

**ESTIMATION OF STAYABILITY TRAITS IN
BLACK-AND-WHITE COWS IN SLOVENIA****J. Pogačar, K. Potočnik, I. Kump, Anka Dolinar****Summary**

Average stayability rate at age 48 months, which is 75%, at age 60 months, which is 61%, and at age 72 months, which is 47%, was estimated for 4742 Black-and-White cows offspring of 35 bulls that had at least 30 daughters. For estimation of stayability, values should be corrected to milk production. Heritability rates for stayability traits were estimated as follows: 0.05 for stayability at age 48 months, 0.08 for stayability at age 60 months and 0.09 for stayability at 72 months. The genetic variability for stayability traits is satisfactory so that selection to stayability traits is reasonable and necessary from the point of view of economy.

Key words: cattle, breeds, Black-and-White, longevity, stayability, selection, heritability, Slovenia

Introduction

Longevity of animals, which is a function of constitution of animal and resistance to various diseases, is besides high lactation rate and good composition of milk very important for economical production of milk.

More lactations, regular reproduction as well as high lifetime and production period diminish annual expenses of herd regeneration. Annual regeneration can be diminished from 30% to 22% and 24% respectively (Ferčej et al., 1988). Increase of production period of cows from three to four lactation periods increases annual income by 11% to 13% (Essl, 1984), and 2.2 months longer production period corresponds to 100 kg more milk yield (Allaire and Gibson, 1992).

Longevity of cows depends on undesired causes like diseases, hurts, fertility as well as desired ones such as early removal of cows with low milk

Rad je priopćen na 6th Int. Symp. "Animal Science Days", Portorož, Slovenia, Sept.16-18, 1998.

J. Pogačar, Univ. of Ljubljana, Biotechnical Fac., Zootechnical Dept., Groblje 3, SI-1230 Domžale, Slovenia, Prof., Ph. D., B. Sc. Agr.; K. Potočnik, same address, B. Sc. Agr.; I. Kump, same address, B. Sc. Agr.; Anka Dolinar, same address, B. Comp. Sc.

production (Statt, 1994). Owing to desired removals a positive correlation from 0.1 to 0.4 exists between longevity and milk production (Charffedine et al., 1996). Therefore a correlation with milk production is necessary for estimation of production period, which is a result of constitution and resistance of an animal and is called functional productive life (Ducrocq, 1994).

Longevity, which has been measured by productive life and has turned out to be very unsuitable being known only after the slaughter or removal of an animal, has been replaced by stayability till a certain age, for example 36, 48, 60, 72 and 84 months or until other ages. Stayability or survival rate, which is a binary trait with values 0 or 1, has been defined by Robertson and Barker (1996), and Shaeffer and Burnside (1974).

The objective of our research was to find out the stayability rate in Black-and-White breed in Slovenia, heritability rates, variability among bulls and potential selection to longevity.

Material and methods

Black-and-White cows from regular milk production control that were born between the years 1987 and 1991 and were at least 72 months old at time of investigation were taken into investigation. Only data from bulls that had at least 30 daughters were considered so that data for 4742 cows from 35 different bulls were processed.

Analysis of variance was used for analysis of system and random effects, and the following model:

$$y_{ijklm} = \mu + Y_i + S_j + h_k + f_l + b(M_{ijklm}) + e_{ijklm} \dots (1)$$

y_{ijklm} - stayability at age 48, 60 and 72 months (1 = cow still lives, 0 = cow was removed)

μ - mean value

Y_i - year of birth (i = 87, 88, 89, 90 and 91)

S_j - season of calving (j = spring, summer, autumn, winter)

h_k - random effect of herd k

h_l - random effect of bull l

b - coefficient of regression

M_{ijklm} - kg of milk at first recording after first lactation

e_{ijklm} - random error

Data were processed by statistical package SAS/STAT (SAS/STAT, 1994). Components of variance were estimated by Restricted Maximum-Likelihood Method.

Results

Simple statistical parameters (\bar{x} and SD) show that stayability traits are in the same limits as reported in literature. 75% of cows live till age 48 months, 61% till 60 months and 47% till 72 months (Table 1).

Table 1. - SIMPLE STATISTICAL PARAMETERS

	Traits	Unit	μ	\bar{x}	SD	CV
Stayability	48 months	%	4742	75.0	43.3	57.7
	60 months	%	4742	60.9	48.8	80.1
	72 months	%	4742	47.3	49.9	105.5
Milk production ¹		kg	4742	21.2	4.8	22.6

¹ kg of milk at first recording after first lactation

Analysis of variance (Table 2) explains 12.1% of variance at 60 months of stayability and 13.5% at 48 months. The effect of herd and regression of starting milk production are highly significant ($p \leq 0.001$). The effect of bull is significant too ($p \leq 0.01$). Stayability traits are not affected by season while the year of birth affects only the stayability at age 48 months ($p \leq 0.01$) and partly the stayability at age 60 months ($p \leq 0.05$).

Table 2. - ANALYSIS OF VARIANCE AND ESTIMATION OF EFFECTS BY F-TEST

Effect	Degrees of freedom	F-values for stayability		
		48 months	60 months	72 months
Year	4	3.51**	2.84*	0.95
Season	3	120	0.42	0.13
Herd	220	2.23***	2.14***	2.63***
Bull	34	1.71**	1.87**	1.88**
Milk production ¹	1	130.8***	72.04***	33.8***
R, %	-	13.5	12.1	13.2

¹ kg of milk at first recording after first lactation; * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

A coefficient of linear regression (Table 3) shows that at age 48 months exists the highest probability that percentage of stayability increases by 1.7% if the starting milk production increases by 1 kg. At age 60 months the

coefficient of regression is 1.4%, and at age 72 months 1.0%. Table 3 shows also simple coefficients of correlation between milk production and stayability traits and are in limits reported in literature.

Table 3. - COEFFICIENTS OF CORRELATION AND REGRESSION BETWEEN STAYABILITY TRAITS AND KG OF MILK AT FIRST LACTATION MILK PRODUCTION

Stayability	Milk production ¹	
	bv%	r
48 months	1.7	0.15
60 months	1.4	0.11
72 months	1.0	0.08

¹ kg of milk at first recording after first lactation

In our study estimations of heritability (h^2) correspond to the estimations reported in the literature, and are shown in Table 4 for the Black-and-White breed. It has been reported that heritability coefficient for stayability rate is 8%, that genetic variability is satisfactory and that selection to longevity is sensible.

Table 4. - ESTIMATIONS OF HERITABILITY RATES (h^2) FOR STAYABILITY TRAITS IN OUR STUDY AND ESTIMATIONS REPORTED IN LITERATURE

Author	Country	Year	Trait	h^2	s_{h^2}	s_e V%
Our study	SI	1998	stayability 48 m	0.05	0.02	9.5
Our study	SI	1998	stayability 60 m	0.08	0.03	13.8
Our study	SI	1998	stayability 72 m	0.09	0.04	15.0
Ferčej	SI	1988	stayability 48 m	0.10	-	-
Ferčej	SI	1988	stayability 60 m	0.04	-	-
Robertson and Barker	GB	1966	stayability 48 m	0.03	-	-
Robertson and Barker	GB	1966	stayability 60 m	0.06	-	-
Caro and Alaire	USA	1995	stayability 48 m	0.07-0.10	-	-
Caro and Alaire	USA	1995	stayability 60 m	0.07-0.11	-	-

Deviations were estimated for all 35 bulls with more than 30 daughters (Model 1). Deviations were calculated for 22 bulls with 80 and more daughters. Table 5 shows coefficients of correlations between stayability traits and breeding values for IPF index.

$$IPF = 2 * \text{breeding value protein} + \text{breeding value fat}$$

Coefficients of correlation show that coefficients are higher due to more reliable estimation if number of daughters is less than 80 and not 30. Wilmink (1998) reported that for a reliable estimation of breeding value for stayability the estimation of 150 daughters was considered.

Table 5. - CORRELATIONS BETWEEN STAYABILITY TRAITS AND IPF INDEX

Traits	r	
	≤ 30 daughters	≤ 80 daughters
48 months: 60 months	0.76	0.92
48 months: 72 months	0.65	0.83
60 months: 72 months	0.75	0.88
48 months: IPF	0.30	0.44
60 months: IPF	0.31	0.50
72 months: IPF	0.15	0.20

Table 6. - RANG LIST OF BULLS ACCORDING TO STAYABILITY TRAITS AND IPF

Rang	Bull	48 ¹	Bull	60 ²	Bull	72 ³	Bull	BV IPF ⁴
1	DENIS	0.073	MAKI	0.104	ROK	0.080	IKON	61.34
2	IND	0.069	DENIS	0.090	DENIS	0.079	BELON	56.83
3	MAKI	0.068	ROK	0.067	BAR	0.059	NEDI	50.63
4	IKON	0.058	IKON	0.057	COL	0.052	MAKI	50.05
5	ROK	0.028	IND	0.036	MAKI	0.031	KOL	46.05
6	NEDI	0.027	COL	0.030	IKON	0.023	DENIS	42.65
7	KOL	0.026	HALF	0.028	KOL	0.022	FRANK	38.28
8	DRUZ	0.026	KOL	0.028	IND	0.019	IND	38.23
9	HALF	0.014	DRUZ	0.018	MARK	0.017	MARK	35.97
10	MARK	0.011	NEDI	0.018	DRUZ	0.014	DRUZ	19.99
11	COL	0.005	MARK	0.016	HALF	0.011	IVANKO	13.18
12	BAR	-0.012	FRANK	-0.007	NEDI	0.004	ŠUMI	12.05
13	ŠUMI	-0.015	BELON	-0.021	ŠUMI	-0.009	HALF	9.81
14	ATOM	-0.016	SAK	-0.025	BUČKO	-0.014	SING	9.21
15	FRANK	-0.022	BAR	-0.026	FRANK	-0.017	BUCKO	1.78
16	SAK	-0.026	SING	-0.032	ATOM	-0.020	COL	1.45
17	SING	-0.026	ŠUMI	-0.034	SING	-0.033	RON	-0.87
18	BUČKO	-0.030	ATOM	-0.043	SAK	-0.033	BAR	-8.41
19	IVANKO	-0.035	IVANKO	-0.047	BELON	-0.053	SAK	-9.32
20	KIT	-0.041	BUČKO	-0.052	IVANKO	-0.054	ROK	-10.08
21	BELON	-0.069	KIT	-0.067	KIT	-0.063	ATOM	-17.57
22	RON	-0.113	RON	-0.139	RON	-0.112	KIT	-41.22
Standars deviation		0.046		0.056		0.047		

¹ estimation for stayability at age 48 months; ² age 60 months; ³ age 72 months; ⁴ breeding value for IPF

Table 6 displays rang list of stayability traits and IPF if deviations are estimated in bulls for 80 and more daughters. The rang of bulls repeats in all three stayability traits. Bulls ranged by IPF do not match much, therefore IPF and stayability should be considered and selections to those traits should be separated. At the end of the table standard deviations for bulls, which are similar to genetic standard deviation (s_g) in table 4, show that variability among bulls is satisfactory and that selection to stayability traits could be possible.

Conclusion

1. Estimation of stayability requires a correction to starting milk production or breeding value for milk production, which is even better.

2. Reliable estimation of deviations and breeding value for stayability can be obtained from 80 daughters but 150 is much better.

3. Even if a heritability rate for stayability traits is low (0.05 to 0.10) genetic standard deviation is satisfactory and selection to stayability and longevity is reasonable and necessary from the point of view of economy.

4. Considering correlations among stayability traits and h^2 estimation of length of generation interval it can be said that the best trait for selection is stayability at age 60 months corrected to milk production.

REFERENCES

1. Allaire, F. R., J. P. Gibson (1992): Genetic value of herd life adjusted for milk production. *J. Dairy Sci.*, 75, s. 1349-1356.
2. Charffeddine, N., R. Alenda, M. J. Carabano, F. Bejar (1996): Selection for total merit in the Spanish Holstein-Friesian. In: *Proc. Int. Workshop Genetic Improvement of Functional Traits in Cattle Interbull bulletin no. 12, Gembloux, 01-21/23*, s.142-146.
3. Ducrocq, V. (1994): Statistical analysis of length of productive life for dairy cows of the Normande breed. *J. Dairy Sci.*, 77, s. 855-866.
4. Essl, A. (1984): Zusammenhang zwischen Leistungszucht und Nutzungsdauer bei Kuhen. *Zuchtingkunde*, 56, s. 337-343.
5. Ferčej, J., J. Pogačar, M. Štepec (1988): Ocenitev sistematičnih vplivov na mlečnost prevesnic in preživitveno dobo krav. *Znanost in praksa v govedoreji*, 12. zvezek, s. 17-27.
6. Lobo, C. H., F. R. Allaire (1995): The effect of alternative economic and genetic covariation structures on the relative economic gain from selection using stayability traits. *J. Dairy Sci.*, 78, s. 2299-2307.
7. Robertson, A., J., S. F. Barker (1966): The correlations between first lactation milk production and longevity in dairy cattle. *Anim. Prod.*, 8, s. 241-252.
8. Schaeffer, L. R., E. B. Burnside (1974): Survival rates of tested daughters of sires in artificial insemination. *J. Dairy Sci.*, 57, s. 1394-1400.

9. Wilmink, J. B. M., (1998): High lifetime production, a performance. Veepr Magazine, 31, s. 18-19.
10. SAS/STAT, User's guide., Vol.2., GLM-Varcomp. (1994).

PROCJENA SPOSOBNOSTI PREŽIVLJAVANJA U CRNO-ŠARIH KRAVA U SLOVENIJI

Sažetak

Prosječna stopa preživljavanja u dobi od 48 mjeseci je 75%, u dobi od 60 mjeseci 61%, u dobi od 72 mjeseca 47%, a procijenjena je na 4742 krave, potomaka bikova koji su imali najmanje 30 kćeri. Za procjenu preživljavanja vrijednosti bi trebalo ispraviti na proizvodnju mlijeka. Stopa heretabilnosti procijenjene su ovako: 0.05 za preživljavanje u dobi od 48 mjeseci, 0.08 za preživljavanje u dobi od 60 mjeseci i 0.09 za preživljavanje po mjesecima. Genetski preživljavanje zadovoljava pa je selekcija na sposobnost preživljavanja razumna i potrebna s gospodarskog stajališta.

Ključne riječi: goveda, pasmine, crno-šaro, dugovječnost, preživljavanje, selekcija, heretabilnost, Slovenija

Primljeno: 20. 9. 1998.