EFFECT OF SOME NON-GENETIC FACTORS ON GROWTH OF LAMBS OF THE CHAROLLAIS BREED

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SUMMARY

The evaluation of effect of some non-genetic factors (sex, litter size, age of dam at lambing, month of lambing and year of birth of lamb) on growth of lambs of the Charollais breed was carried out in operation conditions on the University School Farm in Žabčice within an interval of six subsequent years. In all years under study feeding ration of lambs was based on intake of mother milk (*ad libitum*). Their feeding ration before grazing period further consisted of meadow hay *(ad libitum*), mineral lick (*ad libitum*) and concentrate supplement ČOT (concentrate supplement for early weaning of calves). The average daily consumption of ČOT per lamb was 0.10 kg. During the grazing period the feeding ration of lambs was as follows: mother's milk (*ad libitum*), grazing on alfalfa-grass stand (*ad libitum*), concentrate supplement ČOT (0.12 kg/head/day), meadow hay (*ad libitum*) and mineral lick (*ad libitum*). The evaluation of the effects of the factors of sex, litter size, age of dam and year of birth of lamb showed that all these factors had a significant effect on the majority of growth traits under study. On the other hand, the factor month of lambing had non - significant effect on all body weights and on majority of daily gains under study. From the point of view of the individual non-genetic factors the highest daily gains from birth to 100 days of age were recorded in males (291 g), in singles (289 g), in lambs of three-years-old dams (279 g), in lambs born in March (277 g) and in lambs born within the last year of evaluation (284 g). The phenotypic correlations between and in lambs born within the last year of evaluation (284 g). The phenotypic correlations between birth weight and the others body weights showed a tendency to increase with the increasing age. All phenotypic correlations between particular body weights were positive and high ($P \leq 0.01$). The majority of phenotypic correlations between particular daily gains were also positive and high ($P \leq 0.01$). Growth ability of Charollais lambs was relatively high within the whole period under study and the highest daily gains were recorded in all factors within the period from birth to 30 days of age.

ÖSSZEFOGLALÁS

Kuchtik, J. – Dobeš, I. – Tőzsér J.: NÉHÁNY NEM GENETIKAI TÉNYEZŐ HATÁSA CHAROLLAIS BÁRÁNYOK NÖVEKEDÉSÉRE

A szerzők néhány nem genetikai tényező értékelését (ivar, alomszám, anya életkora az elleskor, bárányozás hónapja, bárány születési éve: évjárat) végezték el Charollais fajtájú bárányok esetében — hat éven keresztül — az egyetem bemutató farmján Žabčice-ben (Csehország). A bárányok takarmányozása minden évben az anyák tejtermelésére alapozódott (*ad libitum*). A legeltetési időszak előtt takarmányozásuk réti szénából *(ad libitum*), nyalósóból (*ad libitum*) és borjúkoncentrátumból (korai borjúválasztásra használt) állt. Az átlagos napi borjúkoncentrátum felvétel bárányonként 0,10 kg volt. A legeltetési időszakban a bárányok takarmányozása tejre (*ad libitum*), lucernára (*ad libitum*), borjúkoncentrátumra (0,12 kg/bárány/nap), réti szénára (*ad libitum*) és nyalósóra (*ad libitum*) épült. Az ivar, az alomszám, az anya életkora az elleskor és az évjárat hatásának elemzése során az összes tényező jelentős szerepét mutatták ki a növekedési tulajdonságok legtöbbjére. A bárányozás hónapja ellenben nem volt szignifikáns hatással az élősúly-paraméterekre. Az egyedi nem genetikai tényezők szempontjából, a legnagyobb napi súlygyarapodást — a születéstől 100 napos életkorig — a kos bárányok (291 g), az egyes bárányok (289 g), a három éves anyák (279 g), a márciusban született bárányok (277 g), és a legutolsó évben született bárányok (284 g) esetében tapasztalták. A fenotípusos korrelációk a születési súly és más élősúly adatok között, tendenciájában az életkor növekedésével szorosabbá váltak. Az összes fenotípusos korreláció — különösen az élősúlyok között — szoros és pozitív volt ($P \leq 0,01$). A napi súlygyarapodások közötti fenotípusos korrelációk szintén szorosak és pozitívak voltak ($P \leq 0,01$). A Charollais fajtájú bárányok növekedési képessége relatíve nagy volt az egész vizsgálat ideje alatt. A legnagyobb súlygyarapodásokat a születéstől 30. napos életkorig állapították meg.

INTRODUCTION

Production of lambs became the most important commodity in sheep breeding in the Czech Republic after 1990 because of economic reasons. In this context, however, it should be mentioned that in 1990, the share of meat sheep breeds was less than 1% and that it was necessary to begin with their imports. In the period to follow, sheep of the Charollais breed became the most important imported breed. At present the proportion of meat sheep breeds in the Czech Republic is approximately 36% and the most important ones are Charollais and Suffolk (*Bucek et al.,* 2004). In the last half of 1990´, rams of the Charollais breed were used above all within the framework of absorption or commercial crossings with merino ewes. On the other hand, however, a significant part of the population of this breed was reared as purebred, above all in flocks of the size up to 50 ewes. In this context it should be, however, mentioned that in the Czech Republic sheep are kept in relatively small flocks and approximately 84% of ewes are registered in the flocks with the size up to 50 ewes (*Bucek et al.* 2004). The total number of pure breed ewes in Charollais breed is approximately 120 at 7 flocks in Hungary (*MAJUSZ,* 2003).

Growth is one of the fundamental performance traits, which influences the efficiency of sheep husbandry and a high growth potential of lambs enables to reach the required slaughter weight. In the Czech Republic, the average slaughter weight of lambs is 31 kg. Lambs of meat breeds should reach this body weight at the age of 100 days. The growth of lambs is influenced by a great numbers of different factors. Regarding the fact that the coefficient of heritability of the growth is relatively low (*Fogarty,* 1995; *El-Fadili et al.,* 2000), the growth ability is above all influenced by nutrition, genotype and health condition. Other factors, which can more or less influence the growth ability are sex, litter size, age of dam at lambing, month of lambing and year of birth of lamb. Effects of sex, litter size and age of dam at lambing on the growth of lambs in the breed Bharat Merino were studied by *Dixit et al.* (2001). *Mavrogenis* (1996), *Analla et al.* (1998), *Komlósi* (1990) and *Ploumi et al.* (1997) analysed effects of these factors in lambs of breeds Awassi, Spanish Merino and Florina, respectively.

As mentioned above, the Charollais breed is one of the most important breed of meat sheep in the Czech Republic. Considering this fact, the main objective of our study was to evaluate effects of some non-genetic factors (sex, litter size, age of dam at lambing, month of lambing and year of birth of lamb) on growth of lambs of this breed.

MATERIAL AND METHODS

This study was carried out on the University School Farm in Žabčice (180 m above sea level). Data from a total of 294 lambs (158 males and 136 females), progeny of 204 ewes and 6 rams, from 1997 to 2002 were used. Triplets were eliminated from this study due to their very low number and relatively very high mortality. Natural mating of ewes with rams (the so-called harem system) was used during the whole study period. Different ram was used each year. In all years under study lambing occurred indoors within the period from second half

of January to the end of first half of April. After lambing the lambs were reared from birth till the end of the first half of April indoors. In the period to follow, lambs were reared on pasture in a classical way, i. e. under their mothers and their contacts with mothers were not regulated. Climatic conditions in the sheepfold were relatively very good in all years under study, as e.g. the indoor temperature varied between 6–14 °C and relatively humitidy fluctuated roughly between 60–75%. During the pasture period the daily temperatures varied between 9–31 °C and the monthly precipitation ranged between 28–65 mm.

In all years under study feeding ration of lambs was based on intake of mother milk (*ad libitum*). Their feeding ration before grazing period further consisted of meadow hay *(ad libitum*), mineral lick (*ad libitum*) and concentrate supplement ČOT (concentrate supplement for early weaning of calves, PDI-E 105 g/kg, NEF 7,8 MJ/kg). The average daily consumption of ČOT per lamb was 0.10 kg. During the grazing period, the feeding ration of lambs was as follows: mother´s milk (*ad libitum*), grazing on alfalfa-grass stand (*ad libitum*), concentrate supplement ČOT (0.12 kg/head/day), meadow hay (*ad libitum*) and mineral lick (*ad libitum*). Health condition and nutritional status of dams and their lambs were good during the whole study period.

All lambs were classified by sex and litter size and were weighed at birth. Weighing of lambs was done regularly in three-week intervals independent of age until the end of the monitoring period; the first weighing in each year of monitoring was carried out when the oldest lamb had reached the age of 21 days. In each case the lambs were weighed individually and all determinations of weight were carried out to the nearest 0.1 kg. The main reason of this system of weighing was our effort to minimize the stress of animals in the sheep flock, which could finally have had a negative impact on growth ability of lambs. On the basis of the results of weighing the body weight was adjusted to average age 30 (LW 30), 70 (LW 70) and 100 days (LW 100) by using a linear interpolation method. Daily gains (DG) were calculated in grams (g) for the following intervals:

DG 0–30=DG between (BW 0) and (LW 30),
DG 30–70=DG between (LW 30) and (LW 70),
DG 0–70=DG between (BW 0) and (LW 70),
DG 30–100=DG between (LW 30) and (LW 100),
DG 70—100=DG between (LW 70) and (LW 100),
DG 0—100=DG between (BW 0) and (LW 100).

Recorded data were statistically analysed using the classical least-squares method (SAS; PROC GLM variant ss4, STDERR; PDIFF). The systematic effects were sex, litter size, age of dam at lambing, month of lambing and year of birth of lamb. T-test procedure was applied for multiple comparisons of the least square means. All interactions investigated in this study were not included in the model because they were found non-significant.

The following model equation was used for statistical calculation:

$$Y_{ijklm}=\mu+S_i+LS_j+A_k+M_l+YB_m+e_{ijklm}$$

Y_{ijklmn}=measured trait,
μ=overall mean,
S_i=effect of the *i*th sex (fixed effect – 2 classes),
LS_j=effect of the *j*th litter size (fixed effect – 2 classes),
A_k=effect of the *k*th age of dam (fixed effect – 4 classes),
M_l=effect of the *l*th month of lambing (fixed effect – 4 classes),
YB_m=effect of the *m*th year of birth of lamb (fixed effect - 6 classes),,
e_{ijklm}=residual error.

Phenotypic correlations were calculated by Pearson´s method. Statistical analysis was carried out using the mathematical-statistical programme SAS version 8.2.

RESULTS AND DISCUSSION

Least-squares means and standard errors of body weights (BW) and daily gains (DG) according to sex, litter size, age of dam at lambing, month of lambing, and year of birth of lamb are presented in *Tables 1. and 2.* Sex of lamb had significant effect on all the growth traits under study. Higher daily gains in all intervals under study were found in males. Similar findings have been reported by *Martin et al.* (1980), *Nagy et al.* (1999), *Shelton et al.* (1991), *Momani-Shaker et al.* (1995), *Ploumi et al.* (1997) and *Dixit et al.* (2001). Highest difference among the levels of daily gains between males and females was recorded in the period from birth to 30 days of age (46 g). The final body weight in males at the age of 100 days (33,32 kg) was markedly higher than *Momani-Shaker et al.* (1995) and *Pind'ak et al.* (2003) mentioned in males of this breed.

Litter size had highly significant effect on all growth traits under study excepting DG 70–100. Singles were heavier in all observed intervals which is in agreement with the results of *Sierra* (1983), *Djemali et al.* (1994), *Analla et al.* (1998) and *Goetsh* (1998). Singles grew more rapidly ($P\leq0.01$) from birth to 70 days of age, however in the following interval (DG 70–100) insignificantly higher daily gain was found in twins. Similar findings have been reported by *Mavrogenis* (1996) and *Macit et al.* (2002). In our opinion the significantly higher daily gain of singles in the period from birth to 70 days of age compared to twins was above all influenced by their higher consumption of mother´s milk.

Age of dam had a singnificant effect on all growth traits under study. This is in agreement with the results published by *Nikolaou et al.* (1994) and *Dixit et al.* (2001). On the other hand, *Ploumi et al.* (1997) did not recorded any significant effect of this factor and *El-Fadili et al.* (2000) recorded a significant effect of this factor only within the time interval from birth to 30 days of age. It was also observed that birth weight of lambs increases as a function of age of dam. On the other hand, as far as growth ability was concerned, it was found that this factor was a source of some variations because the highest values of DG 0–30, DG 30–70 and DG 70–100 were found in lambs of three-years-old dams, five and

more-years-old dams and four-years-old dams, respectively. However, the highest DG 0–100 and BW 100 were found in both cases in lambs of five and more-years-old dams.

Table 1.

Least-squares means and standard errors of birth weights (BW) and live weights (LW) according to sex, litter size, age of dam, month of lambing and year of birth of lambs

LW, kg(1)	n	BW 0(2)	LW 30(3)	LW 70(4)	LW 100(5)
		L.S.M.±S.E.M.			
Sex(6)		**	**	**	**
Male (A)(7)	158	4.18±0.05^{B}	13.61±0.21^{B}	25.42±0.34^{B}	33.32±0.31^{B}
Female (B)(8)	136	3.86±0.06^{A}	11.91±0.22^{A}	22.57±0.36^{A}	29.51±0.33^{A}
Litter size(9)		**	**	**	**
Singles (A)(10)	115	4.31±0.06^{B}	13.68±0.24^{B}	25.97±0.39^{B}	33.21±0.36^{B}
Twins (B)(11)	179	3.74±0.05^{A}	11.85±0.19^{A}	22.03±0.32^{A}	29.62±0.29^{A}
Age of dam(12)		**	**	**	**
2 (A)	91	3.67±0.07^{CD}	11.93±0.27^{BCD}	22.03±0.45^{BCD}	28.39±0.41^{BCD}
3 (B)	102	3.85±0.07^{DE}	13.29±0.25^{A}	24.38±0.42^{A}	31.78±0.38^{A}
4 (C)	68	4.14±0.08^{ABC}	12.34±0.31^{bE}	23.62±0.51^{aD}	31.77±0.46^{A}
5 and more (D)	33	4.44±0.11^{AC}	13.49±0.43^{A}	25.95±0.72^{AC}	33.72±0.66^{ABC}
Month of lambing(13)		NS	NS	NS	NS
January (A)	53	3.87±0.10	12.30±0.39	23.22±0.65	31.37±0.59
February (B)	88	4.16±0.08	12.63±0.29	23.46±0.48	31.49±0.44
March (C)	95	4.09±0.07	12.65±0.27	24.56±0.45	31.78±0.41
April (D)	58	3.97±0.09	13.47±0.36	24.75±0.60	31.03±0.55
Year of birth of lamb(14)		NS	NS	**	**
1 yr (A)	50	4.13±0.09	12.05±0.36	22.07±0.59^{BDeF}	29.64±0.54^{BDeF}
2 yr (B)	48	4.14±0.10	13.17±0.37	24.27±0.61^{A}	32.18±0.56^{A}
3 yr (C)	53	3.82±0.09	12.36±0.36	23.55±0.60^{d}	31.76±0.54^{A}
4 yr (D)	52	3.98±0.09	13.40±0.34	25.42±0.57^{Ac}	30.98±0.52^{f}
5 yr (E)	49	3.96±0.09	12.84±0.37	24.13±0.61^{a}	31.38±0.55^{a}
6 yr (F)	42	4.11±0.10	12.77±0.40	24.54±0.67^{A}	32.55±0.61^{Ad}

* P≤0.05; ** P≤0.01; ^{abcdef}=column mean values within each group with different superscripts are significantly different P≤0.05(15); ^{ABCDF}=column mean values within each group with different superscripts are highly significantly different P≤0.01(16)

1. táblázat: Az élősúlyok legkisebb négyzetes átlagértékei (L.S.M.) és a hiba (S.E.M.) az ivar, az alomszám, az anya életkora, a bárányozás hónapja és a bárány születésének éve szerint

élősúly(1), születési súly(2), 30. napos súly(3), 70. napos súly(4), 100 napos súly(5), ivar(6), kos(7), jerke(8), alomszám(9), egyes bárány(10), iker bárány(11), anya életkora(12), bárányozas hónapja(13), bárány születési éve(14), ^{abcdef}=azonos csoportban oszlopon belül a különböző kitevők szignifikáns különbséget jelölnek P≤0,05(15), ^{ABCDF}=azonos csoportban oszlopon belül a különböző kitevők szignifikáns különbséget jelölnek, P≤0,01(16)

Month of lambing, compared to the previous is factors, had non-significant effect on all body weights under study. This is in agreement with the results by *Momani-Shaker et al.* (1995). With the exception of DG 30–100 and DG 70–100, a similar tendency was observed also in the case of daily gains. *Stritzke and Whiteman* (1982) and *Dixit et al.* (2001), however, mentioned a highly significant effect of the factor of season of lambing on daily gains. In this context, however, it should be mentioned that in their studies the effects of the different seasons of lambing were analysed and they did not evaluated the effect of individual months as in our study. Month of lambing was, as well as the factor of age of dam, a source of some variation of daily gains, because the highest DG

0–30, DG 30–70 and DG 70–100 were found in lambs born in April, March and January, respectively. However, the above-mentioned variability of daily gains did not affect the levels of daily gains in the period from birth to 100 days of age and these daily gains were very uniform.

Table 2.

Least-squares means and standard errors of daily gains (DG) according to sex, litter size, age of dam, month of lambing and year of birth of lambs

DG, g(1)	n	DG 0–30(2)	DG 30–70(3)	DG 0–70(4)	DG 30–100(5)	DG 70–100(6)	DG 0–100(7)
		L.S.M.±S.E.M.					
Sex(6)		**	**	**	**	*	**
Male (A)(7)	158	314 ± 6.60^{B}	295 ± 6.23^{B}	303 ± 4.83^{B}	282 ± 3.87^{B}	263 ± 9.35^{b}	291 ± 3.02^{B}
Female (B)8)	136	268 ± 6.94^{A}	266 ± 6.56^{A}	267 ± 5.08^{A}	251 ± 4.07^{A}	231 ± 9.83^{a}	256 ± 3.17^{A}
Litter size(9)		**	**	**	**	NS	**
Singles (A)(10)	115	312 ± 7.59^{B}	307 ± 7.16^{B}	309 ± 5.55^{B}	279 ± 4.44^{B}	242±10.74	289 ± 3.47^{B}
Twins (B)(11)	179	270 ± 6.08^{A}	254 ± 5.74^{A}	261 ± 4.44^{A}	254 ± 3.56^{A}	253±8 60	259 ± 2.78^{A}
Age of dam(12)		**	**	**	**	*	**
2 (A)	91	275 ± 8.69^{B}	253 ± 8.21^{bcD}	262 ± 6.36^{BD}	235 ± 5.09^{BCD}	212 ± 12.31^{bC}	247 ± 3.97^{BCD}
3 (B)	102	315 ± 8.15^{AC}	277 ± 7.69^{ad}	293 ± 5.96^{A}	264 ± 4.77^{AD}	247 ± 11.54^{a}	279 ± 3.72^{A}
4 (C)	68	274 ± 9.78^{B}	282 ± 9.24^{a}	278 ± 7.15^{d}	278 ± 5.73^{A}	272 ± 13.85^{A}	276 ± 4.47^{Ad}
5 and more (D)	33	302±13.91	311 ± 13.13^{Ab}	307 ± 10.17^{Ac}	289 ± 8.15^{AB}	259±19.69	$293\pm6.35^{A}c$
Month of lambing(13)		NS	NS	NS	*	*	NS
January (A)	53	281±12.53	273±11.83	276±9.16	272±7.34d	272±17.74d	275±5.72
February (B)	88	282±9.31	271±8.79	276±6.81	269±5.45d	268±13.18D	273±4.25
March (C)	95	285±8.68	298±8.20	292±6.35	273±5.08D	241±12.29	277±3.96
April (D)	58	317±11.60	282±10.95	297±8.49	251±6.80abC	209±16.43aB	271±5.30
Year of birth of lamb(14)		*	*	**	**	**	**
1 yr (A)	50	264±11.42	250 ± 10.78^{cDeF}	$256\pm8\ 35^{BcDEF}$	251 ± 6.69^{bCF}	252 ± 16.17^{D}	255 ± 5.22^{BCdEF}
2 yr (B)	48	301±11.83	278±11.16	287 ± 8.65^{A}	272 ± 6.93^{ad}	264 ± 16.74^{D}	280 ± 5.40^{A}
3 yr (C)	53	285±11.53	280 ± 10.89^{a}	282 ± 8.44^{ad}	277 ± 6.76^{AD}	274 ± 16.33^{D}	279 ± 5.27^{A}
4 yr (D)	52	314±11.03	301 ± 10.42^{A}	306 ± 8.07^{Ac}	251 ± 6.46^{bCF}	185 ± 15.62^{ABCeF}	270 ± 5.04^{af}
5 yr (E)	49	296±11.73	282 ± 11.08^{a}	288 ± 8.5^{8A}	265±6.87	242 ± 16.61^{d}	274 ± 5.36^{A}
6 yr (F)	42	289±12.94	294 ± 12.22^{A}	292 ± 9.47^{A}	283 ± 7.58^{AD}	267 ± 18.33^{D}	284 ± 5.91^{Ad}

* P≤0.05; ** P≤0.01; ^{abcde}=column mean values within each group with different superscripts are significantly different (P≤0.05)(15), ^{ABCDEF}=column mean values within each group with different superscripts are highly significantly different (P<0.01)(16)

2. táblázat: A súlygyarapodások legkisebb négyzetes átlagértékei (L.S.M.) és a hibái (S.E.M.) az ivar, az alomszám, az anya életkora, a bárányozás hónapja és a bárány születésének éve szerint

súlygyarapodás(1), súlygyarapodás 0–30., 30–70., 0–70., 30–100., 70–100., 0–100.(2), as in Table 1 (6–16)

Year of birth of lamb had a significant effect on the majority of growth traits under study. This is in agreement with the results published by *Ploumi et al.* (1997) and *Dixit et al.* (2001). On the other hand *Momani-Shaker et al.* (1995) did not recorded a significant effect of this factor on growth of lambs of the Charollais breed. However, in this context it is necessary to emphasise that their study covered the time interval of only two years.

The significantly lowest daily gains in all intervals under study were recorded in the first year of the evaluation (1997). In the following years the daily gains were very uniform, while for example the difference between the highest and the lowest DG 0–100 was only 14 g. In our opinion the significantly lower growth ability of lambs in the first year of evaluation compared to the other

years was probably influenced by small shortcomings in the management of breeding, by the environment and by the sire.

All phenotypic correlations (*Table 3.*) between particular body weights under study were positive and high (P≤0.01). The phenotypic correlations between birth weight and the others body weights showed a tendency to increase with the increasing of age. On the other hand *Vogot et al.* (1967) and *Dixit et al.* (2001) reported opposite tendency. The highest phenotypic correlations between LW were between LW 30 and LW 70 and between LW 70 and LW 100. The majority of phenotypic correlations between particular body weights and DG 0–30, DG 30–70, DG 0–70, DG 30–100 and DG 0–100 was positive and high (P≤0.01). The majority of phenotypic correlations between DG 0–30, DG 30–70, DG 0–70, DG 30–100 and DG 0–100 was also positive and high (P≤0.01). On the other hand the phenotypic correlations between DG 0–30 and DG 70–100, DG 30–70 and DG 70–100 and between DG 0–70 and DG 70–100 were negative and high (P≤0.01).

Table 3.

Phenotypic correlations of all growth characteristics of the study

	LW 30	LW 70	LW 100	DG 0–30	DG 30–70	DG 0–70	DG 30–100	DG 70–100	DG 0–100
BW 0	0.389**	0.411**	0.494**	0.155**	0.235**	0.249**	0.329**	0.142*	0.366**
LW 30		0.777**	0.616**	0.964**	0.317**	0.752**	0.057	–0.229**	0.592**
LW 70			0.739**	0.729**	0.843**	0.989**	0.375**	–0.368**	0.728**
LW 100				0.524**	0.588**	0.698**	0.822**	0.354**	0.990**
DG 0–30					0.275**	0.742**	–0.033	–0.290**	0.535**
DG 30–70						0.849**	0.516**	–0.359**	0.591**
DG 0–70							0.342**	–0.410**	0.707**
DG 30–100								0.614**	0.826**
DG 70–100									0.356**

* P≤0.05; ** P≤0.01

3. táblázat: Fenotípusos korrelációk a növekedési tulajdonságok között
lásd 1–2. táblázat

In conclusion, the present results though based on a relatively small number of animals showed that the factors of sex, litter size, age of dam and year of birth of lamb had a significant effect on the majority of growth traits of Charollais´ lambs under study. On the other hand the factor of month of lambing had non-significant effect on all body weights and on majority of daily gains under study. Growth ability of Charollais lambs was relatively high within the whole period under study and the highest daily gains were recorded in all factors within the period from birth to 30 days of age. However, it is important to add that in our opinion the Charollais breed is quite sensitive to climatic conditions (mainly regarding the temperature). Therefore we recommend to keep this breed in the regions with moderate climate and in lower altitudes. Further, mothers with higher fertility should be given priority in reproduction, because they produce more lamb meat per ewe. However, the breeders should also count with lower growth ability of twins in the period from birth to 70 days of age due to above all their lower consumption of mother´s milk. On the other hand, in

the next period the growth ability in twins can be either identical or even higher than in singles. We also recommend a prudent approach of breeders to culling of younger ewes (2–3 years), as older ewes (4–5 years) reach the highest fertility and milk production, which has a positive impact on the growth of lambs. On the other hand, ewe culling is recommended for ewes over 6–7 years of age.

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