CROSSBREEDING PARAMETERS FOR GROWTH PERFORMANCE OF BROILER RABBITS*

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The growth of broiler rabbits: two parental lines *59* (paternal) and *19* (maternal) and three groups of crossbreds F_1 (*59* x *19*), F_2, *59* x F_1 were analysed in six weeks fattening period (42 d to 84 d of age). The analysed traits were live weight (BW), the average daily gain (ADG), average daily feed consumption (ADF) and feed conversion (FC) (weekly). The estimated least squares means were used as input data for estimating the crossbreeding effects. The model of Dickerson (1969, 1973) was used in all calculations. Three kinds of crossbreeding effects were included: additive effect, heterosis and recombination loss. By the end of the fattening period, the heaviest crossbreds F_1 attained 2802.5 g and paternal line *59* 2935.8 g of BW, whereas the lowest BW was noticed for crossbreds F_2 (2606 g). For BW direct additive effects of line *59* were ranging from 1.5 g to 321.4 g during the whole fattening period. Heterosis was negative and non-significant (–10.37 g to –112.14 g). Recombination loss occurred negative, high and significant (–14.72 g to –493.51 g). Significant additive effect for ADG was found only in the first week of test (20.34 g), significant heterosis occurred in the third week of experiment (3.29 g). Recombination loss was in the range from –23.86 g to 16,92 g. Additive effects for ADF were non-significant (–23.03 g to 51.11 g) the heterosis was significant and mostly positive (37.03 g to 42.39 g). The recombination loss ranged between –74.10 g and 55.70 g. The estimates of crossbreeding effects for FC were small and non-significant.

rabbit; growth; feed conversion; crossbreeding; maternal line; paternal line

INTRODUCTION

The broiler rabbit is generally a two-way or a four-way hybrid. A performance of these hybrids is determined by several crossbreeding effects, especially by heterosis. In addition, crossbreeding with specialized breeds or strains make use of the complementarity between dam lines, which have a good reproductive efficiency, and sire lines, which possess a good meat production efficiency. Knowledge of a magnitude and a direction of crossbreeding effects are important for crossbreeding scheme decision.

The testing of broiler rabbits has been conducted by the Department of Genetics and Animal Production of the Czech University of Agriculture in Prague since 1992. The testing is concentrated on growth, feed consumption, feed conversion and carcass quality (Mach, 1992; Mach, Majzlík, 1993; Mach et al., 1997a, b; Dědková et al., 1999, 2002).

The objective of the present study was the estimation of crossbreeding effects for growth performance of two parental lines and their crossbreds during the fattening period from 42 days to 84 days of age.

MATERIAL AND METHOD

The growth of broiler rabbits: two parental lines *59* (paternal) and *19* (maternal) and three groups of crossbreds F_1 (*59* x *19*), F_2, *59* x F_1 were analysed. The test was carried out at the Faculty Test Facilities of the Department of Genetics and Breeding of the Czech University of Life Sciences in Prague. The six weeks long fattening period started at 42 days and finished at 84 days of age of the rabbits. The live weight (BW) and individual feed consumption was weekly measured until the end of the experiment. The average daily gain (ADG), average daily feed consumption (ADF) and feed conversion (FC) expressed as a feed consumption per 1 kg of ADG was calculated from data for every experimental week.

The analysis was carried out by the ordinary least squares method in the procedure GLM of statistical software SAS (SAS, 1988). A linear model included the factors of the rabbit group and factor of breeder. The estimated least squares means were used as input data for the program package CBE4, version 4.0 (Wolf, 1995) that was used for estimating the crossbreeding effects. The model of Dickerson (1969, 1973) was used in all calculations. Three kinds of crossbreeding effects were included: additive, heterosis and recombination effects. The additive effects for maternal line 19 were set to zero. The additive effects for paternal line *59* were therefore expressed as deviations from maternal line.

The coefficients for these effects were expressed as given in Wolf et al. (1995). Then the full model for crossbreeding effects has the following form :

$$CBE = \alpha_{59}\alpha_{59} + \delta_{19,59}h_{19,59} + (4\alpha_{19}\alpha_{59} - \delta_{19,59})r_{19,59}$$

where: α – additive effect of line *59*
h – heterosis for combination *19* x *59*
r – recombination loss for breed combination *19* x *59*

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The α's and δ's are the coefficients, which are specific for each animal.

The estimation was carried out by weighted least squares using the reciprocals of the variances of the genetic group means as weights.

RESULTS AND DISCUSSION

By the end of the fattening period, the heaviest crossbreds F_1 attained 2802.5 g, paternal line *59* 2935.8 g, whereas the lowest BW was noticed for crossbreds F_2 (2606 g) (Fig. 1).

The ADG (Fig. 2) dropped off within weeks of the fattening period for all the groups of rabbits. The highest ADG was found for paternal line *59* (51.79 g), for crossbreds F_1 (45.16 g) and *59* x F_1 (44.07 g) in the first week of the test. For crossbreds F_2 the ADG varied between weeks of fattening period.

Feed consumption (ADF) was proportional to the ADG of rabbits. The highest ADF (Fig. 3) was found for line *59* (141.79 g) and crossbreds F_1 (137.19 g) and *59* x F_1 (143.44 g) in the first week of fattening. The values of ADF fluctuated for crossbreds F_2.

No marked differences were found for FC among all groups (2.90 to 5.98) (Fig. 4). An increase of FC was observed with the age of rabbits, especially in the last week of fattening period (max. 12.52). We cannot confirm findings of Brun and Ouhayoun (1989) who found out that feed efficiency is reduced by crossbreeding.

The estimates for crossbreeding effects are presented in Table 1. Positive estimates of additive effect on behalf of line *59* were found for BW (31.5 g to 321.4 g) during the whole fattening period. It is in agreement with Dědková et al. (2002). Heterosis for BW was negative and non-significant (–10.37 g to –112.14 g). On the contrary, Mach, Majzlík (1993) and Brun, Ouhayoun (1989) found positive heterosis effects for BW

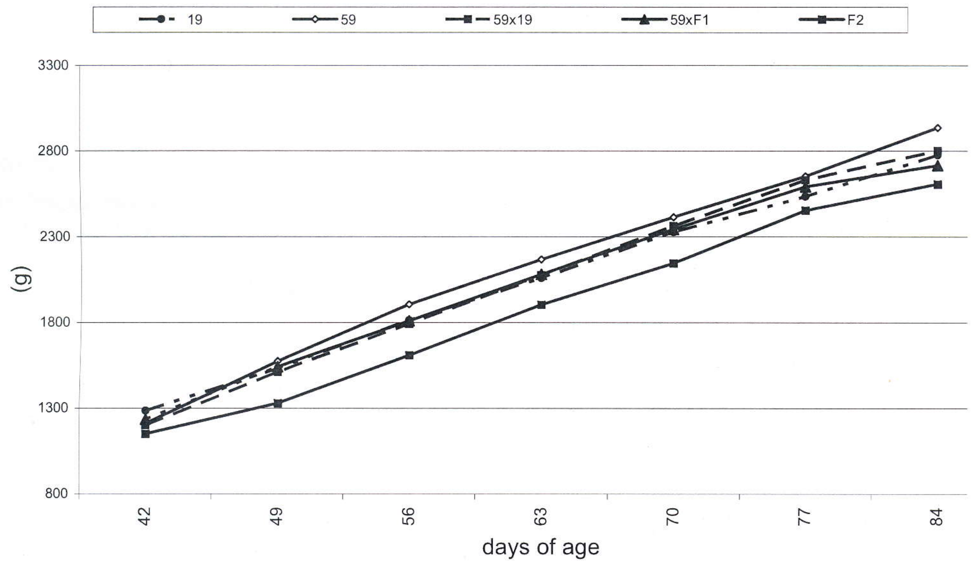

Fig. 1. Body weight of rabbits for the fattening period

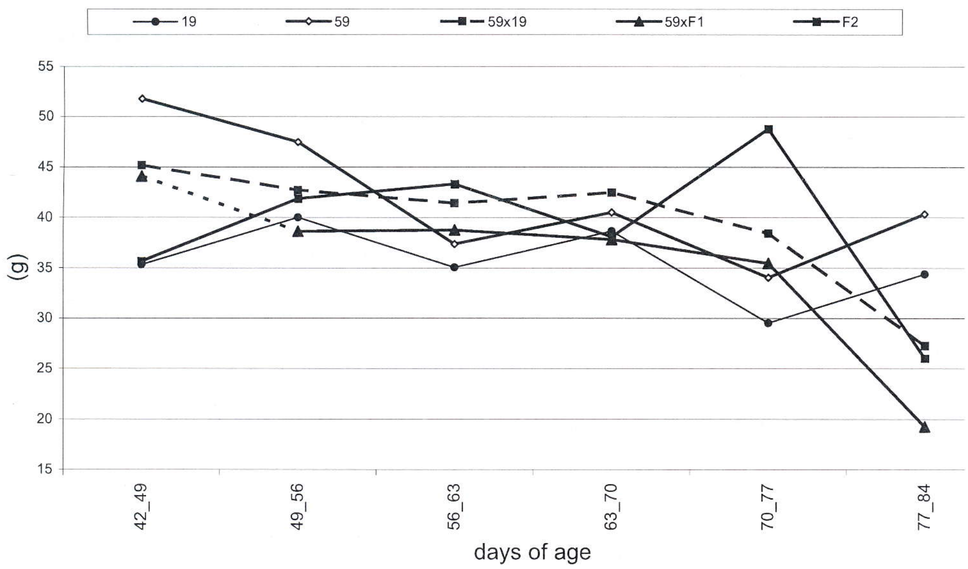

Fig. 2. Average daily gain of rabbits for the fattening period

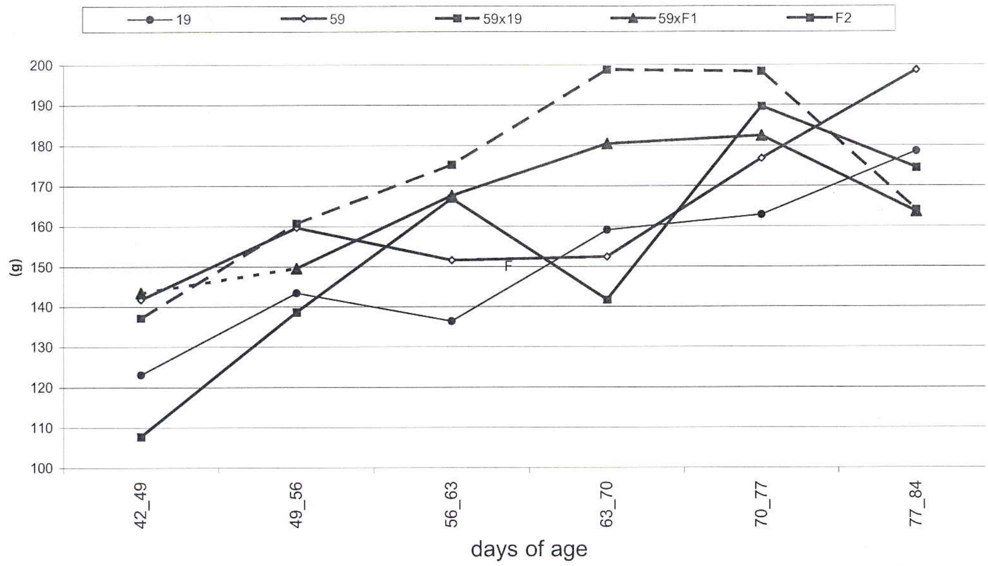

Fig. 3. Average daily feed consumption of rabbits for the fattening period

Table 1. Estimates of crossbreeding effects for analysed traits

Age (days)	Additive effect	SD		Heterosis	SD		Recombination loss	SD	
Body weight (g)									
42	31.49	64.446	ns	–10.37	39.132	ns	–14.72	86.553	ns
49	257.59	73.833	**	–46.77	46.214	ns	–326.80	86.830	**
56	292.23	85.463	**	–112.14	53.494	*	–472.13	100.507	**
63	304.15	90.967	**	–69.27	56.939	ns	–416.37	106.980	**
70	288.88	104.818	**	–36.88	65.608	ns	–493.51	123.269	**
77	303.46	106.585	**	–14.68	66.715	ns	–413.28	125.347	**
84	321.41	113.712	**	–24.65	71.175	ns	–482.15	133.728	**
Average daily gain (g)									
42–49	20.34	5.587	**	–2.38	3.393	ns	–23.86	7.503	**
49–56	4.85	5.587	ns	–1.04	3.393	ns	–11.49	7.503	ns
56–63	0.19	5.262	ns	6.48	3.292	*	8.57	6.213	ns
63–70	–1.04	5.014	ns	3.03	3.140	ns	–9.84	5.951	ns
70–77	1.02	6.530	ns	3.42	4.083	ns	16.92	7.759	*
77–84	1.75	5.623	ns	–1.24	3.511	ns	–7.06	6.742	ns
Average daily feed consumption (g)									
42–49	51.11	11.526	**	37.03	6.999	**	35.69	15.480	ns
49–56	13.83	15.215	ns	–21.26	9.523	*	–74.10	17.893	**
56–63	22.62	12.914	ns	36.66	8.084	**	30.28	15.188	ns
63–70	23.80	13.718	ns	40.44	8.587	**	–55.70	16.133	**
70–77	–6.28	14.148	ns	42.39	8.923	**	10.46	16.674	ns
77–84	–23.03	20.007	ns	–52.75	12.523	**	–97.62	23.529	ns
Feed conversion (feed consumption per 1 kg of ADG)									
42–49	–0.78	0.804	ns	0.70	0.488	ns	2.33	1.080	*
49–56	0.66	1.482	ns	2.58	0.930	**	2.39	1.745	ns
56–63	0.44	1.306	ns	0.44	0.817	ns	1.12	1.543	ns
63–70	0.84	1.743	ns	1.69	1.092	ns	1.09	2.069	ns
70–77	–0.69	1.274	ns	0.92	0.796	ns	–0.42	1.513	ns
77–84	0.62	5.000	ns	–1.88	3.122	ns	–6.18	5.995	ns

SD – standard deviation; ns – non-significant; * – $P < 0.05$; ** – $P < 0.01$

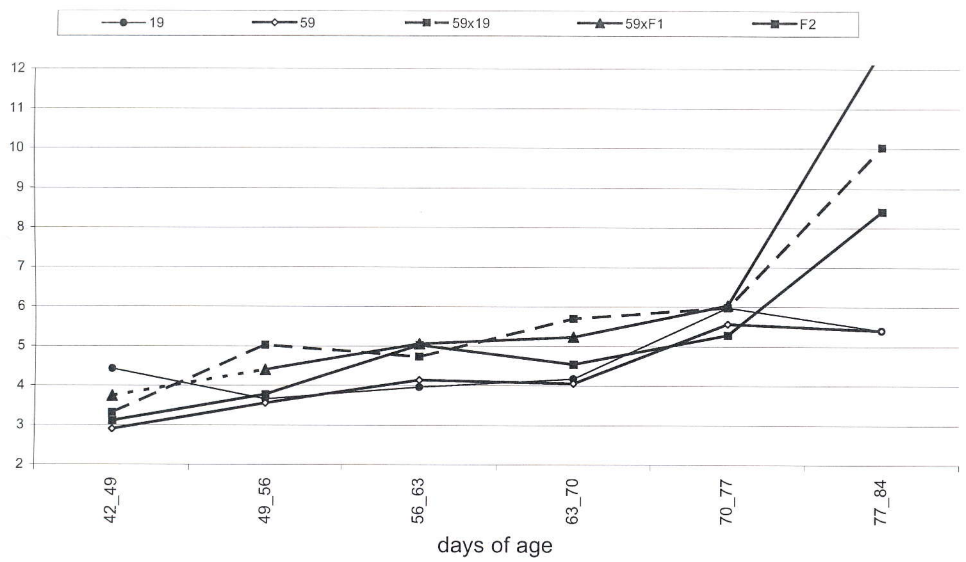

Fig. 4. Feed conversion of rabbits for the fattening period

at the end of fattening period (91 days of age, 79 days of age respectively). Recombination loss occurred negative, significant and high (–14.72 g to –493.51 g).

The crossbreeding effects for the rest of the analysed traits did not show obvious trends. The ADG was found to have significant additive effect only in the first week of test (20.34 g), significant heterosis occurred in the third week of experiment (3.29 g). The positive heterosis for daily gain was reported by Brun and Ouhayoun (1989) or Krogmeier and Dzapo (1991). Recombination loss was in the range from –23.86 g to 16.92 g. While the additive effects for ADF were non-significant (–23.03 g to 51.11 g), the heterosis turned out to be significant and mostly positive (37.03 g to 42.39 g). The estimates of recombination loss fluctuated between –74.10 g and 55.70 g. The estimates of crossbreeding effects for FC were small except for two of them, which were non-significant.

We can conclude that the crossbreeding effects mostly influenced only body weight of the rabbits in this experiment. The positive additive effect increased the BW of rabbits proportionally to the part of the *59* line gene. On the contrary, the negative estimates of recombination loss restrained the BW of crossbreds especially in the F_2.

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Parametry křížení pro ukazatele růstu brojlerových králíků.

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Byl vyhodnocen růst brojlerových králíků během šestitýdenního výkrmu (42 až 84 dní věku) u otcovské linie *59* a mateřské linie *19* a jejich kříženců F_1 (*59* x *19*), F_2 a *59* x F_1. Pro živou hmotnost (BW), průměrný denní přírůstek (ADG), průměrnou denní spotřebu krmiva (ADF) a konverzi krmiva (FC) byly v každém týdnu výkrmu na základě průměrů nejmenších čtverců odhadnuty efekty křížení. Efekty křížení byly definovány podle modelu Dickersona (1969, 1973). Odhadnut byl aditivní efekt, heterozní efekt a rekombinační ztráta. Na konci výkrmu dosáhli největší BW kříženci F_1 (2802,5 g) a králíci otcovské linie *59* (2935,8 g), zatímco nejnižší BW byla nalezena u kříženců F_2 (2606 g). Aditivní efekt linie *59* se pohyboval mezi 1,5 g až 321,4 g během celé doby výkrmu. U BW byl heterozní efekt negativní a statisticky nevýznamný (–10,37 g až –112,14 g). Rekombinační ztráta pro BW byla negativní a statisticky významná (–14,72 g až –493,51 g). Statisticky významný aditivní efekt pro ADG byl nalezen pouze v prvním týdnu testu (20,34 g), podobně se statisticky významný heterozní efekt pro ADF objevil jen v třetím týdnu experimentu (3,29 g). Rekombinační ztráta se pohybovala v rozmezí od –23,86 g do 16,92 g. Aditivní efekty pro ADF byly statisticky nevýznamné (–23,03 g až 51,11 g), heterozní efekty naopak signifikantní a většinou kladné (37,03 g až 42,39 g). Rekombinační ztráta se pohybovala mezi –74,10 g a 55,70 g. Odhady efektů křížení pro FC byly malé a statisticky nevýznamné.

králík; růst; konverze krmiva; křížení; mateřská linie; otcovská linie

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