Original scientific paper: DOI 10.7251/JAS1502002D UDK 339.152:636.2]:631.1.017.3

INFLUENCE OF FARMING SYSTEMS ON INDICATORS OF BEEF CALVES GROWTH

Ducháček, J[1]., Toušová, R[1]., Stádník L[1]., Biniová Z[1,2]., Ptáček M[1]., Touš, J[1]., Doležalová, M[1], Maran., B[3].

[1] Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague; Kamýcká 129, 165 21 Praha 6 – Suchdol, Czech Republic.

[2] Natural spol. s.r.o.; Hradištko pod Medníkem 413, 252 09 Hradištko pod Medníkem, Czech Republic.

[3]Odjeljenje za poljoprivredu, Opština Novi Grad, RS, Bosnia and Herzegovina

Corresponding author: Ing. Jaromír Ducháček, Ph.D.; Czech University of Life Sciences Prague; Kamýcká 129, 165 21 Praha 6 – Suchdol, Czech Republic; duchacek@af.czu.cz

ABSTRACT

The aim of this study was to evaluate growth ability of Charolais calves in different systems of farming. The observations were performed in period of 8 years (2007 - 2014) in one herd, which was transiting from conventional to ecological farming system. Period from 2007 to 2010 was of conventional character, 2010 to 2012 transition phase, and from 2012 to 2014 ecological phase. This transfer is directly linked to changes in cow´s welfare and nutrition. Growth ability (live weight at birth, 120, and 210 days of age, average daily gain from birth to 120, from birth to 210, and from 120 to 210 days of age) of 518 Charolais calves was measured. Statistical analyses were performed using SAS 9.3 software, GLM procedure. The model equations contend effect of sex, number of parity, month of calves birth and type of farming system. Difference in birth weight of calves between farming systems was small and insignificant. This fact may be due to breeding system focused on easy calving. Increase of values measured in different age and average daily gains were statistical significant ($P < 0.05$) between conventional and ecological farming. The increase of parameters of weight and average daily gain could be largely connected with genetic progress in Charolais population in Czech Republic and following good selection of bulls to insemination and natural breeding. Nevertheless, the transition from conventional to ecological farming system did not affected growth ability of beef cattle negatively and, in contrary, results of growth improved farm economy.

Key words: Charolais; live weight; gain; calves; breeding system

INTRODUCTION

Breeding of beef is a constantly developing sector in the Czech Republic. The basic aspects of good economic results in beef cattle herds are a good fertility of cows and an excellent growth of their progeny. The growth ability of calves are affected by many factors, such as breed of cattle (Krupa et al., 2005), sex (Stádník et al., 2008), nutrition (Mandell et al., 1997; Priolo et al., 2001), age of cows (Roffeis & Muench, 2007), parity (Toušová et al., 2014), month of birth (Dadi et al., 2002), type of beef cattle production system (Younie, 2001; Sato et al., 2005) and others. Charolais is the most

favored beef cattle breed in the Czech Republic. Beef cattle are usually kept in one of two common types of production systems: conventional and ecological (Wileman et al., 2009). These systems differ in quality and quantity of fodder and feed ratio (Skládanka & Veselý, 2007), as well as in welfare of the cattle (e.g. use of some systems of conventional housing is forbidden in ecological system) (Capper, 2012). Some authors (Fernández & Woodward, 1999; Glanc et al., 2015) observed lower daily gain and final slaughter weight achived in organic farming system. Also differences in economy of organic farming are mentioned in number of studies, for example Gillespie and Nehring (2013). The aim of this study was to compare systems of farming and evaluate their effect on outputs in beef cattle herds.

MATERIALS AND METHODS

This study was performed during 8 years period (from 2007 to 2014) in one herd with Charolais cattle. During this period, the farm underwent the transition from conventional to ecological farming system. Period from 2007 to 2010 was of conventional character, transition phase took place from 2010 to 2012, followed by ecological phase from 2012 to 2014. The dataset has included 518 calves born during 8 years. Weight after birth, weight at 120 days of age, weight at 210 days of age, daily gain from birth to 120 days of age, daily gain from birth to 210 days of age, and daily gain from 120 to 210 days of age were evaluated as indicators of growth performance in the herd. Statistical evaluation was performed using SAS software (SAS/STAT® 9,3, 2011), ANOVA method (GLM procedure). Akaike Information Criterion was used for the best model determination. The model equation included sex of calves, parity, month of birth, and period of farming system.

The Tukey-Kramer method was applied for comparison and evaluation of significant differences between least square means. Significance levels $P < 0.05$ and $P < 0.01$ were used to evaluate the differences between groups.

RESULTS AND DISCUSSION

The results are shown in Tab 1 and 2. The results show that sex affects all considered parameters of growth. Statistically significantly higher weights and daily gains were observed in bulls. Similar results were observed in study of Stádník et al. (2008). The parity had an effect on weight in 120 and in 210 days of age, on daily gain to 120 days of age and on daily gain since birth to 210 days of age. The statistically significantly highest values were recorded in progeny of cows giving birth on fourth and fifth occasion. This is in accordance with study of Toušová et al. (2014). The effect of the month of birth had statistically insignificant effect on all characteristics observed since birth to 120 days of age. The highest weights after birth were obtained in calves born in August (36.29 kg), and in contrary the lowest in those born in November (32.60 kg). The weight in 120 days of age and daily gain to 120 days of age were highest in calves born in January (175.99 kg; 1,090.93 g/day) and lowest in calves born in December (158.58 kg; 1,035.75 g/day). There were found some statistically significant effects of the month of birth on characteristics observed from 120 to 210 days of age. The weight in 210 days was statistically significantly superior ($P < 0.05$) in calves born in February (283.86 kg) over calves born in May (257.06 kg) and June (256.37 kg). The same calves shown also significant differences ($P < 0.05$) in daily gain since birth to 210 days (1,191.32 g/day in February over 1,066.53 g/day in May and 1,062.89 g/day in June) and daily gain since 120 to 210 days (1,254.08 g/day in February over 1,058,57 g in May and 1,023.79 g in June). The effects of other months of birth were statistically insignificant ($P > 0.05$). These results confirmed importance of winter season of calving.

The season affects growth performance of calves in spring and summer pasture period in accordance with results of Krupa et al. (2005) and Stádník et al. (2008).

There were found no statistically significant differences ($P > 0.05$) in weight after birth between the systems of farming. This fact may be due to breeding system focused on easy calving during the whole time of this study. On the other hand, statistically significant ($P < 0.01$) higher weight in 120 days was observed in calves born in ecological system of farming compare to those born in conventional system (+14.50 kg). Similar statistically significant ($P < 0.01$) effect was counted for daily gain since birth to 120 days of age (+117.27 g in favor of ecological farming). The statistically significant ($P < 0.05$) change was recorded in the weight of calves in 210 days and in their daily gain since birth to 210 days of age, where the weights increased in the ecological system (+12.76 to +13.29 kg) a daily gains (+64.51 to +64.70 g/day). The daily gain between 120 and 210 days of age was statistically significantly ($P < 0.05$) highest in the period of transition (1,190.17 g).

Tab 1. Results obtained using procedure GLM (ANOVA)

effect	level	Live weight at birth	Live weight at 120 days	Average daily gain to 120 days
		LSM ± SE	LSM ± SE	LSM ± SE
Sex	bulls	34,33 ± 0,463^{A}	170,48 ± 3,484^{a}	1137,68 ± 27,945^{a}
	heifers	33,17 ± 0,432^{B}	163,69 ± 3,254^{b}	1086,48 ± 26,102^{b}
parity	1	33,45 ± 0,614	153,34 ± 4,627^{a}	993,35 ± 37,114^{A,a}
	2	33,60 ± 0,613	166,46 ± 4,615	1104,83 ± 37,022
	3	33,42 ± 0,652	169,66 ± 4,910^{b}	1134,10 ± 39,387^{b}
	4	33,03 ± 0,678	172,45 ± 5,110^{b}	1161,16 ± 40,992^{B}
	5	34,30 ± 0,656	170,76 ± 4,941^{b}	1154,83 ± 39,635
	6	34,44 ± 0,598	165,95 ± 4,502	1096,11 ± 36,111
	7	34,09 ± 0,653	170,60 ± 4,919^{b}	1138,12 ± 39,458
	8 and more	33,67 ± 0,555	167,45 ± 4,180	1114,11 ± 33,528
month of birth	January	33,65 ± 0,759	175,99 ± 5,714	1190,93 ± 45,832
	February	33,69 ± 0,519	168,99 ± 3,909	1144,25 ± 31,352
	March	33,67 ± 0,302	170,78 ± 2,272	1141,52 ± 18,224
	April	33,68 ± 0,380	171,62 ± 2,864	1148,89 ± 22,973
	May	33,09 ± 0,551	161,72 ± 4,152	1072,51 ± 33,307
	June	33,17 ± 0,546	164,20 ± 4,116	1092,21 ± 33,014
	August	36,29 ± 1,043	171,25 ± 7,854	1126,62 ± 63,000
	November	32,60 ± 2,771	160,63 ± 20,877	1056,01 ± 167,47
	December	33,91 ± 1,792	158,58 ± 13,502	1035,75 ± 108,31
Farming system	conventional	34,11 ± 0,452	160,08 ± 3,406^{A}	1055,78 ± 27,319^{A}
	transition	33,29 ± 0,521	166,59 ± 3,928	1107,40 ± 31,506
	ecological	33,85 ± 0,509	174,58 ± 3,832^{B}	1173,05 ± 30,734^{B}

A-B …, $P < 0.01$; a-b…, $P < 0.05$.

The increase of parameters of weight and daily gain are probably caused by genetic progress in Charolais population in Czech Republic and following good selection of bulls to insemination and

natural breeding. Fernández & Woodward (1999) and Glanc et al. (2015) observed lower daily gain and live weight in organic farming compared to conventional system. These findings are in contrary with our results. This fact also may be caused by using different breeds, different environmental condition and definition of organic and commercial farming in USA.

Tab 2. Results obtained using procedure GLM (ANOVA)

effect	level	Live weight at 210 days	Average daily gain to 210 days	Average daily gain between 120 and 210 days of age
		LSM ± SE	LSM ± SE	LSM ± SE
Sex	bulls	282,64 ± 4,994^{A}	1182,45 ± 23,698^{A}	1242,14 ± 34,457^{A}
	heifers	255,78 ± 4,665^{B}	1060.05 ± 22,137^{B}	1024,82 ± 32,185^{B}
parity	1	246,62 ± 6,632^{A,a}	1015,10 ± 31,475^{A,a}	1044,10 ± 45,763
	2	269,31 ± 6,616^{b}	1122,43 ± 31,398^{b}	1145,90 ± 45,650
	3	273,80 ± 7,039^{B}	1144,68 ± 33,403^{B}	1158,77 ± 48,566
	4	275,23 ± 7,325^{B}	1153,34 ± 34,764^{B}	1142,92 ± 50,545
	5	279,63 ± 7,083^{B}	1168,23 ± 33,613^{B}	1186,10 ± 48,871
	6	266,36 ± 6,453	1104,40 ± 30,624	1115,46 ± 44,526
	7	272,77 ± 7,051^{b}	1136,59 ± 33,463^{b}	1134,55 ± 48,653
	8 and more	269,97 ± 5,992^{b}	1125,23 ± 28,434^{b}	1140.05 ± 41,342
month of birth	January	284,79 ± 8,190	1195,92 ± 38,869	1202,56 ± 56,513
	February	283,86 ± 5,603^{a}	1191,32 ± 26,589^{a}	1254,08 ± 38,659^{A,a}
	March	274,12 ± 3,257	1145,02 ± 15,455	1149,69 ± 22,470
	April	273,98 ± 4,105	1144,26 ± 19,482	1138,09 ± 28,326
	May	257,06 ± 5,952^{b}	1066,53 ± 28,247^{b}	1058,57 ± 41,069^{b}
	June	256,37 ± 5,900^{b}	1062,89 ± 27,998^{b}	1023,79 ± 40,707^{B}
	August	275,44 ± 11,258	1138,79 ± 53,428	1155,01 ± 77,681
	November	268,34 ± 29,927	1122,53 ± 142,020	1211,23 ± 206,49
	December	248,95 ± 19,355	1023,99 ± 91,852	1008,30 ± 133,550
Farming system	conventional	260,53 ± 4,882^{a}	1078,18 ± 23,168^{a}	1108,06 ± 33,685^{a}
	transition	273,29 ± 5,630^{b}	1142,88 ± 26,719^{b}	1190,17 ± 38,848^{b,c}
	ecological	273,82 ± 5,492^{b}	1142,69 ± 26,065^{b}	1102,21 ± 37,896^{d}

A-B …, P < 0.01; a-b…, P < 0.05,

CONCLUSION

The change from conventional to ecological farming system had positive effect on all parameters of growth excluding weight in birth and daily gain between 120 and 210 days. The transition to ecological system of cattle breeding does not decrease parameters of growth and economical results conditioned by parameters of growth. The growth ability of beef calves to weaning is influenced by a number of factors. Farmers are recommended to secure quality of nutrition and animal welfare to reach maximal growth performance of beef calves and maximal economic results of beef production.

ACKNOWLEDGEMENT

This research was funded by an “S” grant of the MŠMT ČR.

References

Citations:

Capper, J.L., 2012. Is the Grass Always Greener? Comparing the Environmental Impact of Conventional, Natural and Grass-Fed Beef Production System. Animal. 2, 127 – 143.

Dadi, H., Jordaan, G.F., Schoeman, S.J., Van Der Westhuizen, J., 2002. The effect of Charolais and Hereford sires straightbred and crossbred dams on pre-weaning growth of calves. South African Journal of Animal Science. 32, 38-43.

Fernández, M.I., Woodward, B.W., 1999. Comparison of conventional and organic beef production system I. feedlot performance and production costs. Livestock Production Science. 61, 213 – 223.

Gillespie, J., Nehring, R., 2013. Comparing economic performance of organic and conventional U.S. beef farms using matching samples. The Australian Journal of Agricultural and Resource Economics. 57, 178 – 192.

Glanc, D.L., Campbell, C.P., Cranfield, J., Swanson, K.C., Mandell, I.B., 2015. Effect of production system and slaughter weight endpoint on growth performance, carcass traits, and beef quality from conventionally and naturally produced beef cattle. Canadian Journal of Animal Science. 95, 37 – 47.

Krupa, E., Oravcová, M., Poláková, P., Huba, J., Krupová, Z., 2005. Factors affecting growth traits of beef cattle breeds raised in Slovakia. Czech Journal of Animal Science. 50, 14 -21.

Mandell I.B., Gullett E.A., Wilton J.W., Allen O.B., Osborne V.R., 1997. Effects of diet, breed and slaughter endpoint on growth performance, carcass composition and beef quality traits in Limousin and Charolais steers. Canadian Journal of Animal Science. 77, 23–32.

Priolo, A., Micol, D., Agabriel, J. 2001. Effect of grass feeding system on ruminant meat colour and flavor. A review. Animal Research, 50, 185 – 200.

Roffeis, M., Muench, K., 2007. Einfluss des Alters von Fleischrindkühen auf ihre produktiven und reproduktiven Leistungen. Züchtungskunde. 79, 161 – 173.

Sato, K., Bartlett, P.C., Erskine, R.J., Kaneene, J.B., 2005. A comparison of production and management between Wisconsin organic and conventional dairy herds. Livestock Production Science. 93, 105–115.

Scollan, N., Hocquette, J.F., Nuernberg, K., Dannenberger, D., Richardson, I., Moloney, A., 2006. Innovations in beef production systems that enhance the nutritional and health value of beef lipids and their relationship with meat quality. Meat Science. 74, 17–33.

Skládanka, J., Veselý, P., 2007. Výživa zvířat v ekologickém zemědělství. MZLU. Brno. 40 s.

Stádník, L., Louda, F., Bolečková, J., Benešová, L., Matějů, R., 2008. Effect of Charolais dams´ mating method and parity on growth ability of their progeny. Scientia Agriculturae Bohemica, 39, 304 – 309.

Toušová, R., Ducháček, J., Stádník, L., Ptáček, M., Beran, J., 2014. The effect of selected factors on the growth ability of Charolais cattle. Acta Universitatis Agriculturae et Silviculturae Mendeleianae Brunensis. 62, 255 – 260.

Wileman, B.W., Thomson, D.U., Reinhardt, C.D., Renter, D.G., 2009. Analysis of modern technologies commonly used in beef cattle production: conventional beef production versus nonconventional production using meta-analysis. Journal of Animal Science. 87, 3418 – 3426.

Younie, D., 2001. Organic and Conventional Beef Production – a European Perspective. Paper presented at 22nd Western Nutrition Conference, University of Saskatchewan, Saskatoon, Canada, Septemmber 2001.