ANALYSIS OF FACTORS AFFECTING PREWEANING TRAITS OF ANGUS CALVES IN THE CZECH REPUBLIC*

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In the years 1992–1998, the following growth traits of the Angus beef breed (n = 1425) in the Czech Republic were recorded: birth weight, 120-day weight, weaning weight (210 days), average daily gains (birth–120 days, birth–210 days and 120–210 days). In a mixed linear model the following factors were taken into account: year of birth, herd, sex, birth rate, dam's age (parity), sire. Correlation and regression analyses were used for describing the relationship between the preweaning traits. Weaning weights as well as preweaning average daily gain are higher than values found in some USA studies. In some cases the birth weights in the USA were higher than in the Czech Republic. The coefficients of variation for all average daily gains were higher than those found for the 120-day and 210-day weight. So growth characteristics can be regarded as more useful selection criteria than weight traits. Effects of the year, herd, and sex of calf were highly significant ($P < 0.01$) in all traits. The parity was highly significant for all traits with the exception of average daily gain in the period from120 to 210 days. Highly significant differences were reported between singles and twins in all weight traits, significant differences ($P < 0.05$) in average daily gain in the period from birth to 120 days and non-significant differences in preweaning average daily gain from birth to 210 days and in the period of 120–210 days. The sire factor was significant ($P < 0.0001$) in all traits. In general, similar differences between effects within the factors (year of birth, herd, birth rate, parity) were found in numerous USA studies of Angus cattle. Growth traits (excluding birth weight and average daily gain in the period of 120–210 days) have increased from 1994 to 1998 thanks to better maternal characteristics resulting from the improved management system and nutritional conditions. The results of the analysis illustrate a good adaptability of the Angus breed to various environmental conditions. Differences between herds reflect the level of intensity of production systems. The principal eco-

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nomic factors are the production costs and the realized profit for the maternal characters in the agricultural enterprises. Weaning weights and preaweaning average daily gains of the Angus bulls and heifers in the Czech Republic are substantially higher than those recorded in the USA. Highly significant and significant differences between bulls and heifers (in favor of bulls) were found for all preweaning weight traits and average daily gains from birth to 120 days. The difference between both sexes for average daily gain from birth to 210 days and from 120 to 210 days were non-significant. For all preweaning traits with the exception of the period of 120–210 days, higher parity (dam's age) was associated with growth. The sire factor was highly significant for all traits. The variance ratio for sires was very high (16.54–24.13%). It means that the estimation of breeding values on progeny information followed by an efficient selection could considerably contribute to the improvement of all preweaning traits. Variance ratios for the fixed factors were estimated as well correlations between traits. Correlations between birth weight and the other traits were very low. Birth weight cannot be used for the estimation of preweaning growth traits.

beef Angus cattle; preweaning growth traits; analysis; enviromental factors; sire factor; correlation; regression

INTRODUCTION

The preweaning traits of farm animals are very interesting for farmers and breeders. The individual phenotype is conditioned by the genotype and by external and internal enviromental factors, so it is possible to use the phenotype (performance) of the best individuals at early stages for selection. Growth traits characterizing the preweaning period are very important and are strongly influenced by maternal effects (the effects of the dam on the development of the calf).

Birth weight and weaning weight are significant selection criteria influencing efficiency of beef production – fixed costs are shifted to the weaned calf (the higher the weaning weight, the lower the costs per kg weight).

Weaning traits show a considerable variability due to breeds. Direct genetic effects (growth capacity of the calf) and maternal genetic effects (dependent on dam's milk production above all) determine this variability. Selection of bulls and heifers with higher weaning weight is associated with a positive genetic effect on ability to rear high-quality progeny. Liveweight of calves at 120 and 210 days can therefore be efficiently used for the estimation of the differences in the maternal ability. The total weight gain or the average daily gain in the preweaning period are more useful selection criteria than the weaning weight. The individual genotype is influenced by enviromental effects - random (unsystematic) ones and systematic fixed and random ones (Jakubec et al., 1998).

Numerous experiments have been realized in the USA with Angus and Hereford cattle. Large data sets are available – information on the performance of purebred animals and crosses. The results of these experiments were used for reflecting the results of our study. Gregory et al. (1963) studied birth weight, weaning weight, average daily gains in the preweaning period and conformation traits at 200 days of age in Hereford, Angus, Shorthorn cattle, as well as in crosses in the period 1957–1963. Effects of sire and dam breed were analyzed. Two-way and three-way interactions of the mentioned factors were studied, too.

Cundiff et al. (1966) studied effects of age of dam, sex (bull, heifer, steer), breed (Angus, Hereford), grazing system (extensive, semi-intensive, intensive), region, month of birth, management system (suckling with grazing, suckling alone) on the calf weight at 205 days of age. All the factors were highly significant ($P < 0.01$). Long and Gregory (1974) analyzed the performance of Hereford, Angus, and Hereford x Angus cattle in the period 1966–1967. Smith et al. (1976) studied Hereford, Angus, Shorthorn calves and two-breed crosses. Gregory et al. (1978) performed a complete diallele crossing of Red Poll, Brown Swiss, Hereford and Angus and analyzed the following performance traits of the progeny: birth weight, weaning weight and average daily gain in the preweaning period.

Koch et al. (1985) analyzed the following traits of unselected pure bred Angus and Hereford animals, their reciprocal crosses F1, B1 (back crosses), F2 and F3: birth weight, weaning weight and average daily gain. Gregory et al. (1991a) formed synthetic populations from 4 to 6 breeds (Red Poll, Hereford, Angus, Limousin, Braunvieh, Pinzgauer, Gelbvieh, Simmental, Charolais) in the period of 1978–1989. The performance of all these breeds and their crosses was studied in the framework of the project. Birth weight, weaning weight (at 200 days), average daily gains of male and female calves were recorded and correction factors were estimated.

Beef cattle is kept on farms in the Czech Republic since 1974. At that time 800 Hereford heifers have been imported from Canada. Larger imports of beef cattle breeds (Charolais, Simmental, Fleckvieh, Limousin, Galloway, Highland, Salers etc.) are characteristic for recent years (since 1990). Along this line, a large group of Aberdeen-Angus cattle has been imported as well. On January 1st, 1998 959 cows, 374 heifers and 68 sires of the Angus breed were registered in 46 herds. Up till 1997, 1844 calvings were recorded.

Principal objective of the present study was the analysis of environmental and sire effects for the preweaning traits of the Angus calves (birth weight, weaning weight, weight at 120 days, average daily gain in specific periods).

MATERIAL AND METHODS

The following traits were recorded for 1425 Angus calves in the period of 1992 through 1998: birth weight, weights at 120 and 210 days of age, average daily gain for the following intervals: birth–120 days, birth–210 days, 120–210 days. Growth traits of calves were analyzed with respect to year of birth (1992–1998), herd (1–16), sex (male, female), calf number (single, twin), parity (1–7), sire (1–99). The least squares method utilizing the SAS/STAT (1999) GLM procedure was applied for the analysis. The following effects were included in the model:

$$Y_{ijklmno} = \mu + a_i + b_j + c_k + d_l + f_m + g_n + e_{ijklmno}$$

where: $Y_{ijklmno}$ – individual observation of the trait
μ – general mean
a_i – fixed effect of the i-th year of birth (i = 1, ..., 7)
b_j – fixed effect of the j-th herd (j = 1, ..., 16)
c_k – fixed effect of the k-th sex (k = 1, 2)
d_l – fixed effect of the l-th calf number (l = 1, 2)
f_m – fixed effect of the m-th parity (m = 1, ..., 7)
g_n – random effect of the n-th sire (n = 1, ..., 99)
$e_{ijklmno}$ – random residual error

Relationships between the traits analyzed were characterized by means of linear correlation and regression coefficients.

RESULTS AND DISCUSSION

Means, standard deviations, coefficients of variation characterizing the traits analyzed in the Angus breed are summarized in Table I. In general, the values of weaning weight and average daily gain in the preweaning period were higher than values performed in the USA. Variation for average daily gains was higher than variation for body weight traits. Therefore under the assumption of similar heritability for weight and growth traits, growth traits could be more efficient selection criteria than the weights. Table II presents least squares means and their standard errors for the traits analyzed with respect to the environmental factors. General means representing mean values of all effects within the specific factor are given for all traits. The sum of effects (deviations from the general mean) is equal to zero ($\Sigma a_i = \Sigma b_j = \Sigma c_k = \Sigma d_l = \Sigma f_m = \Sigma \gamma_n = 0$). These deviations can be also used as correction factors of primary data.

I. Overall means, standard deviations (SD) and coefficients of variation (CV) for preweaning traits

Trait		Mean	SD	CV (%)
Birth weight	(kg)	32.85	3.30	10.05
120–day weight	(kg)	160.38	28.70	17.70
210–day weight	(kg)	258.19	36.80	14.25
Average daily gain:				
Birth–120 days	(kg)	1.06	0.23	22.37
Birth–210 days	(kg)	1.07	0.17	16.25
120–210 days	(kg)	1.09	0.31	28.92

Parameters presented in Table II formed the basis for the analysis of these factors:

Year: Year effects were highly significant for all growth traits ($P < 0.0001$). In 1992, performance of only 4 calves was recorded, so large standard errors were found for this year. Therefore, this year was excluded from the comparative study of growth traits. The lowest birth weight was found in 1993. From 1994 to 1996 the birth weight was about 32 kg and in the last two years (1997–1998) the birth weight dropped to 31 kg. The difference between the minimum weight and the maximum weight was 2.87 kg. For the other growth traits, the lowest means were recorded in 1994, the highest ones in 1998. The increasing tendency was evident in all traits excluding average daily gain in the period 120–210 days. This positive trend reflects improved management and nutritional conditions resulting from the experience of Angus breeders in these years.

Gregory et al. (1963, 1978, 1991b) found highly significant ($P < 0.01$) and significant ($P < 0.05$) differences between years in birth weight, weaning weight (200 days), average daily gain (birth–200 days) of USA Angus progeny.

Herd (farm effect including breeder and region effect): Effects for all growth traits were highly significant ($P < 0.01$). Differences between the minimum and maximum values were large as compared to the differences associated with the factor of year. The results of the analysis illustrate the good adaptability of Angus cattle to less favourable as well as to higher favourable conditions.

Cundiff et al. (1966) studied the 205-day weight with respect to the grazing system, region, month of birth and management system (suckling and grazing, suckling alone). All factors studied were highly significant ($P < 0.01$).

The above mentioned factors (year of birth and herd) can be affected by the feeding regime, technology and management systems. However, the fac-

II. Least squares means (LSM) and their standard errors (SE) for preweaning traits according to analysed factors (kg)

Factor	Number of observations	Weight						Average daily gain					
		birth		120 days		210 days		birth–120 days		birth–210 days		120–210 days	
		LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE
Overall mean	1425	30.92		145.89		245.97		0.58		1.024		1.112	
Year													
P		0.0001		0.0001		0.0001		0.0001		0.0001		0.0001	
1992	4	29.02	3.52	101.78	30.67	267.25	39.32	0.606	0.254	1.134	0.186	1.838	0.336
1993	89	29.29	0.68	145.09	5.92	224.83	7.59	0.965	0.049	0.931	0.036	0.885	0.064
1994	157	32.11	0.59	143.79	5.12	216.88	6.57	0.931	0.042	0.880	0.031	0.812	0.056
1995	182	32.16	0.55	152.44	4.78	241.29	6.13	1.002	0.040	0.996	0.029	0.987	0.052
1996	272	31.84	0.52	148.51	4.54	248.75	5.83	0.972	0.038	1.033	0.027	1.114	0.050
1997	320	31.00	0.47	157.71	4.23	260.25	5.43	1.056	0.035	1.092	0.026	1.140	0.046
1998	401	30.99	0.47	171.87	4.15	262.54	5.32	1.174	0.034	1.103	0.025	1.007	0.045
Range		2.87		28.08		45.66		0.243		0.223		0.328	
Herd													
P		0.0001		0.0014		0.0001		0.0077		0.0001		0.0001	
1	285	32.24	0.66	154.09	5.76	259.13	7.34	1.015	0.047	1.080	0.035	1.167	0.063
2	154	30.95	0.71	148.36	6.16	259.93	7.89	0.978	0.051	1.090	0.037	1.240	0.067
3	150	33.58	0.77	162.83	6.69	272.74	8.58	1.078	0.055	1.139	0.041	1.221	0.073
4	35	28.15	1.11	154.98	9.69	251.87	12.42	1.057	0.080	1.065	0.059	1.077	0.106
5	18	32.55	1.20	158.11	10.40	264.80	13.33	1.046	0.086	1.106	0.063	1.185	0.114
6	35	26.07	1.55	131.48	13.48	189.87	17.30	0.877	0.112	0.780	0.082	0.651	0.148
7	20	36.53	1.47	158.82	12.78	303.31	16.38	1.019	0.106	1.270	0.078	1.606	0.140
9	6	26.83	1.60	122.72	13.93	214.35	17.86	0.799	0.115	0.893	0.085	1.018	0.153
10	8	37.75	1.40	169.47	12.20	301.95	15.65	1.097	0.101	1.258	0.074	1.472	0.134
100	43	28.29	0.92	139.65	8.02	228.02	10.28	0.928	0.066	0.951	0.049	0.982	0.088
111	14	27.92	1.24	125.99	10.76	201.47	13.79	0.817	0.089	0.826	0.065	0.837	0.118
115	108	29.14	0.75	136.76	6.53	234.87	8.38	0.897	0.054	0.980	0.040	1.090	0.072
220	37	35.26	0.91	140.79	7.91	237.92	10.14	0.879	0.066	0.965	0.048	1.079	0.087
301	216	26.46	0.83	145.19	7.21	229.48	9.24	0.989	0.060	0.967	0.044	0.937	0.079
500	281	31.69	0.67	151.33	5.84	257.04	7.49	0.997	0.048	1.073	0.035	1.175	0.064
600	15	31.24	1.14	133.85	9.87	228.78	12.66	0.855	0.082	0.940	0.060	1.055	0.108
Range		11.68		46.75		113.44		0.298		0.490		0.955	
Sex													
P		0.0001		0.0001		0.0001		0.0001		0.0001		0.0001	
Bulls	712	31.97	0.62	150.46	5.39	254.44	6.91	0.987	0.045	1.059	0.033	1.155	0.059
Heifers	713	29.87	0.62	141.31	5.42	237.49	6.95	0.929	0.045	0.989	0.033	1.069	0.059
Range		2.1		9.15		16.95		0.058		0.060		0.086	
Calf number													
P		0.0001		0.0008		0.0073		0.0335		0.0836		0.9235	
Singles	1382	33.80	0.56	153.71	4.84	254.01	6.21	0.999	0.040	1.049	0.029	1.114	0.053
Twins	43	28.03	0.77	138.06	6.68	237.93	8.57	0.916	0.055	0.999	0.041	1.110	0.073
Range		5.77		15.65		16.08		0.083		0.050		0.004	
Parity													
P		0.0012		0.0001		0.0001		0.0001		0.0003		0.1620	
1	313	29.88	0.60	132.34	5.25	235.71	6.73	0.858	0.043	0.980	0.032	1.149	0.057
2	391	30.22	0.59	138.62	5.15	239.73	6.60	0.903	0.043	0.998	0.031	1.123	0.056
3	337	30.69	0.60	141.72	5.21	245.73	6.68	0.925	0.043	1.024	0.032	1.156	0.057
4	223	31.17	0.62	147.60	5.42	253.39	6.95	0.970	0.045	1.058	0.033	1.175	0.059
5	117	31.56	0.66	145.50	5.74	249.35	7.36	0.949	0.048	1.037	0.034	1.154	0.063
6	37	31.68	0.83	140.93	7.20	234.05	9.23	0.910	0.060	0.964	0.044	1.034	0.079
7	7	31.20	1.45	174.49	12.49	263.83	16.21	1.194	0.105	1.108	0.077	0.993	0.138
Range		1.8		42.15		28.12		0.336		0.144		0.182	

tors of the internal environment, which cannot be affected by the breeder, will also be analyzed.

Sex: There were highly significant differences between both sexes for all traits as well as in the studies of Gregory et al. (1963, 1991b), Cundiff et al. (1966) and Smith et al. (1976).

Gregory et al. (1963) found the following values:

	Male	Female	Mean
Birth weight (kg)	30.51	28.19	29.37
Weaning weight (kg) at 200 days	196.95	183.22	190.11
Preweaning gain (g)	832	775	804

Cundiff et al. (1966) found the following values for the weight at 205 days: 205.77 kg (bulls), 180.3 kg (heifers), 185.5 kg (steers). These values for growth traits of 34 Angus heifers were reported in the study of Smith et al. (1976): birth weight 28.2 kg, weaning weight (200 days) 184.2 kg and preweaning average daily gain, resp. 780 g. Gregory et al. (1991b) mentioned birth weight of 32.6 kg and 34.9 kg, weaning weight–200 days of 192 kg and 204 kg, average daily gain of 799 g and 846 g for female and male Angus progeny, respectively.

Birth weights of Angus progeny in the Czech Republic were somewhat higher than weights recorded by Gregory et al. (1963) and considerably lower than those mentioned by Gregory et al. (1991b). Similarly, differences between both sexes (2.1 kg) are somewhat lower than differences recorded in the studies of Gregory et al. (1963) – 2.32 kg and Gregory et al. (1991b) – 2.30 kg.

Weaning weights and preweaning average daily gains cannot be compared directly due to the different weaning periods (USA: 200 or 205 days, CR: 210 days). In spite of this fact, it is evident, that the weaning weight of both sexes in the CR is higher than in the USA. In the CR the difference between Angus bulls and heifers in weaning weight and in preweaning average daily gain amounted to 9.15 kg and 60 g, respectively. The corresponding values of Angus progeny in the USA are as follows: weaning weight at 205 days – 25.4 kg (Cundiff et al., 1966), weaning weight at 200 days – 13.73 kg (Gregory et al., 1963), 12 kg (Gregory et al., 1991b), preweaning average daily gain – 107 g (Gregory et al., 1963), 47 g (Gregory et al., 1991b).

Calf number: The population analyzed was formed by 1382 single-born calves and 43 twins (3.11%). The effect was highly significant for birth weight, 120-day and 210-day weight. There was a significant effect in case of average daily gain from birth to 120-days and nonsignificant for the calf number from birth to 210 days and the period of 120–210 days.

Parity: Parity was a highly significant factor in all traits, with the exception of average daily gain from 120–210 days similarly as in the studies of Cundiff et al. (1966), Long and Gregory (1974) and Gregory et al. (1978, 1991b). Jakubec et al. (1998) confirmed this fact and found also a higher birth and weaning weight of calves produced by dams of 4 to 9 years of age as compared to dams of 2–3 years of age or 10 years and older.

In general, the lowest values of the first 5 traits are associated with the first parity, the highest ones with the 7th parity excluding birth weight (6th parity). This fact has not been confirmed in case of average daily gain in the period of 120–210 days, since the maternal characteristics are less expressed in this trait. Prenatal and postnatal maternal factors affect preweaning average daily gain significantly.

Sire: This factor was highly significant ($P < 0.0001$) for all traits recorded. The progeny number ranged from 1 to 91. The average birth weight of the progeny ranged from 19.53 kg (Mister) to 40.47 kg (GDAR Rainmak). The average birth weight of the largest progeny set (Ginger Hill Duster 89) was 30.71 kg. Average weight at 120 days varied from 103.26 kg (R and J Austin 13) to 225.63 kg (Rito Evera 865 GDAR). The trend found in average daily gain was similar for the period birth–120 days: 0.524 kg (R and J Austin 13) and 1.612 kg (Rito Evera 865 GDAR). Average weaning weights varied from 168.35 kg (R and J Austin 13) to 336.10 kg (RED RSAR Wheel'O Fortune). Average daily gains in the period of 120–210 days ranged from 0.611 kg (Benlock Invest 2S) to 1.68 kg (Northcote Excitement). Whereas average preweaning daily gains varied from 0.609 kg (R and J Austin 13) to 1.456 kg (Red Cumnock Star 139Z).

Proportions for the variance components of the individual factors to the total variance are presented in Table III. Parity is an unimportant source of variance (1% of the total variance) in all traits analyzed in spite of its high significance (excluding average daily gain in the period of 120–210 days). With the exception of parity the variance proportions of factors for birth weight were quite different from the variance proportions for the other traits.

For the factor of the year, the lowest variance ratio was found in birth weight (1.25%) compared to the variance ratios in the other traits (3–4%). For the effects herd (7.24%), sex (4.91%) and parity (4.33%) the variance ratios in birth weight were substantially higher than those in the other traits.

Cundiff et al. (1966) analyzed the 205-days weight of the Angus breed in the state Oklahoma. They did not find significant differences between groups of calves reared on different pastures. The variance ratio for different pastures was 1%. The same authors found age of dam, sex, region, month of birth and type of management to be important sources of variance. The variance proportion of each of these factors was higher than 5% (from 5% for

III. Variance ratios for preweaning traits with respect to total variance (in %)

Source of variance	% of the total variance					
	Weight at			average daily gain		
	birth	120 days	210 days	birth–120 days	birth–210 days	120–210 days
Total	100	100	100	100	100	100
Year	1.25	3.41	3.15	3.70	3.38	3.83
Herd	7.24	1.75	3.94	1.51	3.44	3.32
Sex	4.91	1.55	2.86	0.94	2.24	1.27
Calf number	4.33	0.53	0.03	0.22	0.13	0.00
Parity	0.84	1.49	1.17	1.32	1.07	0.48
Sire	24.13	16.54	19.22	17.68	20.02	18.57
Residual error	57.29	74.74	69.63	74.63	69.72	72.53

the region to 17% for the sex). Our results were somewhat different from these values.

The variance proportion for sires was much higher (16.54–24.13%) than the variance proportions of all single enviromental factors. Therefore, utilization of improved sires in breeding programs could substantially enhance the level of preweaning traits.

Coefficients of correlation (r) and linear regression (b) are given in Table IV. Correlations between birth weight and the other preweaning traits were very low, it means that on the basis of birth weight we cannot estimate the other traits. The 120-day weight can be regarded as an univocal criterion for estimating average daily gain from birth to 120 days and the 210 day weight is an excellent criterion for the average daily gain in the period birth–210 days ($r = 0.99$). The 120-day weight is a reliable criterion for the weaning weight (210 days) and preweaning average daily gain ($r = 0.72$) and for the average daily gain in the period from birth–120 days ($r = 0.71$) and 120–210 days ($r = 0.68$). The average daily gain from birth to 120 days and from 120 to 210 days can be used for the estimation of preweaning average daily gain ($r = 0.71$, $r = 0.68$, respectively).

The regression coefficients show an increase of 4.81 kg for the 120-day weight and of 7,75 kg for the 210 day weight for a change of 1 kg in birth weight. An increase of 1 kg in the 120-day weight is associated with +1.58 kg difference in the 210-day weight. Regression coefficients characterizing the relationship between the birth weight and growth characteristics amount to

IV. Coefficients of correlation and linear regression between preweaning growth traits – correlations (r) are given above the diagonal, regression coefficients (b) below the diagonal; the independent variables (x) are mentioned in the headline, the dependent ones (y) in the 1st column

r / b	Weight at			Average daily gain		
	birth	120 days	210 days	birth–120 days	birth–210 days	120–210 days
Birth weight	1	0.15	0.17	0.02	0.08	0.08
120–day weight	4.81	1	0.72	0.99	0.72	–0.01
210–day weight	7.75	1.58	1	0.71	0.99	0.68
Average daily gain:						
Birth–120 days	0.032	0.008	0.004	1	0.72	–0.02
Birth–210 days	0.032	0.007	0.004	0.979	1	0.68
120–210 days	0.033	0.006	0.004	0.950	1.02	1

0.032 kg. In case of relationships between 120-day weight and weaning weight (x) and growth traits (y) regression coefficients vary from 0.004 to 0.008. Regression coefficients characterizing relationships between average daily gain in the period birth–120 days and birth–210 days (x) on the one hand and average daily gain in the period of 120–210 days (y) on the other hand amount to 1 g approximately.

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Analýza faktorů působících na hmotnost telat od narození do odstavu plemene angus v České republice.

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V letech 1992–1998 byly u plemene angus v České republice sledovány tyto ukazatele růstu telat: hmotnost telat při narození, ve 120 a 210 dnech věku a dále průměrné denní přírůstky od narození do 120 dnů, od narození do 210 dnů a od 120 do 210 dnů věku u 1 425 jedinců. Ukazatele byly analyzovány metodou nejmenších čtverců s ohledem na tyto faktory: rok narození telat, stádo, pohlaví, četnost porodů, věk matky při narození telete a otec telat. Byla provedena analýza s ohledem na vzájemné vztahy a těsnost těchto vztahů mezi sledovanými ukazateli pomocí korelační a regresní analýzy. Mezi dvěma vlastnostmi byly vždy vypočteny příslušné koeficienty korelace a lineární regrese. Hodnoty hmotnosti ve 210 dnech i přírůstky od narození do 210 dnů věku jsou vyšší v porovnání s údaji, které byly zjištěny u stejného plemene v podmínkách USA. V některých případech byly hodnoty hmotnosti telat při narození v USA vyšší než v předkládané práci. Variační koeficienty jsou pro všechny ukazatele přírůstků vyšší než pro hmotnost ve 120 a 210 dnech, což naznačuje, že ukazatele přírůstků mohou být vhodnějšími selekčními kritérii než hmotnosti ve 120 a 210 dnech věku. Rok narození, stádo a pohlaví byly pro všechny sledované ukazatele vysoce významné na hranici $P < 0,01$. Pořadí porodu bylo vysoce významné pro všechny ukazatele, s výjimkou přírůstků od 120 do 210 dnů, u kterého byl tento faktor nevýznamný. Mezi jedináčky a dvojčaty byl vysoce významný rozdíl u všech tří hmotností (narození, 120 a 210 dnů), významný u přírůstků od narození do 120 dnů a nevýznamný u přírůstků od narození do 210 dnů a od 120 do 210 dnů. Ve všech šesti sledovaných ukazatelích byl faktor otce významný na hranici $P < 0,0001$. Většina autorů v USA, kteří se zabývali u plemene angus analýzami stejných ukazatelů užitkovosti a stejnými faktory, dospěla ke stejně významným rozdílům mezi efekty uvnitř sledovaných faktorů (rok narození, stádo, četnost porodu, věk matky) jako autoři příspěvku. Hmotnost při narození byla v roce 1993 nejnižší. V letech 1994–1996 se pohybovala na úrovni 32 kg a v posledních dvou letech (1997–1998) poklesla na 31 kg. S výjimkou hmotnosti při narození a přírůstku od 120 do 210 dnů byla u ostatních ukazatelů růstu zaznamenána vzrůstající tendence od roku 1994 do roku 1998. Znamená to, že se mateřská užitkovost v období od narození do 120 dnů vlivem zlepšeného chovatelské prostředí a výživy v těchto letech zlepšovala. U všech ukazatelů růstu od narození do 210 dnů byly v případě faktoru stádo mezi minimálními a maximálními hodnotami daleko větší rozdíly než mezi roky. Z výsledků vyplývá, že plemeno angus je velice adaptabilní na rozdílné podmínky prostředí. Rozdíly mezi stády ve sledovaných ukazatelích jsou vyjádřením extenzity, resp. intenzity podmínek chovu, které mohou být záměrné. Konečným kritériem úspěšnosti chovu plemene angus jsou náklady a realizovaný zisk pro dané ukazatele mateřské užitkovosti v daném zemědělském podniku. Z porovnání hmotnosti při odstavu a průměrných denních přírůstků od narození do odstavu v USA a ČR vyplývá, že hodnoty těchto ukazatelů jsou v ČR podstatně vyšší jak u býčků, tak i jaloviček. Pro ukazatele hmotnost při narození, ve 120 a 210 dnech a průměrné denní přírůstky od narození do 120 dnů byl efekt četnosti porodu vysoce významný a významný, zatímco pro přírůstek od narození do 210 dnů a od 120 do 210 dnů byl nevýznamný. Znamená to, že i když měla dvojčata nižší živou hmotnost ve všech sledovaných obdobích, měla průměrný denní přírůstek nižší pouze od narození do 120 dnů věku. S výjimkou průměrných denních přírůstků mezi 120 a 210 dny byl potvrzen fakt, že s postupujícím věkem matek, resp. zvyšujícím se počtem porodů se zvyšují ukazatele růstu, které zobrazují mateřskou užitkovost. Faktor otce byl považován za náhodný a byl vysoce významný pro všechny sledované ukazatele. Podíl variance otců na celkové varianci byl vysoký (16,54–24,13 %). Z toho vyplývá, že odhad plemenné hodnoty plemeníků na základě potomstva a pochopitelně i dalších příbuzných jedinců, s následnou selekcí, může přispět ke zlepšení všech sledovaných ukazatelů u plemene angus. Současně byly analyzovány podíly variancí jednotlivých analyzovaných faktorů na celkové varianci sledovaných ukazatelů. Korelace mezi hmotností při narození a ostatními ukazateli jsou velmi nízké. Na základě hmotnosti při narození nelze usuzovat na hmotnosti v pozdějším věku ani na uvedené přírůstky. Avšak hmotnost ve 120 dnech je jednoznačným kritériem pro přírůstky od narození do 120 dnů ($r = 0,99$). Stejně tak i hmotnost ve 210 dnech je jednoznačným kritériem pro přírůstky od narození do 210 dnů ($r = 0,99$).

masné plemeno angus; ukazatelé růstu od narození do odstavu; analýza faktorů prostředí a otce; korelace, regrese

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