03	0,11	0,11	0,10	0,13	0,13	0,18
Litter weight gain (0-21 days)	G	0,13	0,20	0,22	0,26	0,30	0,30	0,32	0,38
	H	0,08	0,11	0,16	0,23	0,30	0,33	0,38	0,32
	K	0,04	0,14	0,22	0,26	0,30	0,30	0,31	0,38
Individual weight gain (0-21 days)	G	0,15	0,12	0,18	0,22	0,27	0,27	0,34	0,32
	H	0,16	0,22	0,28	0,27	0,31	0,35	0,36	0,42
	K	0,21	0,27	0,22	0,21	0,24	0,28	0,30	0,33

Interrelationship between litter size at birth (1), litter size at day 21 (2), survival rate (3), litter weight gain up to day 21 (4), and individual weight gain up to day 21 (5), in two New-Zealand White (G and H) lines and in a Californian stock (K)

Characteristics X - Y	Stock	r	Linear function Y = a + bX	r	Second power parabola $Y = a + bX + cX^2$
1 - 2	G	0,60	Y=2,12+0,52X	0,64	$Y= -1,21+1,43X-0,056X^2$
	H	0,70	Y=1,43+0,64X	0,71	$Y= -0,80+1,28X-0,041X^2$
	K	0,65	Y=1,35+0,63X	0,66	$Y= -0,43+1,10X-0,029X^2$
1 - 3	G	-0,36	Y=104,5-3,01X	0,39	$Y= 84,4+2,46X-0,338X^2$
	H	-0,28	Y=102,4-2,31X	0,30	$Y= 90,5+1,10X-0,220X^2$
	K	-0,23	Y=97,7-2,04X	0,23	$Y= 91,3-0,32X-0,105X^2$
1 - 4	G	0,23	Y=1300+57,9X	0,35	$Y=469+285X-14,03X^2$
	H	0,38	Y=1146+83,9X	0,41	$Y=498+269X-11,94X^2$
	K	0,34	Y=1057+74,4X	0,36	$Y=520+217X-8,69X^2$
1 - 5	G	-0,52	Y=449-18,5x	0,56	$Y=578-537X+2,18X^2$
	H	-0,56	Y=446-19,2X	0,59	$Y=555-50,1X+2,00X^2$
	K	-0,44	Y=398-15,4X	0,46	$Y=476-36,1X+1,26X^2$
2 - 4	G	0,67	Y=700+169X	0,69	$Y=242+345X-14,7X^2$
	H	0,71	Y=697+170X	0,72	$Y=266+327X-12,5X^2$
	K	0,66	Y=703+148X	0,70	$Y=102+370X-17,8X^2$
2 - 5	G	-0,58	Y=449-24,0X	0,58	$Y=480-35,8X+0,98X^2$
	H	-0,59	Y=438-22,2X	0,60	$Y=483-38,4X+1,29X^2$
	K	-0,56	Y=402-20,0X	0,56	$Y=386-14,3X-0,46X^2$
3 - 2	G	0,49	Y=2,39+0,051X	0,57	$Y=2,61+0,22X-0,0012X^2$
	H	0,46	Y=2,23+0,052X	0,53	$Y=3,00+0,22X-0,0012X^2$
	K	0,56	Y=1,56+0,060x	0,60	$Y=1,81+0,18X-0,0008X^2$
3 - 4	G	0,49	Y=765+12,8X	0,54	$Y=202+44,9X-0,23X^2$
	H	0,48	Y=709+13,3X	0,52	$Y= -188+41,7X-0,20X^2$
	K	0,49	Y=698+11,9X	0,56	$Y= -262+44,5X-0,24X^2$
5 - 4	G	0,12	(Y=1567+0,73X)	0,27	$Y=768+5,7X-0,007X^2$
	H	0,07	(Y=1697+0,43X)	0,37	$Y=116+12,2X-0,018X^2$
	K	0,18	(Y=1361+1,11X)	0,40	$Y= -90+11,6X-0,017X^2$

Comment: n = G: 1232, H: 984, K: 580

Table 3.