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PRODUCTIVE LIFE OF HIGH YIELDING DAIRY COWS

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SUMMARY: The objective of the research was to investigate the significance of the main systematic effects on productive life of high yielding Black-and-White dairy cows. The average length of productive life reached 1494.18±463.66 days Observed by genotypes, the mean values were as follows: 1377.35 days (>73% HF), 1477.47 days (58-73% HF) and 1627.71 days (<58% HF). Differences in length of productive life came as a result of highly significant (P≤0.01) effect of the class of HF genes, bull sires and year of culling, whereas the reason for culling had no significant effect (P>0.05).

Key words: *productive life, high yielding dairy cows, systematic effects*

INTRODUCTION

Length of productive life is an extremely complex trait. It is considered one of the best indicators for longevity of cows. Much research on average age of culling implies a relatively short productive life of high yielding dairy cows. Decision on culling is affected by numerous factors that constantly change over time (Ducrock, 2005).

More important indicators for evaluating cow longevity are length of productive life, age at culling, number of lactations and a lifespan. The lifespan of cows is precisely determined by two periods. The period from birth to the first calving is the period of growth and development. The productive period is a period from the first calving to culling and it shows potential of an animal to survive in production conditions as long as possible (Sewalem et al., 2008).

The period from the first calving to culling from a herd should be a period for im-

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proving total lifetime production. Enhancing the length of productive life per cow can lead to a decreased need for replacement heifers, which results in a greater proportion of cows in lactations producing on a mature level, better use of the genetic basis and fewer health and reproduction expenses (Hare et al., 2006). The goal of functional breeding (breeding of functional traits: udder structure, somatic cell score, normal movement and prolificacy) is to decrease involuntary culling and increase culling for breeding reasons (Hadley et al., 2006; Chirinos et al., 2007; Lopez de Maturana et al., 2007).

Productive life is number one indicator for longevity. As ability to survive in certain production conditions, it is the most important functional trait of high yielding dairy cows. From economic aspect, the length of productive life is a necessary condition for milk production sustainability (Berry et al., 2005). Longevity traits have low heritability, ranging from 0.03 to 0.20, depending on evaluation methods (Boettcher et al., 1999; Tsuruta et al., 2005; Páchová et al., 2005; Terawaki and Ducrocq, 2009). Good health and good prolificacy affect prolonging of productive life of cows by decreasing the culling rate, which positively impacts breeding intensity and a level of economic results (Caraviello et al., 2004; de Vries et al., 2010; Bogdanović et al., 2012).

Knowing the significance and power of systematic effects on productive life of Black-and-White cows is important in terms of including them in mathematical-statistical models. According to individual significance of systematic effects, their objective assessment was carried out in order to evaluate the obtained results as precise and correct as possible. For estimating their role in achieved results, it is necessary to determine those systematic factors that lead to considerable phenotypic variation of investigated traits.

The objective of this research is to use appropriate methods to investigate the significance of the main systematic factors on length of productive life of high yielding Black-and-White dairy cows with different proportion of genes of the Holstein breed.

MATERIALS AND METHODS

Investigation and analysis of the key systematic factors on length of productive life were conducted in a herd of high yielding Black-and-White dairy cows. The cows included in the research were European type Black-and-White cattle. All the animals were in the final stage of intensive improvement using the Holstein breed. The high yielding cows included in the sample were under the same housing, nutritive and care conditions and the same method of exploitation.

The analysis of effects of particular systematic factors was done by the method of least squares (Harvey, 1987) The advantage of this method is that enables parallel and simultaneous determination of multiple effects on investigated traits. In an overview of the investigated factors shown below, animal distribution is displayed according to the previously defined classes:

Table 1. Distribution of animals according to the defined classes

Class of HF genes	<58%	58-73%	>73%
n	83	125	123

Year of culling	1	2	3
n	88	140	103

Reason for culling	1	3	4
n	278	47	6

The following statistical model was used:

$Y_{ijklm} = \mu + O_i + HF_j + G_k + R_l + e_{ijklm}$

Where:

Y_{ijklm} - result of m-cow, daughter of i-sire, belonging to j-group according to the share of HF genes, culled in k-year for l-reason

μ - mean

O_i - effect of i-sire

HF_j - effect of j-group of HF genes

G_k - effect of k-year of culling

R_l - effect of l-reason for culling

e_{ijklm} - random error

Within the applied model the following codes were used:

For reason of culling: 1-economical culling, 3-involuntary slaughtering and 4-death.

RESULTS AND DISCUSSION

The analysis of the mean value (lsm), the mean value error (Slsm) of least squares and the significance of the investigated traits on productive life of high yielding Black-and-White cows at birth are shown in Table 1.

Table 2. Mean values (lsm) and mean value errors (Slsm) of least squares for the investigated traits on productive life of cows (in days)

Effects	N	lsm	Slsm
Total			
μ	331	1494.18	463.66
*Class of HF genes (df_1=2, df_2=307, $f\text{-}_{exp}$=8.112**)*			
<58%	83	1627.71	465.09
58-73%	125	1477.47	464.50
>73%	123	1377.35	464.79
*Sires (df_1=17, df_2=307, $f\text{-}_{exp}$=54.962**)*			
23	42	2068.41	67.67
28	20	1561.39	91.44

33	3	2506.01	204.60
35	29	926.45	82.32
36	45	1134.36	70.71
38	11	515.28	116.98
270	22	2324.17	87.62
283	5	2764.67	161.20
293	8	136.73	132.07
337	7	327.09	137.87
762	21	2232.88	89.69
795	6	2949.36	149.08
816	33	1884.92	78.06
879	7	638.95	136.93
927	31	1220.64	74.59
1040	19	617.63	91.79
1304	15	1545.38	101.52
5368	7	1859.38	137.48
*Year of culling (df_1=2, df_2=307, $f\text{-}_{exp}$=49.747**)*			
1	88	1218.08	464.25
2	140	1508.68	464.64
3	103	1755.76	464.82
Reason for culling (df_1=2, df_2=307, $f\text{-}_{exp}$=2.603ns)			
1	278	1581.63	461.65
3	47	1623.12	463.81
4	6	1277.78	481.99

NS (P>0.05),*P≤0.05,*P≤0.01.

The average length of productive life reached 1494.18±463.66 days (49.08±15.24 months or 4.09±1.27 years).

Observed by genotypes, the mean values varied from 1377.35 days (>73% HF), 1477.47 days (58-73% HF) to 1627.71 days (<58% HF). Differences determined in length of productive life came as a result of highly significant (P≤0.01) effect of the class of HF genes, bull sires and year of culling, whereas the reason for culling had no significant effect (P>0.05).

The research has shown that high yielding Black-and-White dairy cows of different genotypes have a relatively short lifespan. The results of other researchers support this. In milking cows, days of productive life was analyzed as an alternative to the current trait lifespan score. Cows that died in 2009 on average lived for 6.8 years with an average production of 4.3 years. (Pritchard et al., 2013)

While investigating the productive life of the Brown Swiss breed, Vukašinović et al. (1997) determined a productive life of 29.5 months (based on full data), and 38.5 months (incomplete data). Moreover, it was determined that the average length of productive life of all heads was 32.4 (± 25.5) months.

De Vries (2003) in his results stated that about 20% of total number of cows culled in 365 days from the day of the first calving, 50% was culled after 827 days (mid-productive life), whereas 10% of cows were retained in herd after 1580 days.

Van Raden et al. (2006) stated the following values of productive life of the cows born in 1997 and standard deviation (in months): Ayrshire 25.9 ± 12.5, Brown Swiss 25.3 ± 12.7, Guernsey 23.0 ± 12.9, Holstein 24.6 ± 12.7, Jersey 29.3 ± 13.3, and Milking Shorthorn 25.5 ± 13.0.

In research that included 13.8 million dairy cows, which calved for the first time in the interval of 15 years, the sample consisted of cows of different dairy breeds (Ayrshire 0.5 %, Brown Swiss 0.9 %, Guernsey 1.3 %, Holstein 92.6 % and Jersey 4.7 %). The average rate of survival was 73 % to the second lactation, 50 % to the third lactation, 32 % to the fourth, 19 % to the fifth, 10 % to the sixth, 5 % to the seventh, whilst 2 % of cows reached the eighth lactation (Hare et al., 2006).

In some countries with developed cattle breeding, analysis of survival has become an official way to estimate longevity of cows. This method enables one to include all the cows in research, regardless they are present in herd or culled. The main limiting factors in direct longevity are time for collecting data necessary for accurate estimation of breeding value of studs and low heritability. With improving genetic potential of dairy cows, the significance of body traits related to length of productive life has also increased.

CONCLUSION

The average productive life reached 1494.18±463.66 days (49.08±15.24 months or 4.09±1.27 years). Observed by genotypes, the mean values were 1377.35 days (>73% HF), 1477.47 days (58-73% HF) and 1627.71 days (<58% HF). Differences in length of productive life came as a result of highly significant ($P \leq 0.01$) effect of the class of HF genes, sires and year of culling, whereas the reason for culling had no significant effect ($P > 0.05$). The research has shown that different genotype of high-yielding Black-and-White cows had a short productive life. The expressed length of productive life was not satisfactory, which contributed to a low level of lifetime milk production and an increase in culling, having direct consequences on economic and breeding effects. One should pay more attention to having continuous insight into length of productive life of cows in complex technological conditions present on cattle farms. Body traits that are evaluated in first-calving cows could make the breeding process more efficient, since they can have higher heritability than other longevity traits, and in respect to that they could be a starting point for indirect breeding for longevity traits.

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PRODUKTIVNI ŽIVOT VISOKOMLEČNIH KRAVA

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Izvod

Cilj istraživanja bio je ispitivanje značajnosti najvažnijih sistematskih uticaja na produktivni život visokomlečnih crno-belih krava. Krave u okviru ispitivanog uzorka imale su različitu proporciju gena holštajn rase. Analiza uticaja sistematskih faktora na produktivni život obavljeno je u stadu visokomlečnih krava, koje su po poreklu pripadale evropskom tipu crno-belih goveda, u fazi intenzivnog oplemenjivanja holštajn rasom. Izvršena je determinacija onih sistematskih uticaja koji su u okviru istraživanja doveli do značajnijeg fenotipskog variranja ispitivane osobine. Prosečno trajanje produktivnog veka iznosilo je 1494.18±463.66 dana (49.08±15.24 meseci ili 4.09±1.27 godina). Posmatrano po genotipovima krava srednje vrednosti iznosile su 1377.35 dana (> 73% HF), 1477.47 dana (58-73% HF) i 1627.71 dana (< 58% HF). Utvrđene razlike između grla u pogledu trajanja produktivnog života nastale su kao posledica visoko značajnog uticaja ($P \leq 0.01$) klase HF gena krava, bikova-očeva krava i godine izlučenja krava, dok razlog izlučenja nije imao značajan uticaj ($P > 0.05$).

Ključne reči: produktivni život, visokomlečne krave, sistematski uticaji.

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