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THE SELECTED FACTORS INFLUENCED GROWTH ABILITY TO WEANING OF ABERDEEN ANGUS CATTLE

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Abstract

TOUŠOVÁ RENATA, DUCHÁČEK JAROMÍR, STÁDNÍK LUDĚK, PTÁČEK MARTIN, BERAN JAN. 2015. The Selected Factors Influenced Growth Ability to Weaning of Aberdeen Angus Cattle. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 63(2): 457–461.

The aim of this study was to evaluate effects of sex of calves, year of calving, cows' parity and sire effect on growth ability to weaning. The evaluation of growth indicators of Aberdeen Angus cattle was performed in the period of 4 years (2010 to 2013) in 2 different farms. A total of 272 calves (bulls, n = 141; heifers, n = 131) were monitored. The indicators of live weight at birth, live weight at the age of 120 and 210 days, average daily gains from birth to 120 and 210 days of age were observed. Statistical software SAS 9.3 was used to analyze the results. The highest result growth parameters of calves were observed from cows on 3rd and 4th parity. In 2012 we observed the highest values of calves' growth ability compare to others. In evaluating the sire effect differences ($P < 0.05–0.01$) were found mainly between the top three sires from the first evaluated herd (PAA240, ZAA562, ZAA595) and three sires from the second evaluated herd (ZAA675, ZAA697, ZAA762). The order of sires according to weight in 210 days of their offspring is then almost perfect reflection of the relative breeding values (RBV) for the direct effect of growth.

Keywords: weaning weight, daily gain, sire effect, cows' parity, Aberdeen angus

INTRODUCTION

The main product of meat cattle is determined by weaned calves. The weight of calves at weaning influences their realization and thus the herd economy. The growth of calves and their weaning weight is influenced by a number of factors (Toušová *et al.,* 2014), e.g. genotype and heritability (Vostrý *et al.,* 2012) as well as individual (Jakubec *et al.*, 2003; Ducháček *et al.*, 2011), the dam age (Roffeis and Muench, 2007), the sex of calves (Stádník *et al.*, 2008), the occurrence of twins (Krupa *et al.*, 2005), the year and period of calving (Dadi *et al.*, 2002), difficulty of calving (Eriksson *et al.*, 2004), nutrition (Zahrádková *et al.*, 2010), or herd management (Staněk *et al.*, 2014). The growth of calves at weaning showed low heritability ($h^2 = 0.12–0.27$) as published by Szabó *et al.* (2006). The weaning weight of cattle is performed by cows'abilities to rear their offspring which presents an important criterion during selection (Atil *et al.*, 2005). According to Jakubec *et al.* (2003); Goyache *et al.* (2003) confirmed the influence of herd, sex of calves, age or parity of cow way of mating (artificial x natural) and year-season of birth on weaning weight Aberdeen Angus (AA) cattle. The reproduction is provided by natural mating or artificial insemination (Stádník *et al.*, 2008).

The aim of presented study was to evaluate effects of sex of calves, year of calving, cows parity and sire effect on live weight of calves at birth, at the age of 120 and 210 days, or total daily gain of calves from birth to 120 and 210 days of age.

MATERIALS AND METHODS

Animals and Herd Management

The evaluation of growth indicators of AA cattle was performed in the period of 4 years (2010 to 2013) in 2 different farms. The calves were given for breeding purpose (heifers and breeding bulls) and for the fattiness (slaughter bulls). A total of 272 calves (bulls, n = 141; heifers, n = 131) were

monitored. Both observed farms mated their herd naturally. The mating period was from May to July period and the calving occurred from February to April period.

In grazing season the cows were in pastures together with their calves. In non-grazing period feed ration was consisted of hay (*ad libitum*), mineral licks (*ad libitum*) and haylage. The haylage was in the standard dry matter of 35% and its amount corresponded to requirements of phase of lactation. The calves received an extra amount of concentrates and mineral feed mixture which corresponded to standard growth curve.

Data Collection

The data about growth performance was collected from Performance Record observed in accordance to the official methodology (ČSCHMS, 2006) and from farm records. The indicators of live weight at birth, live weight at the age of 120 and 210 days, average daily gains from birth to 120 and 210 days of age were observed. Information about sex of calves, cows' parity, year of observation, and sire were taken from evidence of breeders. All calves were born in the period from February to April.

Statistical Analysis

Statistical software SAS 9.3 (SAS/STAT, 2011) was used to analyze the results. The UNIVARIATE procedure was applied for descriptive statistics determination. The final analysis was carried out with the MIXED procedure. Akaike Information Criterion was used for the best model determination. The above mentioned growth ability parameters were evaluated based on the relationship to: sex, parity, year, and sire. The effect of month of birth was insignificant ($P > 0.05$). The model equation used for the evaluation was as follows:

$$Y_{ijklm} = \mu + SEX_i + OC_j + CB_k + SIRE_l + e_{ijklm}$$

where

Y_{ijklm}....dependent variable (BLW, LW120, LW210, LW365, G120, G210, G365);

μ.....mean value of dependent variable;

SEX_i....fixed effect of i^{th} sex of calf (i = bull, n = 141; i = heifer, n = 131);

OC_j.....fixed effect of j^{th} cows parity (j = the 1st parity, n = 43; j = the 2nd parity, n = 36; j = the 3rd parity, n = 28; j = the 4th parity, n = 39; j = the 5th and subsequent parity, n = 126);

CB_k.....fixed effect of k^{th} year of birth (i = 2010, n = 60; i = 2011, n = 68; i =2012, n = 72; i = 2013, n = 72);

$SIRE_l$..fixed effect of l^{th} sire (bull) (l = PAA240, n = 9; l = ZAA562, n = 21; l = ZAA595, n = 80; l = ZAA675, n = 46; l = ZAA697, n = 81; l = ZAA762, n = 35);

e_{ijklm}.....random error.

Significance levels $P < 0.05$; $P < 0.01$ or $P < 0.001$ were used to evaluate the differences between groups.

RESULTS AND DISCUSSION

Basic Statistics

The average live birth weight (BLW) was 35.63 kg, live weight at 120 days (LW120) was 165.69 kg, live weight at 210 days (LW210) 261.10 kg. The average daily weight gains during rearing were as follows: daily weight gain at 120 days (DG120) was 1084.23 g·day^{-1}, at 210 days (DG210) 1073.77 g·day^{-1} and between 120 and 210 days (DG90) 1038.67 g·day^{-1}. However, average values in particular herds were: BLW = 35.67 kg in herd 1, 35.59 kg in herd 2; LW120 = 179.41 kg in herd 1, 157.61 kg in herd 2; LW210 = 269.66 kg in herd 1, 255.94 kg in herd 2; DG120 = 1199.28 g·day^{-1} in herd 1, 1016.51 g·day^{-1} in herd 2; DG210 = 1114.64 g·day^{-1} in herd 1, 1049.11 g·day^{-1} in herd 2; and DG90 = 941.56 g·day^{-1} in herd 1, 1087.87 g·day^{-1} in herd 2.

The basic statistics of model equation for calves' growth performance indicators to weaning are presented in Tab. I. Coefficient of determination ranged from 28.7% to 36.3% in all the indicators observed. All the factors were significant ($P < 0.001$) in statistical model. Effect of sex of calves, year of calves and sire effect was significant ($P < 0.05$) for all growth performance indicators in AA calves. Factor of cow parity was significant ($P < 0.05$) in all the indicators except of average daily gain from birth to 120 and 210 days of age (DG120 and DG210).

I: *Basic characteristics of the model equation used for data analysis*

Traits	MODEL		SEX		PARITY		YEAR		SIRE	
	r^2	P	F-test	P	F-test	P	F-test	P	F-test	P
BLW	0.361	< 0.001	92.67	< 0.001	3.25	< 0.05	9.87	< 0.001	2.82	< 0.05
LW120	0.363	< 0.001	8.14	< 0.001	3.98	< 0.01	7.8	< 0.001	20.51	< 0.001
LW210	0.332	< 0.001	32.37	< 0.001	3.62	< 0.01	16.73	< 0.001	7.85	< 0.001
G120	0.362	< 0.001	11.68	< 0.001	3.56	< 0.01	8.52	< 0.001	21.26	< 0.001
G210	0.322	< 0.001	25.52	< 0.001	3.28	< 0.05	17.78	< 0.001	7.93	< 0.001
G90 (120–210)	0.287	< 0.001	16.27	< 0.001	0.86	> 0.05	5.34	< 0.01	6.82	< 0.001

BLW – birth live weight; LW120, LW210 – live weigh at 120 and 210 days of age; G120, G210, G90 – daily weight gain from birth to 120, to 210, and between 120 and 210 days of age

II: *Calves growth abilities to weaning evaluation*

effects	level	BLW (kg)	LW120 (kg)	LW210 (kg)	G120 (g)	G210 (g)	G90 (120–210) (g)
		LSM ± SE	LSM ± SE	LSM ± SE	LSM ± SE	LSM ± SE	LSM ± SE
SEX	bulls	36.74 ± 0.217^{A}	177.70 ± 2.308^{A}	277.94 ± 3.206^{A}	1174.90 ± 18.970^{A}	1148.50 ± 15.130^{A}	1103.50 ± 21.020^{A}
	heifers	34.34 ± 0.208^{B}	166.27 ± 2.193^{B}	256.90 ± 3.117^{B}	1099.40 ± 18.030^{B}	1060.30 ± 14.710^{B}	1004.60 ± 20.360^{B}
PARITY	1	34.70 ± 0.318^{a}	160.81 ± 3.437^{A,a}	251.87 ± 4.640^{A,a}	1052.60 ± 28.260^{a}	1034.30 ± 21.900^{a}	1004.10 ± 30.830^{A,a}
	2	35.28 ± 0.348	175.60 ± 3.740^{b}	268.78 ± 5.432	1167.80 ± 30.740^{b}	1112.80 ± 25.640	1063.30 ± 36.200^{b}
	3	36.05 ± 0.397	176.24 ± 4.171^{b}	275.99 ± 5.786^{B}	1167.90 ± 34.290	1142.90 ± 27.310^{b}	1084.90 ± 37.460^{B}
	4	35.79 ± 0.345	177.41 ± 3.647^{B}	271.87 ± 5.007^{b}	1180.60 ± 29.980^{b}	1124.40 ± 23.630^{b}	1056.60 ± 32.460
	5	35.90 ± 0.229^{b}	169.85 ± 2.460	268.60 ± 3.427^{b}	1117.10 ± 20.230	1107.60 ± 16.170^{b}	1061.20 ± 22.750
YEAR	2010	36.31 ± 0.304^{A}	162.75 ± 3.144^{A}	252.94 ± 4.512^{A}	1053.70 ± 25.850^{A,a}	1031.20 ± 21.290^{A}	997.10 ± 28.690^{A}
	2011	34.50 ± 0.276^{B,C}	172.42 ± 2.831	263.13 ± 4.009^{C}	1149.20 ± 23.520^{b}	1089.00 ± 18.920^{C}	1014.60 ± 25.450^{C}
	2012	35.35 ± 0.288^{D}	181.88 ± 3.247^{B,a}	290.21 ± 4.384^{B,D,E}	1360.00 ± 26.700^{B,c}	1430.00 ± 20.690^{B,D,E}	1445.00 ± 31.900^{B,D,E}
	2013	36.00 ± 0.285	170.87 ± 3.076^{b}	263.42 ± 4.276^{F}	1122.20 ± 25.290^{d}	1083.00 ± 20.180^{F}	1059.40 ± 28.440^{F}
SIRE	PAA 240	35.60 ± 0.726	186.25 ± 7.565^{A}	292.33 ± 11.008^{A,a}	1730.00 ± 62.200^{A,a}	1250.00 ± 51.950^{A,a}	1136.00 ± 70.380
	ZAA 562	35.00 ± 0.477	196.04 ± 4.967^{C,a}	281.56 ± 7.048^{C,c}	1170.00 ± 40.830^{C,c}	1174.90 ± 33.260^{C,c}	1179.60 ± 45.220^{A}
	ZAA 595	35.82 ± 0.244	179.04 ± 2.790^{E,b}	269.01 ± 3.815^{E}	1510.00 ± 22.940^{E,d}	1111.20 ± 18.000^{E}	957.50 ± 28.510^{B,C}
	ZAA 675	35.58 ± 0.320	153.82 ± 3.323^{B,D,F}	259.18 ± 4.652	985.30 ± 27.320^{B,D,F}	1064.30 ± 21.950^{d}	1163.40 ± 29.650^{D,E}
	ZAA 697	34.97 ± 0.238^{a}	157.52 ± 2.519^{B,D,F}	248.26 ± 3.474^{B,D,F}	1020.00 ± 20.710^{B,D,F}	1015.50 ± 16.400^{B,D,F}	1012.30 ± 22.650^{F}
	ZAA 762	36.28 ± 0.355^{b}	159.22 ± 3.726^{D,F,b}	254.20 ± 5.070^{b,d}	1023.60 ± 30.630^{D,F,b}	1037.90 ± 23.930^{b,d}	1074.50 ± 32.650

BLW – birth live weight; LW120, LW210 – live weigh at 120 and 210 days of age; G120, G210, G90 – daily weight gain from birth to 120, to 210, and between 120 and 210 days of age; a – b, c – d; resp. A – B, C – D, E – F = different superscript letters confirm statistical significance of difference among within the effect rows at the $P < 0.05$; resp. $P < 0.01$ level.

Sex Differences

The results of evaluated effects are presented in Tab. II. Significantly higher values in all the growth performance indicators were observed in bulls compared to heifers ($P < 0.01$). More specifically the bulls had +11.43 kg higher LW120 and +21.94 kg in LW 210. These results are in accordance to previous studies (Szabó *et al.*, 2006; Lengyel *et al.*, 2004) who confirmed the lower growth performance in heifers at the age of 205 days.

Effect of Parity

As expected the lower values ($P < 0.05–0.01$) were observed in primiparous, as confirmed in Szabó *et al.* (2006). Generally the highest values of growth performance indicators of calves were marked in cows on 3rd parity. Subsequent decrease of growth performance ($P < 0.05–0.01$) was marked by cows on 5th and other parity compared to cows on 3rd and 4th parity. Szabó *et al.* (2006) added that the higher growth performance at weaning was observed up to 5 years of age in 8 several meat and multiple-purpose cattle breeds. According to their study the decrease of growth performance was marked from the 6th years of age. These results were in accordance to ours when 5th or 6th year of age corresponded to 3rd or 4th parity. Oppositely Krupa *et al.* (2005) found the higher growth performance at the age of 5 to 7 years (which corresponded to 3rd and 5th parity).

Year of Birth

The highest growth performance indicators were marked in 2012 except of live weight at birth. The highest live weight at birth was observed in 2010 (36.31 kg). Generally significant differences were observed among years of 2012 and 2010, 2011 or 2013, respectively. The effect of year of calving was confirmed as previously published by Dadi *et al.*, 2002; Krupa *et al.*, 2005 and Toušová *et al.*, 2014. Differences in particular years of calving could be explained by various climatic conditions during the year, which is connected with variable forage grazing quality. The quality of forage subsequently influence also the quality of bulk fodder fed in winter year-season (Klanic *et al.*, 1993).

Sire Effect

In evaluating the sire effect differences were found mainly between the top three sires from the first evaluated herd (PAA240, ZAA562, ZAA595) and three sires from the second evaluated herd (ZAA675, ZAA697, ZAA762). The differences can be related not only to evaluated herds but also among to sires within particular herds. The importance of sire effect was confirmed by Robinson (1996) and Dadi *et al.* (2002). Statistically significant ($P < 0.05–0.01$) higher weights in 120 and 210 days have achieved calves from first herd (PAA240, ZAA562, and ZAA595). However, order of bulls by weight of offspring in 120 and 210 days are different. These results can be explained by a genetic predisposition for growth. In the case of assessment of weight gains we can assume that the offspring of the first three sires achieved faster initial growth and then decline in growth capabilities. The bulls and heifers of the second three sires (ZAA675, ZAA697 a ZAA762) achieved constant weight gain to weaning. The order of sires according to weight in 210 days of their offspring is then almost perfect reflection of the relative breeding values (RBV) for the direct effect of growth. The highest RBV for direct effect of growth was found in PAA240 (114) and the lowest RBV achieved sire ZAA697 (96).

In conclusion we can say that these results in calves breeding reflect their genetic quality and these results confirmed accuracy of prediction of BVs for these bulls. These results also confirmed the importance of heritability of growth characteristics which are modelled by Vostrý *et al.* (2012).

CONCLUSION

Generally valid principles of the influence evaluated factors on growth performance of beef calves was confirmed also in our study. The highest result growth parameters of calves were observed from cows on 3rd and 4th parity. In 2012 we observed the highest values of calves' growth ability compare to others. Finally it was confirmed the importance of bulls effect. As an important finding, the bulls breeding value for growth ability in direct effect were almost exactly reflected by growth ability of their calves.

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